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POWERBASE

D2.3 Final Functional Requirement Report

Collection of PERO and EERO Needs and Requirements

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D2.3
Final Functional Requirement Report

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About the document

D2.3 Final Functional Requirement Report is built on D2.2 Functional requirements report v1 (from February 2025) and offers a prioritized and specified description of the end-user needs and requirements for solutions supplying energy. The updated needs and requirements have been specified in several steps from prioritization workshop to surveys within the consortium and with EU Member as well as UCPM participating states.

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SEN	Sensitive, limited under the conditions of the Grant Agreement	
CL	Classified information under the Commission Decision No2015/444	

[1] Deliverable types:
R: document, report (excluding periodic and final reports).
DEM: demonstrator, pilot, prototype, plan designs.
DEC: websites, patent filings, press and media actions, videos, etc.
OTHER: software, technical diagrams, etc.

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PLEASE NOTE FOR THIS DOCUMENT!

[Updated! / New!] Additional content and adaptations compared to D2.2 “Functional requirements report v1” are - according to the process of further development in T2.2 “Common requirements, need identification and definition” - highlighted with light grey background colour and remark “Updated” or “New”.

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Updated! Abbreviations

AC	Alternating Current
ASSR	Asociácia samaritánov Slovenskej republiky
AutRC	Austrian Red Cross
BoM	Bill of Materials
BoO(s)	Base of Operation(s)
db(A)	A-weighted Decibels
°C	Degrees Celcius
CIVIPOL	Société de service et de conseil du Ministère de l'Intérieur
CNVVF	Ministero Dell'Interno
CO	Carbon Monoxide
CO2	Carbon Dioxide
COP	Common Operational Picture
CSA	Coordination and Support Action
DC	Direct Current
DG FSCP	General Directorate for Fire Safety and Civil Protection, Bulgaria
EADRCC	Euro-Atlantic Disaster Response Coordination Centre
EAFIP	European Assistance for Innovation Procurement
EC	European Commission
EERO(s)	External Emergency Response Organisation(s)
EN	European Norm
ERO(s)	Emergency Response Organisation(s)
ES(s)	Emergency Shelter(s)
ETC	Emergency Temporary Camp
EU	European Union
FhG	Fraunhofer Gesellschaft
GB	Openbaar Lichaam Gezamenlijke Brandweer
GHG	Greenhouse Gas
h	Hour(s)
HCSOM	Magyar Maltai Szeretetszolgalat Egyesulet
HUSAR	Heavy Urban Search and Rescue
IEC	International Electrotechnical Commission
INSARAG	International Search and Rescue Advisory Group
IP	Ingress Protection
ISO	International Standardization Organisation
KE.ME.A	Kentro Meleton Asfaleias
kg	Kilogramm
km	Kilometer
km/h	Kilometer per hour
kW (h)	Kilo Watt (hours)
LUSAR	Light Urban Search and Rescue
M	(Project) Month
m	Meter
mm	Millimeter
MoI-F	Ministere de l'Interieur
MoSCoW	Must have – Should have – Could have – Won't have Rating
MS	Member States
MSB	Myndigheten for Samhallsskydd och Beredskap
MUSAR	Medium Urban Search and Rescue
NATO	North Atlantic Treaty Organization
NGT	Nominal Group Technique
NHS	National Health Services
NIC	National Innovation Centre of the National Health Services
OMC	Open Market Consultation
PERO(s)	POWERBASE Emergency Response Organisation(s)
PCP	Pre-Commercial-Procurement
PNO	(former known as Arttic) PNO Innovation
PS	Participating States
SAR	Search and Rescue
SOP	Standard Operating Procedure(s)

SOTA	State of the Art
T	Task
THW	Bundesanstalt Technisches Hilfswerk
UCPM	Union Civil Protection Mechanism
USAR	Urban Search and Rescue
V	Volt
VIEIRA	Vieira Procurement Legal Services
V2L	Vehicle 2 Load
WIBGI	Wouldn't it be great, if (Methodology)
WP	Work package
WS	Workshop(s)

Updated! Executive summary

This Deliverable is the final version of the “Functional Requirements Report” (D2.3, final) in POWERBASE project. It is based on D2.2 “Functional Requirements Report v1” (published in February 2025), that was following the initial steps of D2.1 “Scenario Definitions” (T2.1, (Liščinský & Szabján, 2024)). The final version of the D2.3 includes information about the objectives of T2.2 “Common requirements, need identification and definition”, different methodologies in line with the “Wouldn’t it be great if” (WIBGI, (Operational Efficiency Programme Final Report, 2009)) approach that have been applied in all conducted workshops. Furthermore, this document reflects and clusters the outcomes of one internal workshop (WS2) with POWERBASE Emergency Response Organizations (PEROs) as well as 9 national workshops (WS3) with external Emergency Response Organizations (EEROs) and stakeholders, an internal Prioritization Workshop (WS4) plus two surveys for refinement of requirements in Workpackage 2 (WP2) “Scenario & requirement definition, SOTA and capability gap analysis”.
The collected data is represented in the individual workshop and survey results as well as a clustered list of refined requirements as common basis for the POWERBASE path to potential Pre-Commercial-Procurement (PCP) and is strongly to the State-of-the-Art-Analysis (D2.4, D2.5) as well as the Open Market Consultation (WP3).
As a complementary perspective, researchers of POWERBASE participated close to the end of the project in the NATO exercise “BULGARIA 2025” and collected additional insights, especially for USAR teams and civil-military cooperation.

Following the iterative approach the Functional Requirements Report has been updated internally in M08 (May 2025) and is available in its final public version in M12 (September 2025) as given Deliverable 2.3.

1. Updated! Introduction

As agreed by all parties in the Grant Agreement of POWERBASE and based on the scenarios further defined in T2.1 "Definition of Scenarios" (D2.1) the results of T2.2 "Common requirements, need identification and definition" collect and analyse functional requirements from the broader community of Emergency Response Organizations (EROs) in Europe for power supply systems.

The operational framework for Bases of Operations (BoOs) for staff resources are considered as well as Emergency Shelter (ESs) - or also called Emergency Temporary Shelter (ETS) - settings. Offering a guidance for specifying the (unmet) needs the scenarios and the settings in BoOs and ESs / ETS, the practitioners and first responders can create a wishful thinking of their tools for future use in power generation and supply.

The gained results for both versions of the Deliverable (D2.2 and D2.3) show a long and extensive list of requirements, which have been condensed from wishful thinking (D2.2) to specific performance and functionality aspects (D2.3). The Final Functional Requirements report (D2.3) serves as basis for the preparatory phase within a future Pre-Commercial-Procurement-Project (PCP).

This Deliverable offers insights to the methodology used for different workshop and survey settings to gain insights into challenges that responders face in terms of power supply and identified deficiencies and gaps. Furthermore, the discussed and framed results are listed and compiled in a list of functional requirements.

2. Updated! Assessment of Needs and Requirements

Innovation Procurement starts with creating the "Common Operational Picture" (COP) – a tool which practitioners use to create a situational overview – on the unmet needs for innovative solutions, which is "*a requirement or set of requirements that you (public procurers) have now or (preferably) one that you will have in the future, that current products, services or arrangements cannot meet, or can only do so at excessive cost or with unacceptable risk.*" (Department for Business, 2021).
Therefore, the POWERBASE partners (mainly PEROs) and external stakeholders – most of them External Emergency Response Organisations (EEROs) from at least 9 different European countries (see 2.2.2)- have collected their needs and requirements in a series of workshops.
In addition, a consortium internal Prioritization Workshop (Workshop 4, Berlin 2025) took place including participants from POWERBASE Advisory Board.
Furthermore, two surveys have been conducted – one internally with represented 8 Emergency Response Organisations and one externally open to participants from all European Union Member States (MS) as well as Union Civil Protection (UCPM) Participating States (PS). All results are further described in this section.

2.1. Objectives

The objectives of WP2, T2.2 "Common requirements, need identification and definition" are set by defining "*the gap of unmet needs related to new low-emission power supply solutions of EROs*" and "*identify specific functional & operational requirements a power supply solution (single or modular) must fulfil and to describe the unmet needs/challenge for a future PCP*". (POWERBASE Grant Agreement, Description of Action, 2023)

The objectives are strongly linked to other tasks (T2.1, T2.3, T2.4) and Deliverables (D2.1, D2.4 and D2.5) in WP2.

2.2. Updated! Methodology

For the assessment of needs and requirements of stakeholders in the context of Bases of Operations and Emergency Shelters an open-minded approach using the "WIBGI" (Wouldn't it be great, if...) spectrum was used. This methodology is recommended by the European Assistance for Innovation Procurement (EAFIP) and was already defined in the project preparation phase as guiding methodology for needs assessment by leading experts in innovation procurement within based on the pioneers' approach by National Health Services in the UK.
WIGBI has been applied for WS 2 (see 2.2.1) and together with other formats according to target audience in the series of WS 3 (see 2.2.2).

Within the Prioritization Workshop (WS 4) a matrix approach combined with group work (similar World Café methods) have been applied (see 2.2.3).
For surveys to refine the requirements internally (PERO) and externally (EERO) statements with MoSCoW rating and simplified LIKERT scale were used – published via EU Survey Tool (see 2.2.4).

2.2.1. Methodology PEROs Workshop (WS2)

As a baseline for Workshop 2 the WIGBI (Wouldn't it be great, if) methodology pioneered by National Innovation Centre (NIC) of the National Health Services (NHS) in the United Kingdom (UK) was chosen, as the recommended set up for needs analysis prior to Innovation Procurement set by the European Assistance for Innovation Procurement (EAFIP) in its "EAFIP Toolkit on Innovation Procurement, Module 2 (2021)" (EAFIP Toolkit on Innvoation Procurement, Module 2, 2021). This methodology supports to "to facilitate and stimulate ... sessions, themed around specific challenges ...[and] ... use creative techniques to answer needs identified by frontline staff, stimulate intelligent demand ... and focus suppliers' product development." (Operational Efficiency Programme Final Report, 2009)

In support of collecting needs and requirements from PERO target audience a moderated online-Workshop was held on December 13th, 2024, with a duration of two hours, supported with added value by an additional procurement training (hosted by WP3).

For introduction a recap on the three Master Scenario Definitions from WS1 "Scenario Definition" (see also D2.1 (Liščinský & Szabján, 2024)) was presented as well as the pre-discussed and chosen guiding categories from the POWERBASE Grant Agreement and WS1 refreshed.

Master Scenario 1 - Wildfire on a Mediterranean island	Master Scenario 2 – Floods in Winter – Ostrava, Czech Republic	Master scenario 3 – an earthquake scenario in a rural Himalayan region with complex logistics
A severe wildfire breaks out in the Asco Valley (Corsica, France), a rugged and	Ostrava is a city in the north-east of the Czech Republic and the capital of	A devastating 7.9-magnitude earthquake struck Nepal, with its

forested area in the Haute-Corse department, fuelled by a combination of extreme drought, high temperatures, and strong winds as it is in the middle of the Sommer season. The fire spreads rapidly, threatening the local and neighbouring communities and critical infrastructure. The scale of the disaster overwhelms local and national resources, necessitating international assistance.
Rescue teams have to face challenging conditions and adapt. They are tasked with creating a Base of Operation for the retreating teams coming from all over the world, as well as an Emergency Shelter for the people affected by these fires.
The humid and extremely hot environment tests both them and their equipment. The infra structure is non-functional and so they have to be self-sufficient in terms of electricity.

the Moravian- Silesian Region. It lies 15 km from the border with Poland, at the confluence of four rivers: the Oder, the Opava, the Ostravice, and the Lučina. This region experiences a particularly harsh winter. Unusually heavy snowfall during December, followed by a sudden rise in temperatures and intense rainfall in January, leads to rapid snowmelt. This triggers widespread flooding, exacerbated by the frozen ground's inability to absorb the excess water. By mid-January, the rivers in the region overflow their banks. Critical infrastructure is disrupted, including power plants, hospitals, and heating systems. With subzero temperatures persisting, displaced populations face severe risks from hypothermia and lack of access to food, clean water, and medical care. Rescue teams have to face challenging conditions and adapt. Their task is to create a Base of Operation for the rescue teams and an Emergency Shelter for the people. It is necessary to provide basic human needs for the evacuees but also for the rescue teams. Teams coming from neighbouring countries like Slovakia (ETC module), Poland, Austria, Germany. The cooperation and togetherness of these countries is very important. However, the cold and freezing environment tests both their human preparedness but especially their equipment. Such

epicentre near Langtang National Park, 40 km northeast of Kathmandu, triggering widespread destruction and deadly landslides. The disaster claimed over 15,000 lives, injured 35,000, and displaced more than 1.2 million people, leaving countless families homeless amid harsh winter conditions. The overwhelmed local response prompted urgent calls for international assistance to provide search and rescue teams, medical aid, temporary shelters, and logistical support to reach inaccessible regions. Rescue teams have to face challenging high-altitude conditions and adapt. Their task is to create a Base of Operation for the rescue teams and an Emergency Shelter for the people. It is necessary to provide basic human needs for the evacuated people but also for the rescue teams for whom the deployment is a big challenge. The terrain and places where people are located are difficult to access. In some places, access is not possible except by helicopters. Many people as well as equipment have difficulty adapting to the low O2 content due to the altitude. Wind, dust and various particles along with unstable surfaces sometimes force a quick evacuation and relocation of equipment to a safe zone. Field hospitals and their electrical supplies are sometimes moved after a few days as well. Such conditions will test their

	conditions will test their equipment in harsh cold conditions and the sharing of equipment between teams.	equipment in challenging cold and unstable conditions.

Figure 1 Reference to Brief Overview of Master Scenarios from D2.1 Scenario

Within workshop 2 of POWERBASE project the WIBGI approach was creatively set into action according to the pre-Christmas season to create a “wish list for Christmas” by participating stakeholders.

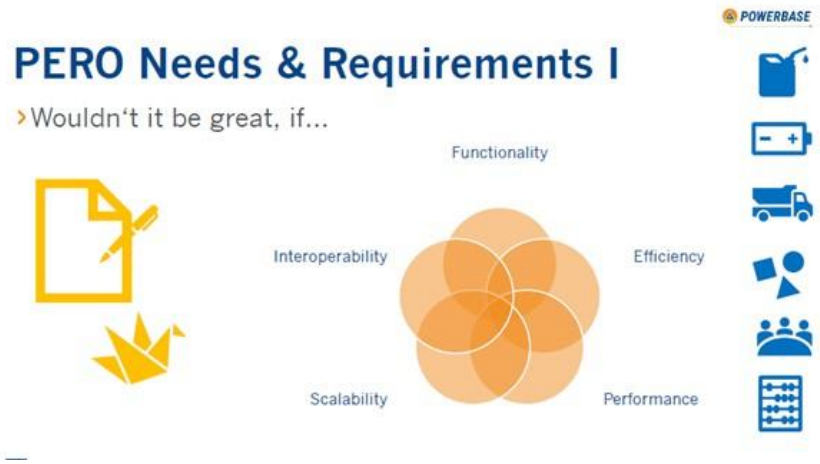


Figure 2 Workshop Introduction (WS2) PEROs online (December 2024)

In this online Workshop (Zoom) POWERBASE Emergency Response Organisations (PEROs) and POWERBASE consortium partners participated and contributed in total with 22 persons representing 11 partners.

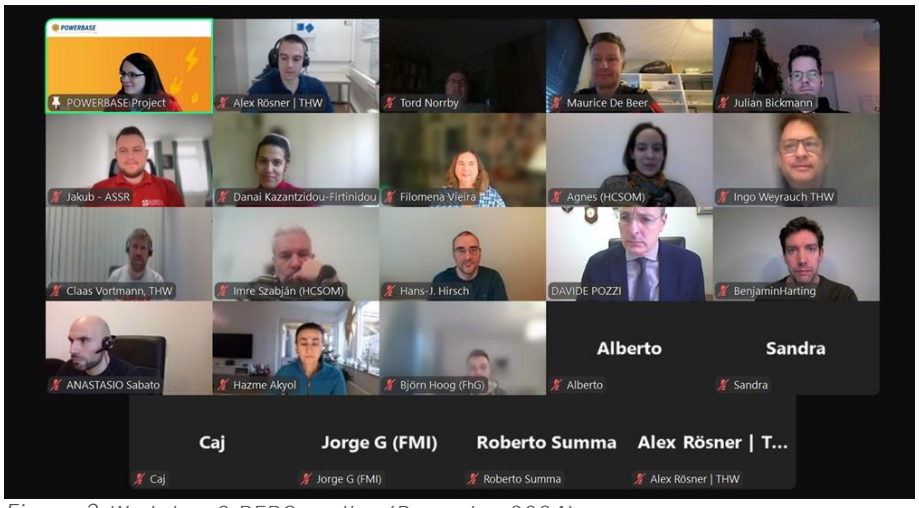


Figure 3 Workshop 2 PEROs online (December 2024)

Accompanying the 90 minutes duration of discussions an online Whiteboard-Tool (conceptboard.com) was used to fill collaboratively the set of categories, with most potential to classify the needs in technology research, in line with the Grant Agreement. Additional categories – such as Safety and Security – were identified.

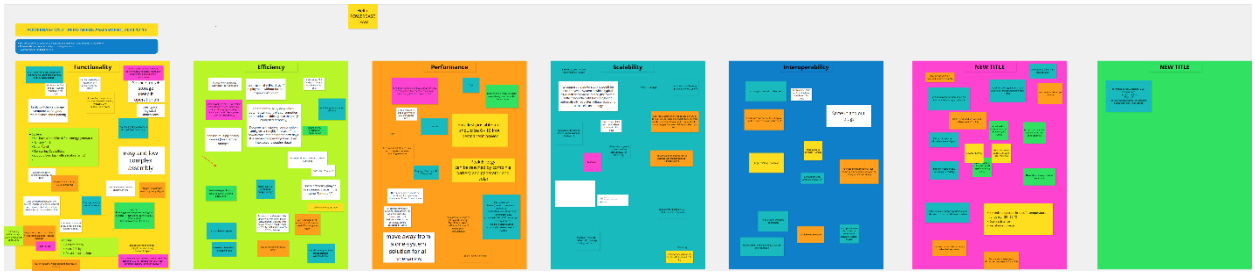


Figure 4 Workshop 2 PEROs Whiteboard collection (December 2024)

Participants interactively listed and named needs in the Whiteboard-Tool and discussed with others their mutual understanding of needs and requirements, clarified different approaches and gave insights to experiences from the field with currently used technologies and tools.

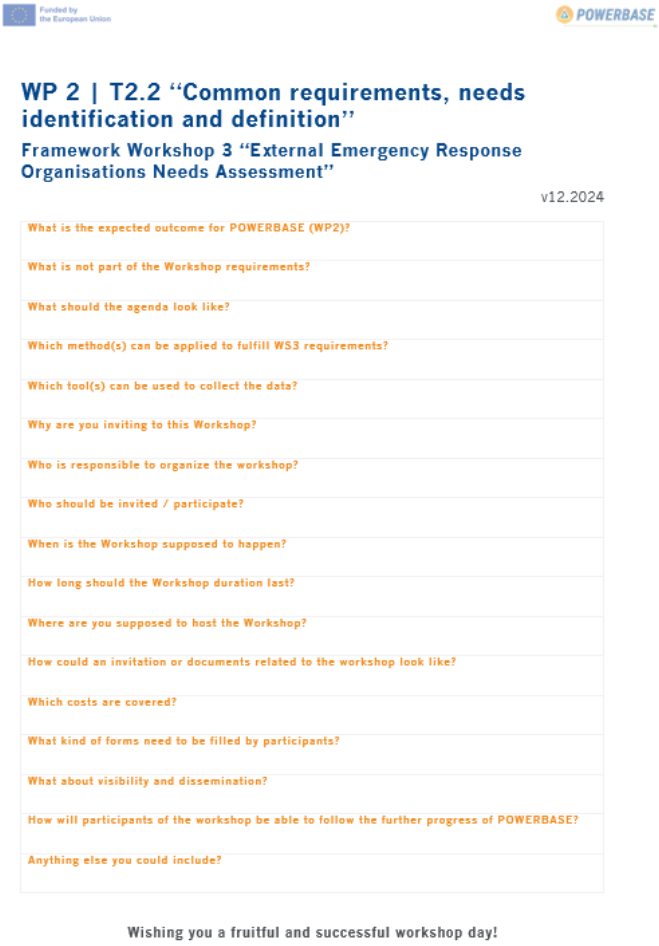
The open discussion to create a « Wishlist for Christmas » partly drifted to an analysis and rating for tools already in use and needed to be re-directed to the workshop's objective accordingly.

Summarizing the collected list ended the online workshop, though the Whiteboard tool was opened to the audience for one more week to add any identified missing needs to be taken into account.

The final list was transferred from the Whiteboard tool into a spreadsheet file to enable clustering.

2.2.2. Methodologies EERO Workshops (WS3)

For Workshop 3 a framework concept was developed in Work package 2 and agreed on with all participating partners.
The framework outlined the main questions (see figure below) and guiding aspects, how to deliver the workshop to keep it comparable and over all enable the consolidation of results for the Functional Requirements Report.



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WP 2 | T2.2 "Common requirements, needs identification and definition"

Framework Workshop 3 "External Emergency Response Organisations Needs Assessment"

v12.2024

What is the expected outcome for POWERBASE (WP2)?

What is not part of the Workshop requirements?

What should the agenda look like?

Which method(s) can be applied to fulfill WS3 requirements?

Which tool(s) can be used to collect the data?

Why are you inviting to this Workshop?

Who is responsible to organize the workshop?

Who should be invited / participate?

When is the Workshop supposed to happen?

How long should the Workshop duration last?

Where are you supposed to host the Workshop?

How could an invitation or documents related to the workshop look like?

Which costs are covered?

What kind of forms need to be filled by participants?

What about visibility and dissemination?

How will participants of the workshop be able to follow the further progress of POWERBASE?

Anything else you could include?

Wishing you a fruitful and successful workshop day!

Figure 5 Concept Frame guidance for Workshop 3

With regard to the methodology chosen for the individual conduction in national settings a choice of five potential methodologies (see Table 1) in line with WIBGI spectrum was offered. Alternatives have been chosen additionally, like the "6-3-5 method" in adopted application.

Table 1 Methodology overview national Workshop 3 series

Methodology	Applied by
Design Thinking	AutRC, GB
Future Backwards Exercise	CNVVF, VIEIRA
Ideation	GB
Nominal Group Technique / NGT	MoI-F
World Café	ASSR, THW
Wouldn't it be great, if	AutRC, HCSOM, KEMEA, VIEIRA
6-3-5 Method (adopted)	THW

In total six different methodologies have been chosen to be applied additionally to **WIBGI** (see Table 5). As WIBGI was set as baseline for the workshop series in WP2 some partners also deepened their knowledge about the method with particular toolkits to "*use it as a light-hearted, risk-free way to have a group share their hopes and expectations*" (Think Fwd Toolkit, last visited: 2025) within POWERBASE project.

Figure 6 National Workshop in Greece hosted by KEMEA

Figure 7 National Workshop in Hungary hosted by HCSOM

The "**Design Thinking**" method was applied by several partners to meet the needs of their workshop audience, as it is known to be "*a structured approach to generating and evolving ideas. The design thinking process is a highly interactive and incremental process, driven by people with different backgrounds and experiences*." (Cerejo & Barbosa, 2012) Participants created an image of solutions and defined the design with all its relevant aspects for operational deployment for this potential tool in the future.

Figure 8 National Workshop in Austria hosted by AutRC

Some partners chose to create the list of unmet needs by applying the "**Future Backwards Exercise**" method, as it is a valuable instrument to "*enable teams to chart a flexible and milestone-driven path to achieve their vision*". (Learning Loop ApS, last visited: 2025) Participants started from the current state of power supply solutions and went through a process of imagination the future solution by discussing the needs to be met as well as attributes to be offered by the potential tools.

Figure 9 National Workshop in Italy hosted by CNVVF

Figure 10 National Workshop in Portugal hosted by VIEIRA

To get the job on workshop 3 done one partner chose to use "**Ideation**" for the journey to the collection of unmet needs, as it "*serves as a powerful catalyst for exploring and solving problems, developing breakthrough products or services, and discovering new opportunities*". (Idea Scale, last visited: 2025) The collected requirements were discussed in iterations with feedback and ranked for their relevant value in the project and finally further refined for submission as workshop results.

Figure 11 National Workshop in Netherlands hosted by GB

Setting up the national workshop was also done in the four stages concept of the "**Nominal Group Technique** (NGT)", which benefits from generating ideas and inputs beforehand, presenting them in the plenum, discussing on various aspects and voting for results. (McMillan SS, 2016). Participants of the workshop were already involved in the planning of the workshop, exchanged and discussed their thoughts with the group during the workshop and were offered to give points on individual requirements.

Figure 12 National Workshop in France hosted by MoI-F

Collecting wishes from practitioners' perspectives, partners also went for the "**World Café**" approach, which is known to be *"a simple, effective, and flexible format for hosting large group dialogue"* (The World Cafe Method, last visited: 2025), and therefore offered a valuable setting for wishful thinking in workshop 3 series. Hosts took responsibility to moderate brainstorming in small groups and note down the created content. In further rotations other groups were offered a short introduction by the table host and had then the chance to add aspects to the already existing brainstorming flipchart.

Figure 13 National Workshop in Slovakia hosted by ASSR

Furthermore, brainstorming on requirements was also done with an adapted "**6-3-5 Method**", which is meant to offer the frame "*for generating ideas based on concrete questions on challenges of simple to medium complexity*". (Atelier für Ideen, last visited: 2025) Participants are asked to fill a table on preset questions; the first participant fills three ideas to the table and the tables are passed to other participants to add content. The concept was scaled down within workshop 3 series due to a reduced number of participants.

Figure 14 National Workshop in Germany hosted by THW

From December 2024 until early February 2025 national workshops on needs and requirements including 58 Emergency Response Organisations (EROs) and further relevant stakeholders for power supply from 9 Countries have been conducted in in-person-settings.

In total 107 participants (incl. 76 male, 19 female) from external stakeholders discussed upon unmet needs and their understanding of requirements for future power supply solutions.

2.2.3. NEW! Methodologies Prioritization Workshop (WS4)

Based on the results of D2.2 "Functional Requirements Report v1" and the consolidated results from previous workshops (WS2, WS3 series) in close timely proximity Workshop 4 (WS4) was held at Fraunhofer premises in Berlin involving PERO group and Advisory Board Members within POWERBASE consortium.
Already approved **World Café** Setting (The World Cafe Method, last visited: 2025) from previous Tasks and Workshop offered the best match setting for collaboration on prioritization of functional requirements. Each of the three groups (see example in Figure 16) discussed with reference to the three main scenarios from D2.1 (Liščinský & Szabján, 2024) and filled prepared hard-copy matrix tables for "importance" (y axis) and "operational impact" (x axis). The matrix tables were created based on the idea of a classic 'Risk Matrix' and set up similar to 'Eisenhower Matrix' (see Figure 15).

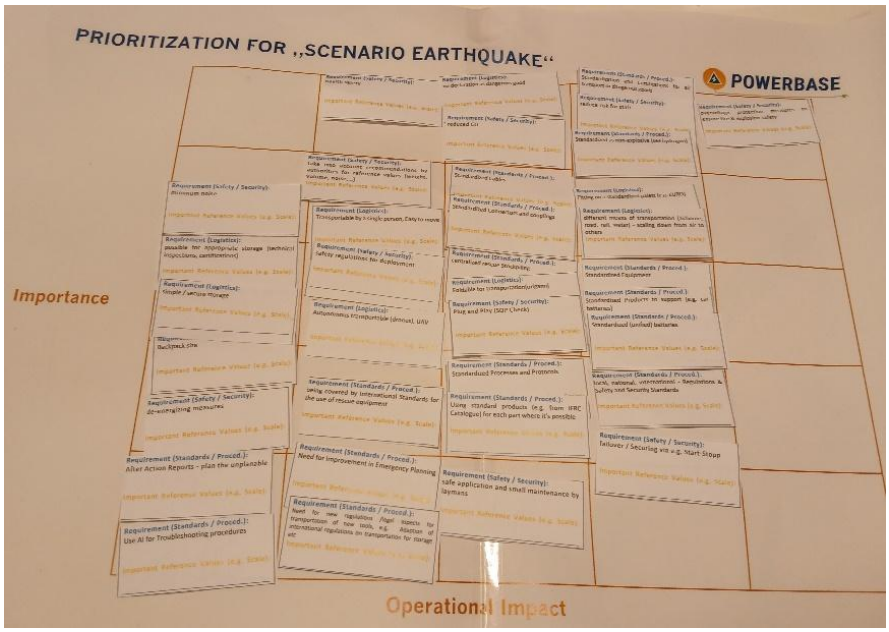


Figure 15 Prioritization Matrix for Earth Quake Scenario

Requirements from the consolidated list given in D2.2 were subject to placement in the matrix cells, while a maximum of three requirements were allowed to being put into one cell (see Figure 15). The requirements presented in pre-printed cards were grouped as in D2.2 presented. The discussing groups of the World Café rotated, offering each group to discuss and add or even rearrange requirements for each scenario.

Figure 16 Group Discussion on Prioritization

Collected results of the prioritization matrix tables were consolidated in a summary matrix table and top priorities were chosen as subject for further processing the requirements analysis (see 3.1.2).

As a process result of prioritization Workshop and discussions also considering presented results from SOTA (T2.3), the lead responder organization and project coordinator THW offered an initial draft for a functional and operational requirements overview to serve as basis for further surveys (see 3.1.3).

2.2.4. NEW! Methodology PERO- and EERO Surveys

In the pre-described path to functional requirements within POWERBASE project based on the Declaration of Action two iterations of surveys were planned. Given the broad variety of wishes and needs expressed during the previously conducted Workshop series (WS2, WS3, WS4) and partly published in D2.2 "Functional Requirements Report v1", the lead coordinator THW had proposed a draft of condensed list to include metrics for performance requirements to the survey (see 3.1.2).
For enabling an agreement and an overview on relevance of requirements including metrics as Common Operational Picture across participating countries and organizations within POWERBASE consortium (PERO survey), Advisory Board members and open to experts from related fields (EERO survey) a list of 14 main statements complemented by 47 sub-statements was created.

This list was set to subject of ranking and evaluation by survey participants using the MoSCoW scale (including an option for Abstention) as it *"can be effective in improving the accuracy of Requirement Prioritization..."*, that *"... provides a structured framework for categorizing requirements into must-have, should-have, could-have, and won't-have categories,..."* (Suchetha Vjayakumar, 2024).

Furthermore, a simplified LIKERT ranking was chosen to serve as reply to method. This as *"Likert scaling is a bipolar scaling method, measuring either positive or negative response to a statement."* (Elaine Allen, 2007)

For the creation of the (in total 61) statements metrics provided in previous Workshops and the lowest common denominator were chosen, such as the set up of a camp (Bases of Operations, Emergency Shelter) for at least 15 persons.

Emergency Energy Supply

Tasks	Provide emergency backup power. Provide staff to handle, assemble/disassemble, install/uninstall, operate and maintain the emergency energy supply capacity when required. Where a handover takes place, train the relevant personnel (local and/or international) before the pull out of the staff of the module.
Capacities	Emergency energy supply units to generate and/or provide emergency energy on site when deployed simultaneously. The module must be capable of providing power for at least one month.
Main components	Power generators of various sizes to allow flexibility and scalability. Adequate connectivity, synchronization, monitoring and power transfer systems to enable connecting the capacity to the affected facilities as well as paralleling control of units. Adequate number of spare parts and other consumables for the functioning of the capacity, such as batteries, energy harvesting equipment, connectivity and synchronizing equipment, other types of apparatus and related services. Adequate procedures to ensure emergency fuel supply for the functioning of the capacity. Adequate procedures to transport, handle, assemble/disassemble, install/uninstall, operate and maintain the emergency energy supply capacity. Lighting equipment for emergency lighting of the affected area as well as lightning protection systems. Adequate storage facilities. Appropriately trained personnel and assets to handle, assemble, install, operate and maintain the emergency energy supply capacity.
Self sufficiency	Article 12 applies.
Deployment	Availability for departure of the technical team and deployable components maximum 12 hours after the acceptance of the offer.

Figure 17 Overview Emergency Energy Supply (Implementing Decision 2025)

Although given definitions for Emergency Energy Supply and Emergency Shelter (250 persons), such as presented in the meanwhile published "Implementing decision - 2025/704 - EN - EUR-Lex" (Commission, 2025) – see figures 17, 18 and 19 - for Union Civil Protection Mechanism (UCPM) modules, offered framing for capacities within the European Union, the previous conducted results from actively involved Emergency Response Organizations built the frame for POWERBASE metrics.

Emergency shelter

Tasks	Provide temporary emergency shelter to the affected population, including space for housing, hygiene and sanitation, basic medical service and social gathering. Provide staff to handle, mobilise, assemble, put in place and maintain shelter units when required. Where a handover takes place, train the relevant personnel (local or international) before the pull out of the shelter capacity.
Capacities	Shelter capacity composed of a physical reserve of assets capable to shelter – when deployed simultaneously – a minimum of 250 persons.
Main components	Shelter units, including tents, with heating (for winter conditions), appropriate aeration systems (for summer conditions), and basic material, such as beds with sleeping-bag and/or blankets. Sanitation and hygiene facilities. Infirmary for basic medical services. Basic hygiene kits. Multi-purpose facilities for preparation (optional) and consumption of food, distribution of drinkable water, social assembling. Power generators and lighting equipment. Appropriate arrangements ensuring the adequate transport and delivery of the units. Appropriately trained personnel and assets to handle, mobilise, assemble, put in place and maintain physical assets in the affected area.
Self sufficiency	Article 12 applies.
Deployment	Availability for departure of physical reserve maximum 24 hours after the acceptance of the offer. Duration of mission and, if applicable, the start of the handover process is to be defined in agreement with the affected country.

Figure 18 Overview Emergency Shelter (Implementing Decision 2025)

Article 12

Self-sufficiency of modules and other response capacities

1. The following elements of self-sufficiency shall be required for each module, unless otherwise specified in the minimum technical requirements set out in Annex II, and for other response capacities, with the exception of relief items:

(a) shelter appropriate for the prevailing weather;

(b) fuel, power generation and lighting covering the consumption of the base of operation and of the equipment required to fulfil the mission;

(c) sanitation and hygiene facilities for the personnel of the module;

(d) food and water for the personnel of the module;

(e) medical or paramedical staff, facilities and supplies for the personnel of the module;

(f) storage and maintenance of the equipment of the module;

(g) equipment for communication with the relevant partners, notably those in charge of the coordination on site;

(h) local transportation, when necessary;

(i) logistical support, equipment and staff to enable the setting-up of a base of operations and the beginning of the mission without delay upon arrival on site.

2. Compliance with the self-sufficiency requirements shall be guaranteed by the offering Member State in one or more of the following ways:

(a) by including in the module or other response capacity the necessary staff, equipment and consumables;

(b) by making the necessary arrangements on the site of operations;

(c) by making the necessary pre-arrangements to combine a non-self-sufficient response capacity with a TAST in order to comply with the requirements referred to in Article 13 prior to the registration of the module concerned in accordance with Article 10(1).

3. The period for which self-sufficiency is to be guaranteed at the onset of the mission shall not be shorter than either of the following:

(a) 96 hours;

(b) the periods laid down in Annex II.

Figure 19 Overview Self Sufficiency of Modules (Implementing Decision 2025)

Both surveys were set up technically in EU-Survey-Tool, while PERO survey was restricted to participation of POWERBASE Emergency Response Organisations, EERO survey was publicly available. To support the filling parties, accompanying documents (see extract in figure 20) including instructions, definitions applicable for POWERBASE project and abbreviation lists were provided.

WP 2 | T2.2 "Common requirements, needs identification and definition"
PERO Survey – May 2025

V05.2025

In this document you will find accompanying information about the ongoing PERO survey:

- How to fill the survey (MoSCoW)
- Terminology and Definitions survey
- Standard Abbreviations POWERBASE
- About the survey

We kindly invite you to fill the survey (1 filled survey per POWERBASE partner organization) by May 16th, 2025, EOB.

FUNCTIONAL REQUIREMENTS SURVEY
FOR EMERGENCY RESPONSE ORGANISATIONS
"LOW EMISSION POWER SUPPLY IN BASES OF OPERATIONS AND EMERGENCY SHELTERS"
June – July 2025

V06.2025

Dear Expert / Emergency Response Organization Team,

Thanks for taking the time and effort to support research and the future of low-emission power supply in emergency operations / missions.

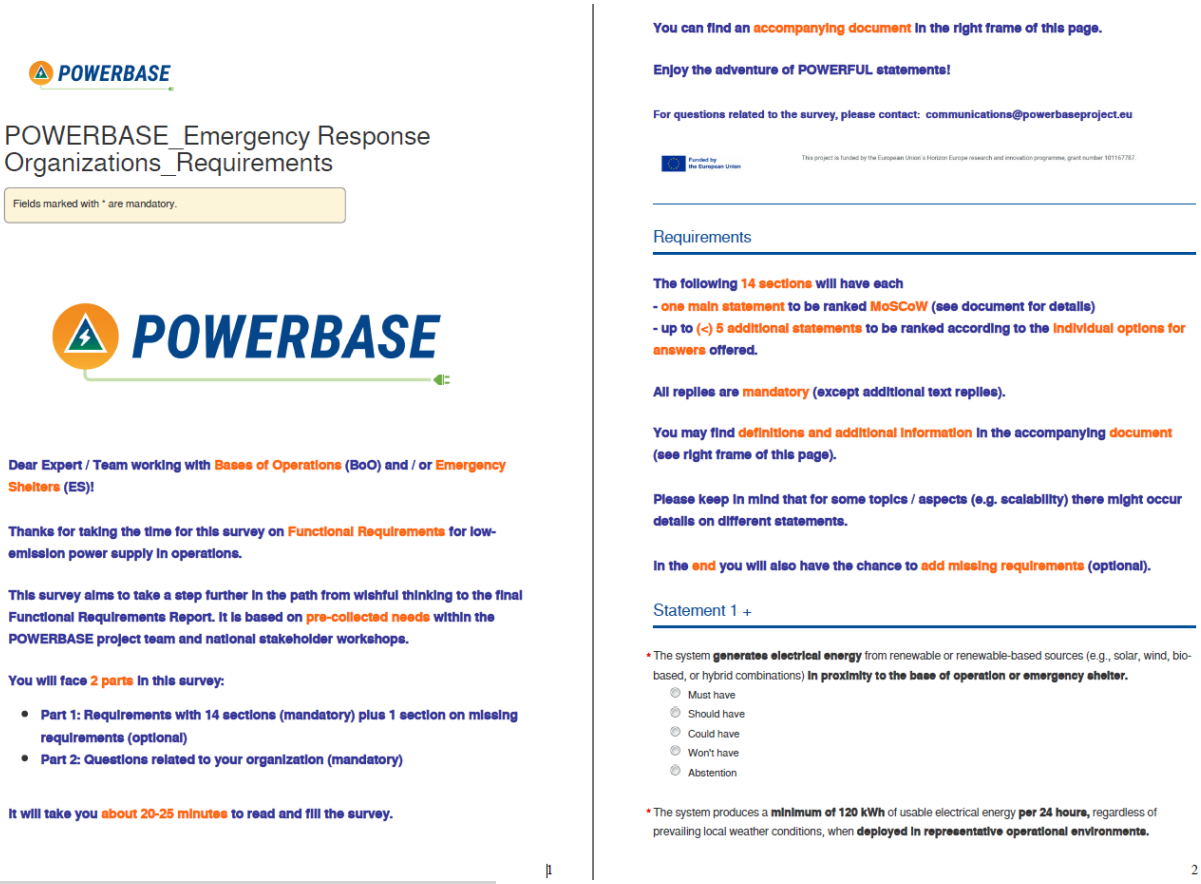
In this document you will find accompanying information about the ongoing "Functional Requirements Survey for Emergency Response Organizations":

- How to fill the survey (MoSCoW)
- Terminology and Definitions survey
- About the survey
- Standard Abbreviations POWERBASE

We kindly invite you to fill the survey not later than ~~July 8th, 2025, EOB~~ EXTENDED DEADLINE: 18th July 2025.

Figure 20 Survey Accompanying Documents for PERO and EERO surveys

In addition to the given supporting documents, instructions were listed in the very beginning of the surveys and coloured highlights presented for swift and easy reading flow (see figure 21).



POWERBASE_Emergency Response Organizations_Requirements

Fields marked with * are mandatory.

Dear Expert / Team working with Bases of Operations (BoO) and / or Emergency Shelters (ES)!

Thanks for taking the time for this survey on Functional Requirements for low-emission power supply in operations.

This survey aims to take a step further in the path from wishful thinking to the final Functional Requirements Report. It is based on pre-collected needs within the POWERBASE project team and national stakeholder workshops.

You will face 2 parts in this survey:

- Part 1: Requirements with 14 sections (mandatory) plus 1 section on missing requirements (optional)
- Part 2: Questions related to your organization (mandatory)

It will take you about 20-25 minutes to read and fill the survey.

1

You can find an accompanying document in the right frame of this page.

Enjoy the adventure of POWERFUL statements!

For questions related to the survey, please contact: communications@powerbaseproject.eu

This project is funded by the European Union's Horizon Europe research and innovation programme, grant number 101167787.

Requirements

The following 14 sections will have each
- one main statement to be ranked MoSCoW (see document for details)
- up to (<) 5 additional statements to be ranked according to the individual options for answers offered.

All replies are mandatory (except additional text replies).

You may find definitions and additional information in the accompanying document (see right frame of this page).

Please keep in mind that for some topics / aspects (e.g. scalability) there might occur details on different statements.

In the end you will also have the chance to add missing requirements (optional).

Statement 1 +

* The system **generates electrical energy** from renewable or renewable-based sources (e.g., solar, wind, bio-based, or hybrid combinations) **in proximity to the base of operation or emergency shelter.**

- Must have
- Should have
- Could have
- Won't have
- Abstention

* The system produces a **minimum of 120 kWh** of usable electrical energy **per 24 hours,** regardless of prevailing local weather conditions, when **deployed in representative operational environments.**

2

Figure 21 Insights to EERO survey (Example)

To enable common understanding of definitions within POWERBASE project a list of used terminology and its definitions has been set up (see table 2).

Table 2 Terminology used in Surveys

Base of Operation - BoO	BoO is a centralized location from which activities, logistics, and personnel are coordinated and deployed to carry out specific missions or tasks. It serves as a hub for planning, communication, resource management, and operational execution.
Emergency (Temporary) Shelter - E(T)S	Emergency Shelter or Emergency Temporary Shelter is a short-term housing solution designed to provide immediate protection and relief for individuals displaced by disasters, conflicts, or crises. These shelters offer basic necessities such as safety, food, water, and medical aid while more permanent housing solutions are arranged.
(System) Component	A (system) component is a self-contained, modular unit of the energy supply system that delivers a distinct and essential function (e.g. energy generation or storage type).
(system) Subcomponent	A (system) sub-component is a functional part or module within a system component that contributes to the component's operation.
System	The system is the overall set of components and subcomponents or modules being deployed as a full set for serving operational needs.
Modular	Modular meaning system's (sub)components that may be separated and recombined offering the highest possible flexibility.
Unit	As a set of system(s) being recognized as one set for deployment.
Trained Personnel	Operational staff (laymen) with potential technical / electrical background trained to maintain simple parts.
Specialized Personnel	Subject matter experts for system or its (sub)components (technical / electrical).
Non-specialized personnel	Operational staff (laymen) without training / instructions and no technical / electrical background.
Bill of Materials (BOM)	Bill of Materials offering a list of raw materials, spare parts, components, sub-components and their individual quantities for manufacturing the product.
Storing / Storage	Preserving the energy for later use.
Consumption	Using the energy.
Conversion	Process of changing energy from one form to another.
Standalone	Able to function alone, by itself or separately.
Hybrid	Hybrid offering to combine different systems or elements.
Socket Prioritization	The sockets pre-set to serve the most important energy consumers are ranked for prioritization meaning a shut down according to their relevance from less to most important.
IP65	see: https://en.wikipedia.org/wiki/IP_code
ISO3744	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane.
ISO11201	Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a workstation and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections.

2.2.5. NEW! Methodology NATO Exercise "BULGARIA 2025"

Between September 8th to 10th, 2025, POWERBASE project team, through KEMEA partner, participated to the research component of NATO Emergency Management Exercise "BULGARIA 2025", co-organised by NATO's Euro-Atlantic Disaster Response Coordination Centre (EADRCC) and the Directorate General Fire Safety and Civil Protection (DG FSCP) of the Ministry of Interior, Republic of Bulgaria. For the first time, such a large full-scale exercise was open to researchers giving them the possibility to collect data in near-to-reality simulated conditions as well as from different civilian and military teams with expertise in emergency response. POWERBASE was among the 39 research proposals which were accepted by the organizers and KEMEA's team was among the - more than 100 - researchers that had the possibility to interact directly with the emergency responders and to disseminate the objectives of the project.

Figure 22 Requirements collection through interview/ semi-structured discussion with representatives of the teams in the BoO

The data collection method was an informally semi-structured discussion/interview (see Figure 22), following a brief explanation of our vision, what increased the availability and willingness of the respondents to interact and explain their views and needs. As discussed within the research teams meetings, this was proved the most efficient method of valuable data collection during the exercise, as the emergency responders were often overwhelmed when being requested to individually respond to questionnaires, in addition to their daily exercise activities. Our survey was conducted in the Base of Operations (BoO) of the teams the day prior to the official start of the exercise as well as during the waiting/resting time.

3. Updated! Clustering Needs and Requirements

According to the EAFIP recommendations *"the use of functional and performance-based requirements offers the opportunity not to pre-define the technical solution and to be open to alternative technical ways to address the needs."* (EAFIP Toolkit on Innvoation Procurement, Module 2, 2021) Following this distinction and approach the generated lists in the given section mainly focuses on functional requirements (see Table 3+4, Table 6+7), offering partly insights to performance requirements (Table 5+8), while also mentioning legal requirements aspects along functional ones, but not including exclusive requirements criteria.

Considering the methodical approach selected for the individual workshops (WS2, WS3 series, WS4) and surveys described in chapter 2, the collected results from each workshop and surveys were listed collectively in spreadsheets and clustered according to their linking attributes.
The given list in within this document reflects all listed items of unmet needs or wishes, highlights multiple nominations for same aspects and was clustered in columns of headlines named as categories for specific attributes.

More distinguished and precise performance-based requirements have been elaborated during the prioritization and refinement phase of Workshop 4, PERO and EERO surveys. The results are reflected in the added subchapters of 3.1 and 3.2 as well as in the consolidated Clustering in 3.3.

3.1. PERO Clustering Results

3.1.1. PERO Results Workshop 2

Following discussions during Workshop 2 "PERO Common requirements, need identification and definition", held on 13th December 2024 via Zoom, accompanied by collaboration in a Whiteboard brainstorming, results of PEROs needs and requirements have been clustered into categories of "functionality", "efficiency", "performance", "scalability" and "interoperability". Furthermore, categories for "resistance", "logistics/transportation" and "standards/procedures" as well as "staff handling/applicability", "sustainability / multi use" and "availability/maintenance" have been identified. Additionally, "financial aspects" were raised and "potential solution approaches" as well as "components to be fed" by the power supply discussed. The clustered results are listed in Table 3 and Table 4.

Table 3 Results for functional requirements of WS 2 PEROs (clustered) Part 1

Functionality	Efficiency	Performance	Scalability	Interoperability	Components to be fed (specific)	Resistance
ready to use	reuse "Waste heat"	**durable**	**Modular in storage**	including set of most common (best case all) big power plugs in Storage incl. Documentation (to use in different countries)	Heating	**Water resistant - Water proof**
Advanced performance monitoring (general consumption / phase distribution) for each Generator or other energy source	can provide the first days of deployment without further major construction	long lifespan	Modular in camp planning	possibility to exchange power with other units	Kitchen	dust resistant
Fault detection to ensure timely maintenance	smart energy distribution optimisation	**serve as an island (e.g. unit per tent)**	smallest unit to be included to survival kits	possiblity to feed from one part of the camp to another part of the camp	Cooling	**self-resilience**
Easy manageable Energy Carriers	ability to use multiply energy sources (like chemical energy)	storage sufficient for night time illmuniation	individual tools / plugs for first responders	same plugs for in and out	Lighting	
Loud and flasching warning signals / alerts at problems or need of maintenance	**smart controlled system (algorithms, e.g. AI) which automatically controls and documents consumption and production (also manually controlled remotely) - stable in key tasks during peaks and lower prio consumption other time**	Cascading to reduce / switch off by operator	**modular (minimum set + addons) "Lego Thinking"**	compatible with ordinary generators	Hydraulic machines	
Data connection between the devices (Generator, energy storage) and the camp staff via a mobile device (smartphone, tablet, PC)	able to be applied to unused space in a camp (e.g. roofs)	**24-7 operational**	**adaptable to scenario**	national and international level · some parts integrated vs to bring along for self sufficiency	Medical components	
Automatic start / stopp according to low / high power consumption phase	Peak Energy can be served by hybrid systems (e.g. battery + generator + solar)	**low noise operations**	have smaller and bigger units that are interoperable	able to combine with other means e.g. heating	WASH (Water, Sanitation, Hygiene)	
able to run tests	efficient energy storage	being self-sufficient with local resources (e.g. wind, solar, water)		able to connect to truck batteries		
Emergency socket to be functional as long as possible	**Alternating generator lines**	technology and automatically regulates voltage according to the cells technology		use of electric vehicles at energy storage (V2L)		
	Failure planning (Plan B) cascading (no use of full capacity)	**fast in deployment**				
	control system (smart) offering a roughly forecast of the power consumption for the next days & a remaining operating time (takes into account weather data)	can operate as a distributed or centralized network / system as well				

Table 4 Results for mainly functional requirements of WS2 (PEROs) clustered Part 2

Availability / Maintenance	Applicability / Staff Handling	Logistics / Transportation	Sustainability / Multi-Use	Standards / Procedures	Financial Aspects	Potential solution approaches
available for purchase in all countries (no more need of bringing into the affected region)	**to be used by First Responders without special training (ease to handle, low complexity)**	Carried by a maximum of 4 persons (~100 kg in total)	to be used even in non disaster areas / times	**Need for new regulations /legal aspects for transportation of new tools**	**Reasonable service fees and storage fees**	Potential of Seawater battery
Printable power supply unit with local materials	to be used within Europe and outside Europe	Enable transportation on aircraft without restrictions (e.g. Lithium Ion batteries need to go on cargo flights) / fitting to standard aircrafts and volume/size/weight limits	System parts can be recycled at the end of its life cycle	Using standard products (e.g. from IFRC-Catalogue) for each part where it's possible	Cost efficiency (purchase, transportation, warehousing)	Potential of Methane technology (resilience)
Easily switchable storage components for good maintenance and repairing	Plug and Play for staff / Personnel	**different means of transportation (airborne, road, rail, water) - scaling down from air to others**	Keep transportation emissions low	IP 67 standard	Cost efficiency by long life span (no frequent replacement or repairs)	Solar power for tents
Replacement parts avaiable world wide	easy to operate in the field (set up, repair, replacements)	Fitting on a standardized palett (e.g. EURO)	Keeping the tool in use and operational	Standardized Products to support (e.g. car batteries)		
periods of min. 4 weeks without maintenance	impossible to connect it wrong	Foldable for transportation(origami)	to be used in everyday operations			
		Within weight restrictions for road transport with most common driving licenses				
		Power Bank as a robot - self flying / multipurpose UAV (Drone)				

Some reference figures from experience in operational conditions from previous deployments and camp settings were provided during the discussion and can be found summarized as quantitative data regarding performance requirements in Table 5.

Table 5 Additional quantitative data from WS 2 regarding performance requirements (PEROs)

Power Output	Weight	Operating Temperature	Module size	Set Up Time	Operational Period	Persons to serve
6-10 kVA for smallest unit	25 kg per unit	°C - 30 +70	fitting on Euro palett	Hours (1-12-24)	Weeks to months	Shelter: >250
	200 kg max for palett					
	100 kg max for 4 persons					
	750 kg max for towed transportation					

Additionally, to the individual requirements discussed overall aspects have been highlighted, such as load aspects in terms of weight for transportation (by persons and means of transportation) but also the load of power used in tools that will be fed by low-emission power supply tools. The objective should therefore, according to the experts involved in the discussion also aim to adapt systems beyond the power supply technology itself.

Giving reference to established module frameworks within the Union Civil Protection Mechanism (UCPM) and particular projects to establish stockpiling and competence hubs, such as rescEU shelter (e.g. by MSB in Sweden) with defined requirements and profiles accomplished the collection of needs and requirements.

3.1.2. NEW! PERO Results Workshop 4

Based on the results of three groups discussing requirements (see 2.2.3 on methodology) for each pre-selected scenario (see D2.1) a consolidated list of five highest ranked requirements on axis (y) for importance in relation to axis (x) of operational impact was created (see figure 23) and served as input to the prioritization statements for survey presented by THW (see 3.1.3).

Importance 5 - Operational Impact 5
Fast deployment
Reliable (Eg. Hybrid)
Autonomously > 3 days
Autonomous
Compatible with ordinary...
Exchange with other units
Periods of min. 4 weeks
Overvoltage protection measures
Benzin / Diesel operating capacities (= addtiional)
Reduce risk for staff
Setup fast vs operational time
Immediate and efficieent response possible
Standardisation and certification for air transport
Constant, stable and continous supply
24-7 operational
Robust for various / all / adverse conditions

Figure 23 Overview highest rated requirements for all 3 scenarios

Reflecting some crucial requirements such as fast deployment, high reliability, autonomous operations, protective measures by also considering adverse conditions, supply chains and transportation methods the top 5 are not representing an exhaustive list of requirements but show some priorities for operational staff in the field.

3.1.3. NEW! ERO Prioritization / Survey Proposal THW

Taking into account results from Workshop 4 with POWERBASE PEROs and Advisory Board Members including parts for requirements prioritization (T2.2) as well as technology presentations and discussions (T2.3), project lead THW offered a first draft of refinement in narrowing the specifications of functional requirements and complementing with performance metrics (see figure 24).

The European funded project POWERBASE provides the basis for future low emission power supply in international emergency response missions. Nowadays, bases of operation[1] and emergency shelters[2] are generally powered by 24/7 running fossil fuel generators. POWERBASE has collected and streamlined needs for mobile low emission power supply from approximately 50 internationally emergency response organizations. These needs are categorized in functional requirements with corresponding performance requirements. All organizations seek for a solution that is able to produce, store, manage and convert electrical energy with maximum efficiency. At the same time, it must be as mobile as possible and worldwide deployable in every disaster scenario. The table below list all functional and performance requirements.

Functional Requirements	Performance Requirements
• **Electrical energy generation** in the proximity of a base of operation or emergency shelter from renewable sources	• At least 120 kWh per day
• **Energy storage** in a base of operation or emergency shelter	• At least 20 kWh
• **Energy management** for energy generation, storage and energy output & distribution	• Manage energy inputs and outputs to optimize fuel consumption and greenhouse gas emissions in "ECO Mode" (default) and to optimize for maximum energy demand in "Power Mode" • Include energy monitoring, data logging and *data communication/remote control* • Converter should only be operated at maximal efficiency point • Automatic energy output distribution (selectable 230 or 400 V) • Socket prioritization with automatic emergency shutdown of low priority sockets
• **Electrical power output**	• Nominal output 10 kW • Peak output 30 kW (1h)
• **Energy conversion** e.g. chemical to electrical energy	• Make use of at least one commercially available fuel to convert into electrical energy • Fuel should be producible in a sustainable manner • At least 50% of the chemical energy should be converted into electrical energy
• System mobility	• Every system component[3] has to be carriable by 4 people • System[4] needs to fit on one pallet • Every system component needs to be transportable on an airplane

Figure 24 Initial draft for Requirements Refinement by THW

Based on the initial set of functional and performance requirements (see figure 24) by THW, Work Package 2 team elaborated on the requirement statements and built a full set of 14 main statements complemented by in total 47 sub-statements to reflect pre-determined functional requirements categories with metrics for performance. These results can be found in 3.1.4 and 3.2.2 as well as in the consolidated list in 3.3.2.

3.1.4. NEW! PERO Results Survey

Once set up in EU-Survey-Tool, the PERO survey version with its accompanying document had been published, POWERBASE Emergency Response Organisations have been invited to participate in the internal survey. Given a response period from May 6th to 16th, 2025, further extended until May 22nd, 2025 with reminders, in total 8 responses have been received.

PERO	Expected 8 FR Responses (ASSR, AutRC, CNVVF, GB, HCSOM, MoI-F, MSB, THW)	
Participants	ASSR, AutRC, CNVVF, GB, HCSOM, MoI-F,THW + 1 one without naming of organisation	8
Nations	AT, DE, FR, HU, IT, NL, SK	7
Individual / Joint	5 Joint / 2 Indidvidual / 1 withou reply	

Figure 25 Overview Demographic Data of PERO survey participants

For PERO survey five joint and two individual replies were submitted, not all replies included the optional data on survey participants filled. From given results we can assume that all Emergency Response Organizations partners within POWERBASE have participated in the PERO survey (see figure 25).

Statistics:
POWERBASE_PERO_Requirements_WP2

The system generates electrical energy from renewable or renewable-based sources (e.g., solar, wind, bio-based, or hybrid combinations) in proximity to the base of operation or emergency shelter.

		Answers	Ratio
Must have		5	62.5 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system produces a minimum of 120 kWh of usable electrical energy per 24 hours, regardless of prevailing local weather conditions, when deployed in representative operational environments. Performance to be verified through simulated or field tests across diverse climate zones and during different seasons.

		Answers	Ratio
Less (>80 kWh/day)		1	12.5 %
Approval of proposal		7	87.5 %
More (> 150 kWh/day)		0	0 %
No Answer		0	0 %

Figure 26 Extract of POWERBASE PERO Requirements survey statistics

Results presented in the PERO survey reflected the given variety but in its crucial sense similar approach by participants in the performance and functional requirements (see extract in figure 26, full results in Annex of this document).

3.2. EERO Clustering Results

3.2.1. EERO Results Workshops 3

Results of unmet needs and wishes for future power supply in Bases of Operations and Emergency Shelters collected during the series of nine national workshops with various stakeholders have been submitted in the pre-set template (text document, spread sheet) in line with the concept frame (see figure 5 in chapter 2) by all hosting partners. The functional – and partly performance - requirements listed have been clustered into a table of unmet needs or wishes, with highlighted multiple nominations for same aspects and in columns of headlines named as categories for specific attributes (see Table 6 and Table 7).

Table 6 Results for mainly functional requirements collected in national WS3 series (part 1)

Functionality	Efficiency	Performance	Modularity and Scalability	Interoperability	Safety / Security	Sustainability / Multi-Use
electrical panel for civil and industrial use	immediate and efficient response possible	high thermal efficiency	Stackable and expandable in capacity	**connectivity to power grid / network (e.g. pre installed connectors to public buildings)**	measures to ensure fire & explosion safety	**100% reusable or recyclable at the end of the life cycle**
remote control systems (user friendly)	Rechargeable within 5 hours (0-100%)	minimal need of surveillance	smaller devices to be linked in a closed circuit system	**to be linked in a (single) network**	reduce risk for staff	integrate sustainable battery storage systems
BESS (Battery Energy Storage Systems)	reduced loss in power generation	**reliable (e.g. via hybrid systems)**	Modular Nanospike package + additional devices	**compatible with vehicle-2-load (V2L) system**	de-energizing measures	Disposal and waste management sustainable
water resistant	smart algorithm integrated (optimized use of the most proper resource throughout the day)	**constant / stable / continous supply (incl. Voltage)**	**Individual components must be interconnectible (smaller units to larger units)**	**hybrid system operations**	overvoltage protection	low environmental burden from production - deployment to end of life
shock resistant	storage for periods of lower availability of renewable sources	no need for cooling but offering cooling	Central Service Centre	Stability of electric current	**minimum noise**	considerable for multi-use-purposes
fire proof	more density with less weight provides more efficiency	continuous operation for 2-3 weeks	Energy Islands (e.g. per tent)	Power connector compatibility	reduced vibration	cleaner than current technologies
dust proof	**set up (fast) vs operational time (sudden to immediate / short vs long term deployment)**	**resistance (e.g. to impact voltage)**	fitting into small spaces (convenient size)	possibility of using domestic energy sources to connect	health safety	to be used in standard operations (not emergencies) as well
Quiet / Low noise	redundancy planned (back up devices)	universal for use in different countries (mains voltage)	possibility for stand-alone systems	included (e.g. smart algorithm) the conventional fuel generator in order to guarantee a baseline supply at least for critical services	reduced CO	Easy operation – national & international
applicable in tunnels		if it is to provide water heating it must have a high output at the expense of other things	expandable for national and EU operations	Powerships	safety regulations for deployment	take into account added value for andere branches - small market for ops
Satellite/Wi-Fi connectivity available		**robust for various / all / adverse conditions (e.g. weather, season, time, altitude, temperature,...)**	from single person use to running the full operational setting	operating possible with locally available byproducts	failover / Securing via e.g. Start-Stopp	
self-chargeable / auto-rechargable systems		**peaks and voltage differences covered for different services: medical / specialized equipment (E.g. WASH)**		including Electric Vehicle Fleet charging	Plug and Play (SOP Check)	
offer charging for operational tools, such as saws		high efficiency over a wide load range		Use available resources such as recycling material / car batteries as puffer	safe application and small maintanance by laymans	
autonomous		work autonomously for at least 3 days		with other components such as medical purposes, heating,...	take into account recommendations by authorities for reference values (weight, volume, noise,...)	
independent of technical fuels		connector for each person involved			Integrated GPS module for safety	
Enable Heating and Cooling		**(fast) charging option**				
communication support		consistent peak performance				
tracking for big consumers (WASH, mobiles,...)						

Table 7 Results for mainly functional requirements collected in national WS3 series (part 2)

Energy Sources, Capacities	Logistics / Transport	Availability / Maintenance (Supply Chain)	Standardisation and Procedures	Application /Staff Handling	Financial Aspects
Energy generation from elements: water, wind, fire	Transportable by a single person	Safe and streamlined maintenance	Standardized Equipment	easy access user manuals	**affordable and cost effective**
On-site CO2-to-fuel generation (+ Nanospikes Ethanol)	**allowed for air transport (plane, helicopter)- cargo use (not only square but arched)**	**option for simple onsite replacement / maintenance without specialized staff**	**Standardized Connectors and couplings**	**energy specialists deployed with teams (similar to communication, medical staff)**	no monthly costs
Must not emit environmental pollutants	roll container feature	Longterm availability of Hardware service	Standardized Cables	easy to handle by non-specialised staff	costefficient / low cost (purchase and maintenance)
using hydrogen	Backpack size	easy to use – selftest	Standardized Processes and Protocols	**Certficiation training for staff (if needed)**	
photovoltaic panels with nano cells	Autonomous transportable (drones)	suitable for mass production	Need for Improvement in Emergency Planning	to be carried by 1-2 persons	
hydropower	safe transport	back up options need to be available	Standardises (unified) batteries	Operable by a single person	
solar	Easy to move	long service life	being covered by International Standards for the use of rescue equipment	simple in put-into-function	
thermal energy	efficiency of material transport in relation to weight and volume	easy to use without explanation	**Standardisation and Certifcations for air transport**	trouble shooting module also applicable by non-experts	
fuel cells - chemical reactions	possible for appropriate storage (technical inspections, certifications)	all life-cycle of the emergency civil protection typical events, from planning to maintenance and also shelf-life challenges	**Regulations and Certifcation for dangerous goods (if applicable)**		
battery banks	simple / secure storage	Use standard parts - make them easily replaceable in any country	Standardized as non-explosive (see hydrogen)		
several sources with complimentarity	norms for transport in vehicles considered	Wear parts can be 3D printed on-site	Possibility to Leave at deployment place as relief item (Host Nation Support)		
photovoltaik solution scalable	low logistic impact	possibility to create spare parts easily	Use AI for Troubleshooting procedures		
Redox!	**no declaration as dangerous good**	Internet connection - remote access for Software repairs	strategies for energy management		
close future = need of resources to be used as fuels	Low weight		centralized rescue Stockpiling		
longter = photovoltaik with storage to be transported via road > air > water, operational within 72 hours, need of specialists	Low volume		**local, national, international - Regulations & Safety and Security Standards**		
	UAV		**Adaption of international regulations on transportation for storage etc**		
			After Action Reports - plan the unplanable		

Additionally, some key figures of quantitative ("performance") requirements have been mentioned during the national workshop series, those can be found in table 8.

Table 8 Additional quantitative data from national WS3 series regarding performance requirements

Power Output	Consumption Reference	Storage Capacity	Weight	Recharge Time	Operating Temperature	Connectivity	Module size
500 kW continously for	473 kwH per day min	7.5 kWh capacity stable	Max. 10-15 kg	0-100% in 5hrs	°C -40 +50	USB-C to 400V/126A	compliant with the capacity of
modularity to 200 kW for 250 persons	5.81 kwH per day per person average						can be carried by a 13 feet Standard ISO
vehicle	100 W Laptop						fitting standard
250 KW to cover the needs of	15 W LED Type lamp						
kitchen (200KW	10 W phone						
20 kW built up	5-15 kw						
380 kV							
20kVA							
2.5 KW for 10							

Summarizing besides all quantitative ("performance") and qualitative ("functional") data collected for unmet needs and requirements for power supply tools in operational settings of Bases of Operations and Emergency Shelters, some key messages were highlighted by the majority of involved experts. The headline could be set by "Flexibility in all dimensions".

A technology offering CO2-neutral application would be appreciated and the maintenance as well as end-of-life support being recyclable material with a zero-emission footprint is welcome. The ability to generate power from water, wind, and fire or any given resource in the field, ensuring versatility in various environments is included to the list of wishful thinking. Meeting the challenging aspect of energy storage whilst being easy to deploy and still robust in adverse conditions – such as extreme temperatures, remote areas, extreme dry or wet settings - are crucial for successful operations.

The challenge of energy storage was met with innovative solutions—ensuring that the system could sustain power without environmental impact while remaining robust and adaptable.

Considering the creation of a modularity system by event type characterization, with the allocation of specific structures for the deployment would offer a complimentary perspective for the tool development or selection.

Last, but not least, the human factor of staff – core and volunteer personnel – using the tool in the field need to be taken into account regarding ease of use and safety.

3.2.2. NEW! EERO Results Survey

Identically set up with 14 statements and 47 supporting statements in EU-Survey-Tool, the EERO survey version with its accompanying document had been published publicly and PERO organizations invited their networks to participate with their expertise. In total various channels – social media, National Contact Points, UCPM modules, UCPM Expert groups, messenger channels, personal mailings and bilateral contacts have been opened to get in touch with experts on the subject. POWERBASE consortium reached out to more than 35 individual organisations, an uncounted number of personal contacts, more than 10 networks and groups given each up to 100 contacts, social media and website posts – project channels (313 followers, more than 3 posts with at least 15 reposts on individual organisation as well as personalized accounts.

The survey initially published to be filled from June 2nd, 2025, to July 8th, 2025, has been extended for response until July 20th, 2025. Although collaborative efforts and several personal as well as online calls for action have been launched, the survey participants rate did not meet the expectations of 20 replies and resulted in a total of 18 external replies (see figure 27).

EERO	Expected min 20 Responses EU MS, UCPM PS	
Participants		18
Nations	AT 5 / CY 2 / DE 2 / GR 3 / HU 1 / IT 2 / RS1 / PT 2 (8 = 7 MS, 1 PS)	8
Organisations	CSO 1 / EMS 1 / FRS 4 / CPO 5 / Reg 1 / Nat 1 + Red Cross, Mountain Rescue Team, Development Cooperation Organisation, Charity	
Individual / Joint	Joint 8 / Individual 10	

Figure 27 Overview Demographic Data of EERO survey participants

For EERO survey eight joint and ten individual replies were submitted, not all replies included the optional data on survey participants filled. Experts from eight different countries (UCPM Member and Participating States) submitted replies, most of them deriving from Civil Protection Organisations followed by Fire and Rescue Services (see figure 27).

Statistics: POWERBASE_Emergency Response Organizations_Requirements

The system generates electrical energy from renewable or renewable-based sources (e.g., solar, wind, bio-based, or hybrid combinations) in proximity to the base of operation or emergency shelter.

		Answers	Ratio
Must have		3	16.67 %
Should have		9	50 %
Could have		5	27.78 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The system produces a minimum of 120 kWh of usable electrical energy per 24 hours, regardless of prevailing local weather conditions, when deployed in representative operational environments. Performance to be verified through simulated or field tests across diverse climate zones and during different seasons.

		Answers	Ratio
Less (>80 kWh/day)		4	22.22 %
Approval of proposal		9	50 %
More (> 150 kWh/day)		5	27.78 %
No Answer		0	0 %

Figure 28 Extract of POWERBASE EERO Requirements survey statistics

Results represented in the EERO survey (see extract in figure 28, full results in Annex) offer the almost same results as PERO survey results (see 3.1.4) and can thus be reflected in the consolidated results see 3.3.2 without special distinction of response group.

3.3. Updated! Consolidated and Clustered Results

Results collected during phases of WS 2, WS 3, WS4, PERO and EERO surveys have been further clustered and rephrased into a table of functional requirements for qualitative aspects to be found in Table 9, as well as summarized results on functional and performance needs in 3.3.2.

3.3.1. Consolidated Clustered Results Initial

Initial clustered results from WS2 and WS3 formats have been summarised in following table and rephrased below.

Table 9 Consolidated results of functional requirements Workshops of PEROs and EEROs

Functionality	"Power supply tool **ready to use**" **Monitoring** # Including Advanced performance monitoring (general consumption / phase distribution) for each Generator or other energy source # Enabling Fault detection to ensure timely maintenance (Loud and flashing warning signals / alerts at problems or need of maintenance) # Tracking for big consumers (WASH, mobiles,...) # Able to run tests # Electrical panel for civil and industrial use **Remote Control** # Remote control systems (user friendly) **Automation** # Automatic start / stop according to low / high power consumption phase # Autonomous **Data / Communication** # Data connection between the devices (Generator, energy storage) and the camp staff via a mobile device (smartphone, tablet, PC) # Communication support **# Satellite/Wi-Fi connectivity available** **Charging** # Emergency socket to be functional as long as possible # Self-chargeable / auto-rechargeable systems # Offer charging for operational tools, such as saws **Storage** # BESS (Battery Energy Storage Systems) **Technical** # Applicable in tunnels # Independent of technical fuels # Enable Heating and Cooling # Easy manageable Energy Carriers

Efficiency	**Energy use / distribution Efficiency** # Reuse "Waste heat" # Smart energy distribution optimization # Ability to use multiply energy sources (like chemical energy) # Peak Energy can be served by hybrid systems (e.g. battery + generator + solar) # Efficient energy storage # Alternating generator lines # Failure planning (Plan B) cascading (no use of full capacity) # Rechargeable within 5 hours (0-100%) # Reduced loss in power generation # Smart algorithm integrated (optimized use of the most proper resource throughout the day) #Storage for periods of lower availability of renewable sources **Control Efficiency** # Smart controlled system (algorithms, e.g. AI) which automatically controls and documents consumption and production (also manually controlled remotely) - stable in key tasks during, lower priority consumers are supplied after peaks # Control system (smart) offering a roughly forecast of the power consumption for the next days & a remaining operating time (takes into account weather data) **Deployment Efficiency** # Can provide the first days of deployment without further major construction # Immediate and efficient response possible # Set up (fast) vs operational time (sudden to immediate / short vs long term deployment) # Redundancy planned (back up devices) **Space Efficiency** # Able to be applied to unused space in a camp (e.g. roofs)
Performance	**Basic performance** # Reliable (e.g. via hybrid systems) # Constant / stable / continuous supply (incl. Voltage) # No need for cooling but offering cooling # Resistance (e.g. to impact voltage) # Universal for use in different countries (mains voltage) # Robust for various / all / adverse conditions (e.g. weather, season, time, altitude, temperature,...) # High thermal efficiency **Life time performance** # Durable # Long lifespan **Mission condition performance** # Low noise operations # Minimal need of surveillance # Fast in deployment # 24-7 operational # Work autonomously for at least 3 days # Continuous operation for 2-3 weeks # Peaks and voltage differences covered for different services: medical / specialized equipment (E.g. WASH) # High efficiency over a wide load range # Connector for each person involved **Set up performance** # Cascading to reduce / switch off by operator # The system self-checks the cells technology and automatically regulates voltage according to the cells technology # Can operate as a distributed or centralized network / system as well # Being self-sufficient with local resources (e.g. wind, solar, water) # Storage sufficient for night time illumination # (fast) Charging option # Consistent peak performance

Scalability	**Modularity** # Modular in storage # Modular in camp planning # Modular (minimum set + addons) "Lego Thinking" # Modular Nanospike package + additional devices # Adaptable to scenario **Individual tool to modular setting** # Individual tools / plugs for first responders # Smallest unit to be included to survival kits # Have smaller and bigger units that are interoperable # Stackable and expandable in capacity # From single person use to running the full operational setting **Stand alone to linked systems** # Smaller devices to be linked in a closed circuit system # Individual components must be interconnectible (smaller units to larger units) # Possibility for stand-alone systems # Central Service Centre # Energy Islands (e.g. per tent) # Expandable for national and EU operations
Interoperability	**Exchange** # Possibility to exchange power with other units and to feed from one part of the camp to another part of the camp # Compatible with ordinary generators for hybrid system operations # Able to connect to truck batteries, use of electric vehicles as energy storage (V2L) and including Electric Vehicle Fleet charging # Connectivity to power grid / network (e.g. pre-installed connectors to public buildings), possibility of using domestic energy sources to connect # To be linked in a (single) network # Stability of electric current # Connecting to Powerships # Operating possible with locally available byproducts, Use of available resources such as recycling material / car batteries as puffer # National and international level (parts integrated vs bring along) for self-sufficiency **Plugs** # Including set of most common (best case all) big power plugs in Storage incl. Documentation (to use in different countries) # Same plugs for in and out # Power connector compatibility
Components to be fed (specific)	Need to **enable and support** needs from module parts such as # Heating # Cooling # Lighting # Kitchen # Medical components # WASH (Water, Sanitation, Hygiene) # Hydraulic machines and other operational tools
Resistance	# **Water** resistant - Water proof # Dust resistant – **dust** proof # **Shock** resistant # **Fire**-proof # Self-**resilient**

Availability / Maintenance	**Purchase** # Available for purchase in all countries (no more need of bringing into the affected region) # Printable power supply unit with local materials # Suitable for mass production **Repair / Replacement** # Replacement parts available worldwide # Use standard parts - make them easily replaceable in any country # Wear parts can be 3D printed on-site # Possibility to create spare parts easily # Internet connection - remote access for Software repairs **Maintenance / Service** # Periods of min. 4 weeks without maintenance # Safe and streamlined maintenance # Option for simple onsite replacement / maintenance without specialized staff # Easily switchable storage components for good maintenance and repairing # Long term availability of Hardware service # Back up options need to be available # Long service life
Applicability / Staff Handling	**Staff Resources** # To be used by First Responders without special training (ease to handle, low complexity) # Energy specialists deployed with teams (similar to communication, medical staff) # Easy to handle by non-specialized staff **Set to operation** # Plug and Play for staff / Personnel, simple put-into-function # Easy to operate in the field (set up, repair, replacements) # Impossible to connect it wrong # Operable by a single person # To be carried by 1-2 persons # Trouble shooting module also applicable by non-experts **Training** # Easy access user manuals # Certification training for staff (if needed)
Safety & Security	**Power** # De-energizing measures # Overvoltage protection measures to ensure fire & explosion safety # Integrated GPS module for safety # Failover / Securing via e.g. Start-Stopp **Staff / Health** # Reduce risk for staff # Minimum noise # Reduced vibration # Health safety # Reduced CO # Take into account recommendations by authorities for reference values (weight, volume, noise,...) **Standard Operating Procedures (SOP)** # Safety regulations for deployment # Plug and Play (SOP Check) # Safe application and small maintenance by layman

Logistics / Transportation	**On Site** # Carried by a maximum of 4 persons (~100 kg in total) # Transportable by a single person, Easy to move # Low weight, Low volume **Transfer to Deployment Area** # Enable transportation on aircraft without restrictions (e.g. Lithium Ion batteries need to go on cargo flights) / fitting to standard aircrafts and volume/size/weight limits # Allowed for air transport (plane, helicopter)· cargo use (not only square but arched) # Different means of transportation (airborne, road, rail, water) · scaling down from air to others # Norms for transport in vehicles considered · Within weight restrictions for road transport with most common driving licenses # Low logistic impact # No declaration as dangerous good # Fitting on a standardized palette (e.g. EURO) # Roll container feature # Power Bank as a robot · self flying / multipurpose UAV (Drone) # Autonomous transportable (drones), UAV # Foldable for transportation(origami) # Backpack size **Warehousing** # Possible for appropriate storage (technical inspections, certifications) # Simple / secure storage
Sustainability / Multi-Use	**Use off deployment** # To be used even in non-disaster areas / times , to be used in everyday / standard (non-emergency) operations # Keeping the tool in use and operational, considerable for multi-use-purposes # Take into account added value for other branches · small market for opportunities EROs **Recycling / Reuse** # System parts up to 100% can be recycled at the end of its life cycle # Disposal and waste management sustainable **Low-Emission effects** # Keep transportation emissions low # Integrate sustainable battery storage systems # Low environmental burden from production · deployment to end of life # Cleaner than current technologies
Standards / Procedures	**Adaptation of Standards / Regulations** # Need for new regulations /legal aspects for transportation of new tools, e.g. Adaption of international regulations on transportation for storage etc. # Need for Improvement in Emergency Planning # Standardization and Certifications for air transport or dangerous goods Possibility to Leave at deployment place as relief item (Host Nation Support) # Use AI for Troubleshooting procedures # Centralized rescue Stockpiling **Existing Standards / Regulations** # IP 67 standard # Using standard products (e.g. from IFRC-Catalogue) for each part where it's possible # Being covered by International Standards for the use of rescue equipment # Local, national, international · Regulations & Safety and Security Standards # After Action Reports · plan the unplannable **Components for Standards / Regulations** # Standardized Products to support (e.g. car batteries) # Standardized Equipment # Standardized Connectors and couplings # Standardized Cables # Standardized Processes and Protocols # Standardized (unified) batteries # Standardized as non-explosive (see hydrogen)
Financial Aspects	# **Reasonable**, cost efficient and low-cost service fees and storage fees, no monthly costs # **Cost efficiency** (purchase, transportation, warehousing, no frequent

	replacement or repairs) # **Affordable** and cost-**effective** components
Potential solution approaches	# Energy generation from elements: water, wind, fire # Several sources with complementarity # Potential of Seawater battery # Potential of Methane technology (resilience) # Potential of Solar power for tents, photovoltaic panels with nano cells # Potential of CO2-to-fuel generation (+ Nanospikes Ethanol) # Potential of hydrogen, hydropower # Potential of thermal energy # Potential of Redox!

Taking a look at the consolidated table (see Table 9), it is obvious that following demands can be summarized per category listed in the predominantly functional requirements analysis:

Functionality: A new low-emission power supply tool shall be ready to use with minimal setup requirements. It must include advanced performance monitoring ("SMART", "AI") for continuous operation and provide fault detection to ensure timely maintenance. Energy carriers should be easily manageable, and the system must feature loud and flashing warning signals or alerts at critical levels.

Efficiency: The innovative tool should optimize energy use by e.g. reusing waste heat. It must be capable of operating for the first days of deployment without external energy sources and ensure smart energy distribution optimization. The ability to use multiple energy sources, such as conventional and renewable options, is essential. Additionally, smart-controlled algorithms (e.g. AI-based) should enhance efficiency.

Performance: The power supply tool must be durable and designed for a long lifespan. It should support a kind of "Energy Island" mode operation (e.g. unit per tent) and provide sufficient storage for example during nighttime illumination. A cascading system should allow automatic processes or actions via operators to reduce or switch off energy consumption as needed.

Scalability / Modularity: The design must support modular storage and application and be adaptable for camp planning. The smallest unit should be included in survival kits, and individual tools or plugs should be available for first responders. The modular approach should follow a "Lego Thinking" principle, with a minimum set and optional add-ons.

Interoperability: The power supply technology should include the most common battery connectors (globally) and ideally be compatible with all available systems. It must allow power exchange between units and enable energy distribution within a camp and scalable units within the camp. Standardized plugs should be used for both input and output connections, ensuring compatibility with ordinary generators.

Components to be fed (specific): The innovative power supply solution must support various critical other modular components in operations, including heating, kitchen appliances, cooling, lighting, and hydraulic machines as well as Emergency Medical facilities.

Resistance: Being water-resistant or waterproof and dust-resistant are crucial for the new technology. It should ensure self-resilience in harsh conditions to maintain operational reliability in all kinds of operational environment (climate, weather, adverse, urban, remote).

Availability / Maintenance: Innovative power supply tools are expected to be available for purchase in all countries without major restrictions. Printable power supply units using local materials should be an option. Storage components should be easily switchable for extended lifespan, and replacement parts must be available

worldwide. The system should be capable of operating for at least four weeks without requiring maintenance.

Applicability / Staff Handling: First responders should be able to use the power supply tool without special training. It must be applicable both inside and outside of Europe for deployment. A plug-and-play design would facilitate ease of use for staff, ensuring simple field setup, repair, and maintenance. The set up is also supposed to prevent incorrect connections.

Safety / Security: The motto of "Safety First" also has to applied for new solutions. Fire and explosion safety measures must be implemented. The tool is expected to minimize risks for personnel, incorporate de-energizing measures, and provide overvoltage protection. Noise levels should be kept to a minimum for operational comfort and to meet with other criteria health safety in the field.

Logistics / Transportation: The power supply tool should be transportable by a maximum of four people (~100 kg in total), best case by one person in a backpack. It must be suitable for air transport without restrictions and adaptable for multiple means of transportation, including airborne, road, rail and sea. The design should fit standardized pallets (e.g. EURO) and container systems and ideally it could be framed as a foldable pack for efficient transport.

Sustainability / Multi-Use: The modular power supply tool should be applicable beyond disaster areas, ensuring continued usage – e.g. in daily operations. Components should be recyclable at the end of their lifespan. Transportation emissions must be taken into account and are to the outmost minimized, and the system should remain operational for extended periods.

Standards / Procedures: Raising awareness for need of standards and regulations to make operational deployment possible is a basis for the innovative solution, which needs to meet relevant regulations and legal frameworks for transport. If necessary, those standards and regulations should be aimed for being adapted. Standardized products, such as those from IFRC catalogues or NATO standard references, should be utilized where possible. Compliance with at least IP67 and other relevant standards is required, ensuring to meet the need in operational conditions and the compatibility with common battery solutions and standardized equipment.

Financial Aspects: Service and storage fees should remain reasonable. The new generation of tool (kits) must offer cost efficiency in purchasing, transportation and warranty coverage. A long lifespan is ideally minimizing frequent replacements, keeping costs low. Affordability must be ensured, with no ongoing monthly costs for practitioners.

Potential Solution Approaches: The power supply system is expected to explore innovative energy solutions. Discussed approaches could be seawater batteries and methane technology for resilience. Solar power might be considered for tent applications, and energy generation from elements like water, wind, and thermal energy could be investigated. On-site CO2-to-fuel generation technologies could further enhance sustainability.

3.3.2. NEW! Clustered Results Refinement

Following the path of prioritization and further specification for functional and performance refinement (provided by THW), the clustered results based on Workshop 4 (Prioritization), PERO and EERO surveys, the rating with MoSCoW and simplified LIKERT scale can be reflected as follows for requirements of POWERBASE regarding low-emission power supply in Bases of Operations and Emergency (Temporary) Shelters (full list of consolidated requirements see Annex).

The presented results are clustered in the 14 survey statements (pie charts) supported by in total 47 sub-statements (bar charts), as far as mainly agreed results are given results are highlighted in green (≥60 % ranked “Must” or “Approved”, presenting results that are not agreed by majority or offer broader scope of variety results are formatted in yellow. Furthermore, one statement that has resulted in different replies as presented in the statement (>50% opted for a different value) is highlighted in red. The colour coding hence also offering optional interpretation in priority ranking of requirements independent their mutual connection with other statements. All consolidated results of PERO and EERO survey are shown in figures 29 to 89, definitions for references can be found in table 2 (see chapter 2).

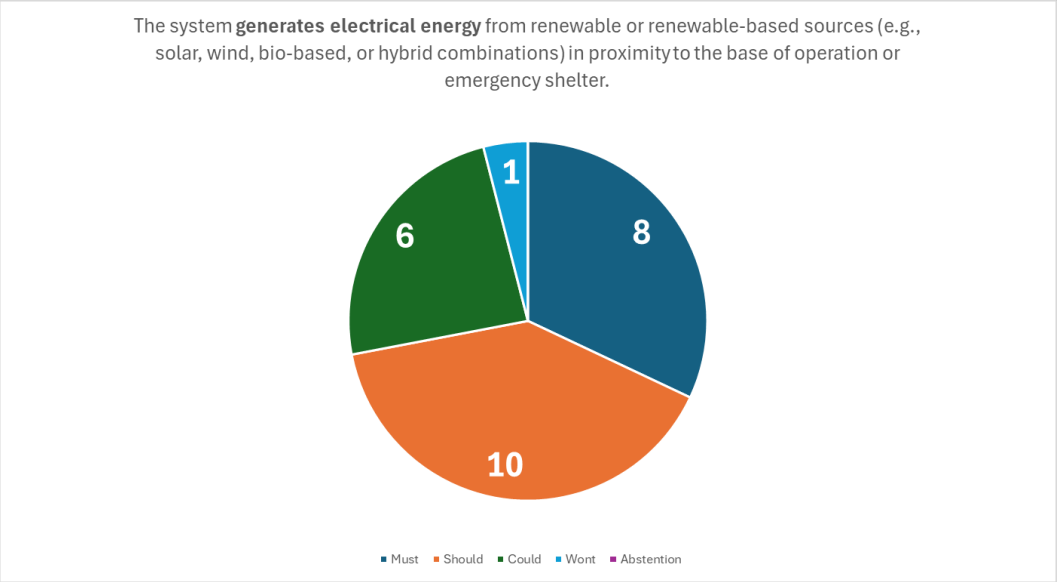


Figure 29 Main Statement no 1 referring to energy generation

While only one third of participants state that energy generation must derive from renewable or renewable based solutions, two thirds admit that this should or could be the case (see main statement no 1).

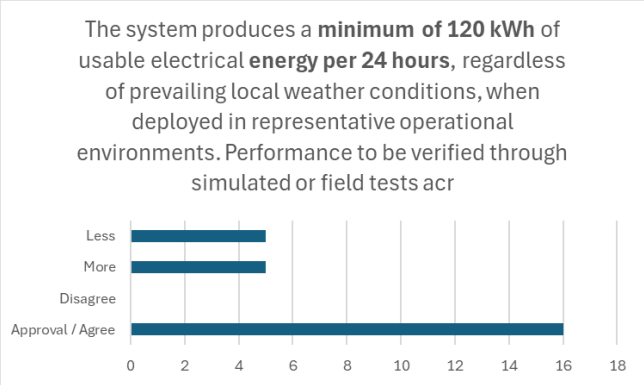


Figure 30 Supporting statement on kWh in 24 hours

Nevertheless, there is an agreement given by more than 60% approving that the minimum produced energy should count of 120 kWh per 24 hours.

Referring to energy storage provided on site in the main statement no 2, almost half of participants see a must, while a bit more of them rank rather should.

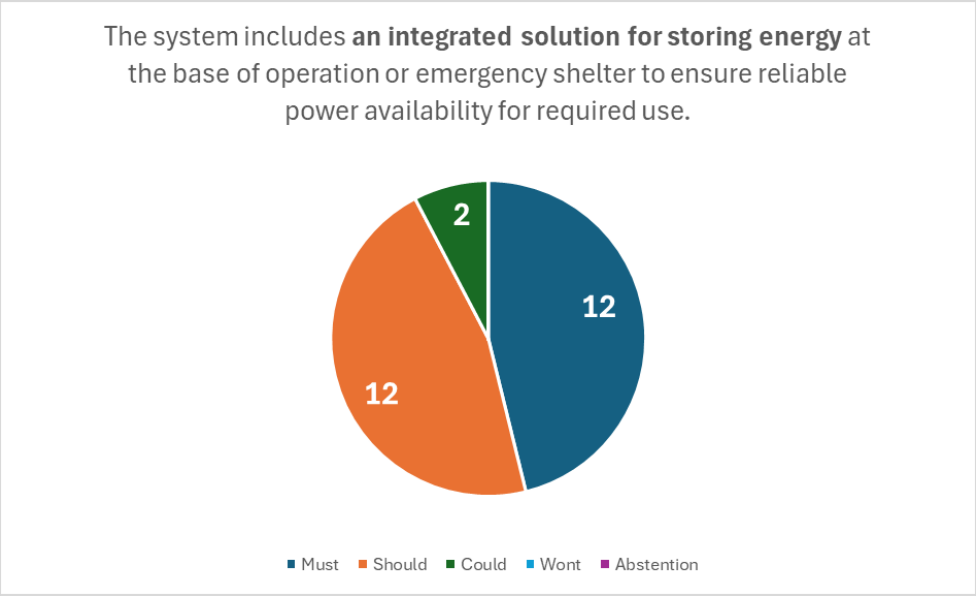


Figure 31 Main Statement no 2 referring to energy storage

Majority of participants in the survey agreed on a minimum storage of 20 kWh for energy, while 25% would aim for more (at least 50 kWh).

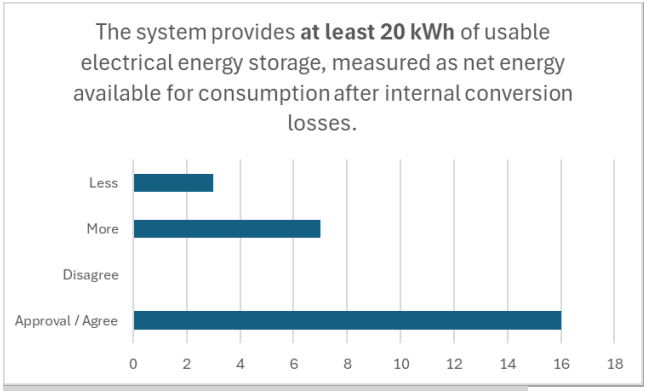


Figure 32 Supporting statement on min. kWh

Regarding variable energy input and output profiles the balance is almost equal in voting for must compared to should and could.

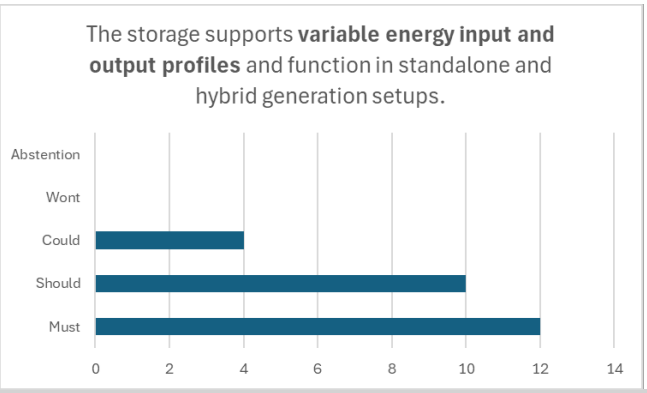


Figure 33 Supporting statement on input / output profiles

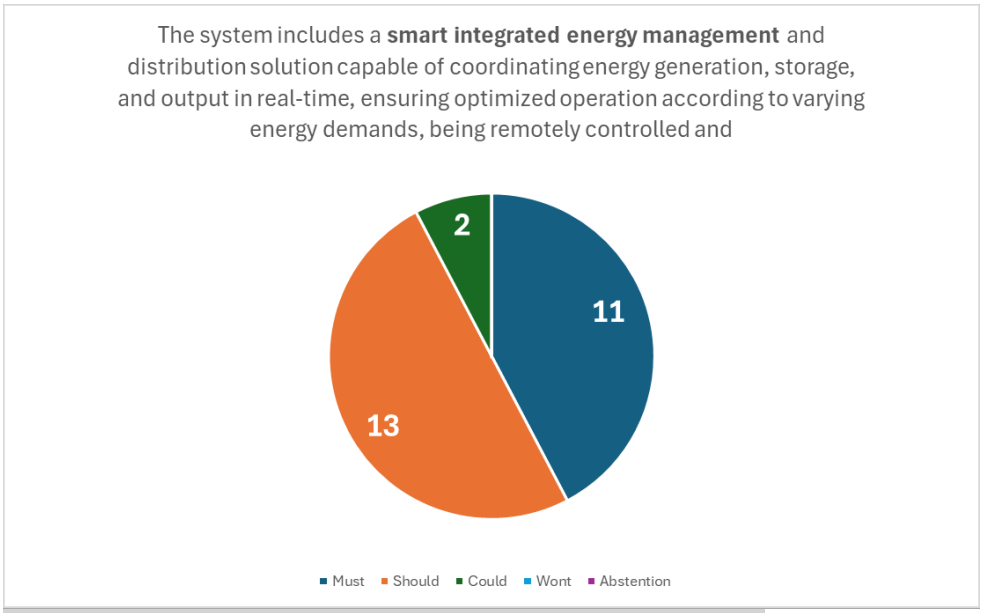


Figure 34 Main statement no 3 on Smart integrated management

Making added value of a smart integrated management system for the energy in operations less than half of participants see a must, but more than 50% rate it as should / could.

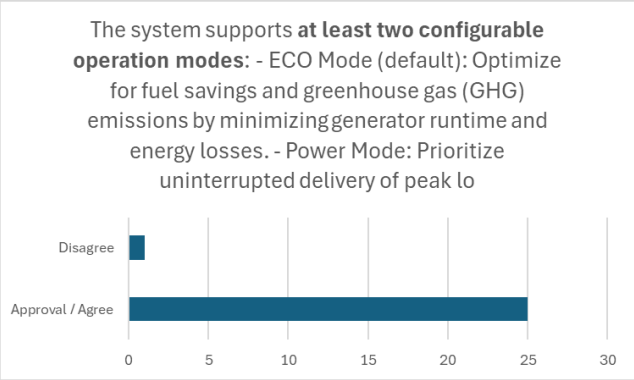


Figure 35 Supporting definition on modes

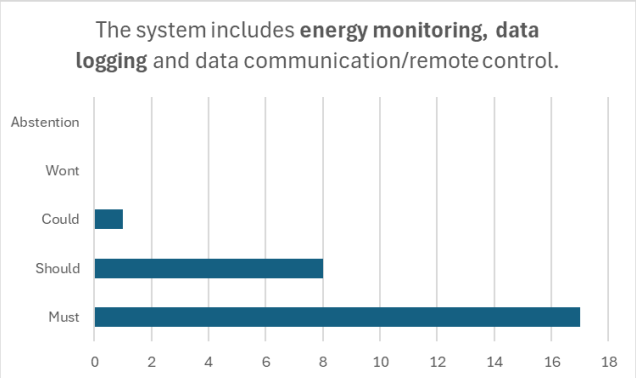


Figure 36 Supporting statement on monitoring and data logging

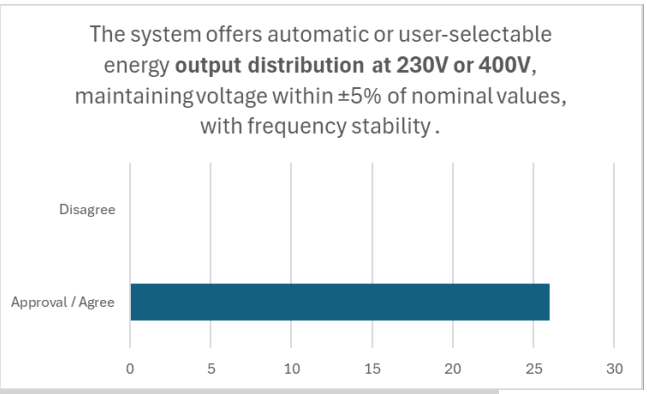


Figure 37 Statement on output distribution

While 100% agree that the output distribution needs to be selectable at 230V and 400 V, and almost all experts vote for at least two configurable modes, only two thirds appreciate energy monitoring and data logging (see figures 35 to 37).

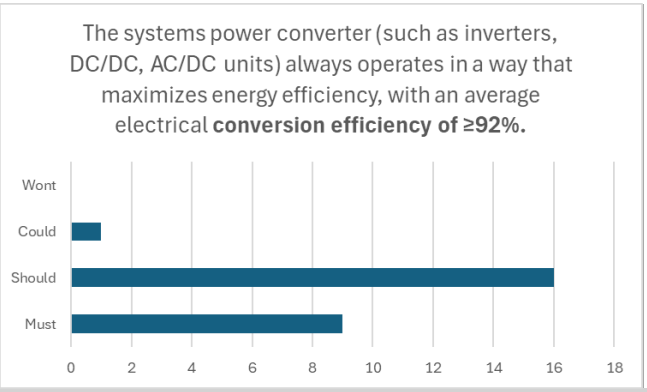


Figure 38 supporting statement on conversion efficiency

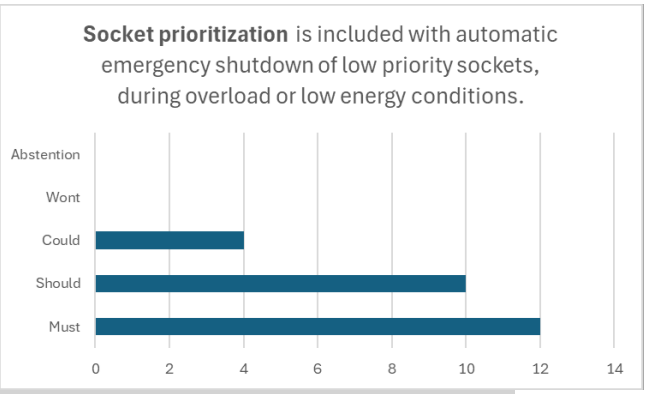


Figure 39 Statement on socket prioritization

A bit more than 34% of survey respondents voted for maximizing energy conversion and efficiency, whereas socket prioritization was rated rather high and must from almost half of respondents (see figures 38 and 39).

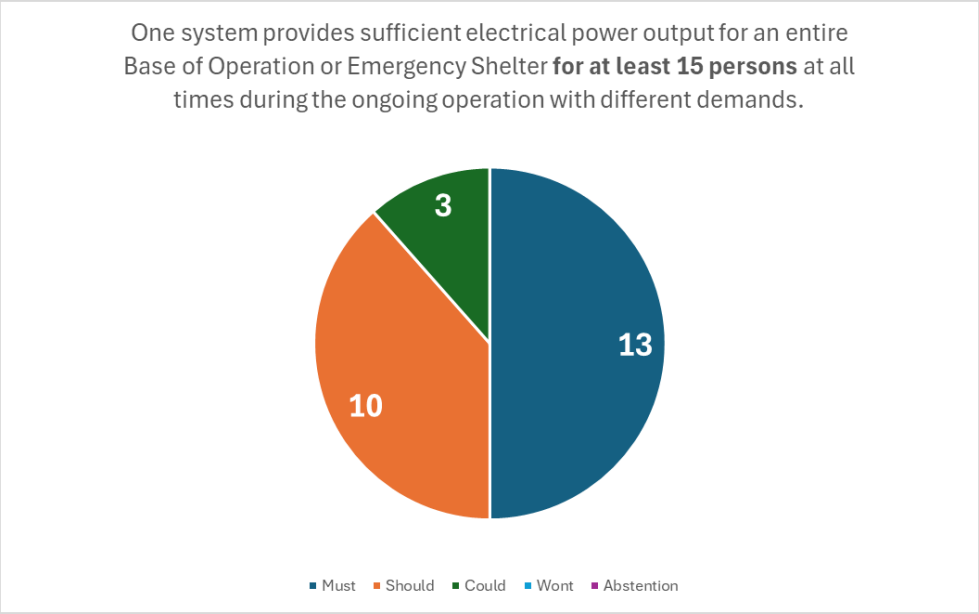


Figure 40 Main statement on persons covered

Opinions by respondents on the number of people covered by the minimum set of Bases of Operations or Emergency (Temporary) Shelter counted for 15 persons are well balanced with 50 to 50%.

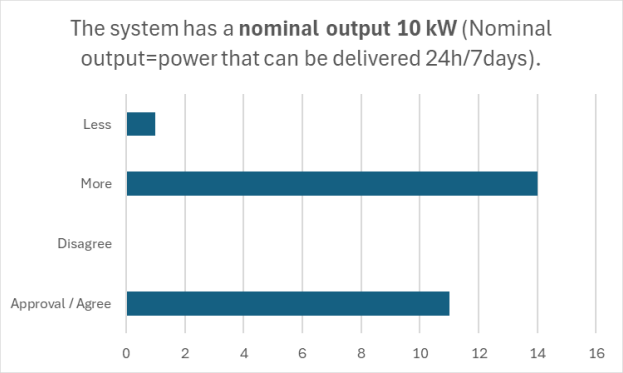


Figure 41 Statement on nominal output

More than half of participants voted for more than 10 kW nominal output (at least 20 kW), while almost same amount approved 10 kW or argued for even less (10 kW). This gives the most splitted reflection on requirements.

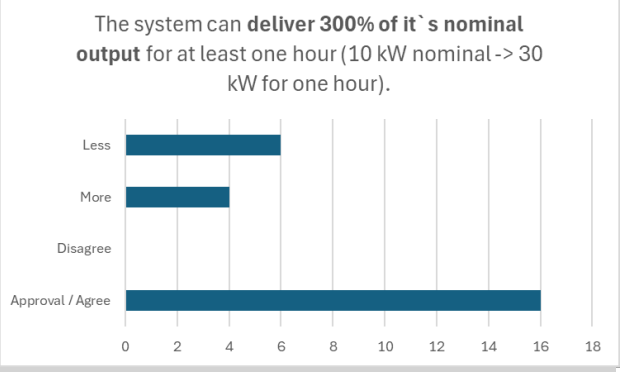


Figure 42 Statement on scalability of nominal output

Regarding scalability of the nominal output, more than 60% approved that 300% is an acceptable range to scale up.

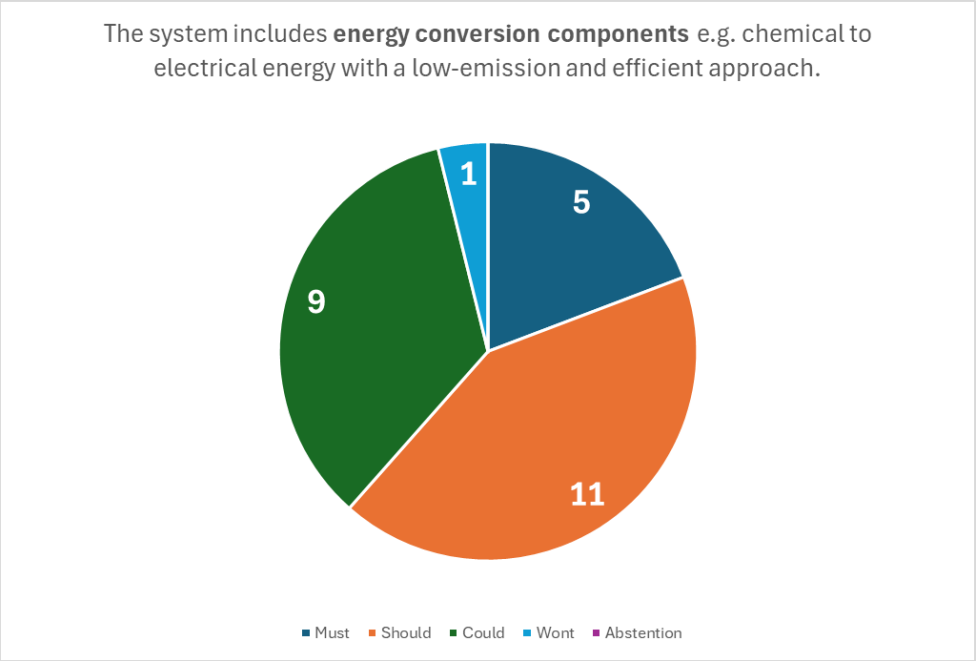


Figure 43 Main statement no 5 on conversion components

Looking into energy conversion, more than 75% of respondents vote for components from different energy sources with low-emission and efficient approach being rather should or could, while 4% even rate it as won't.

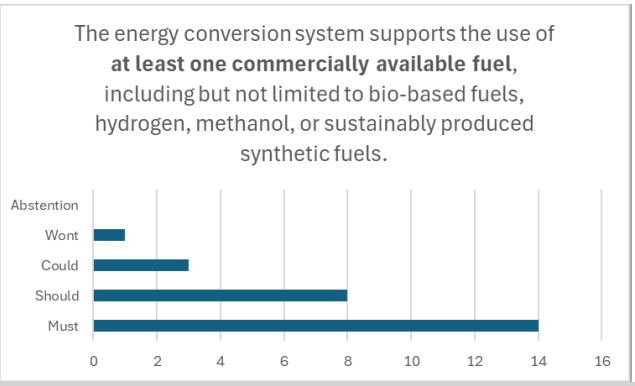


Figure 44 Definition of support of a commercially available fuel

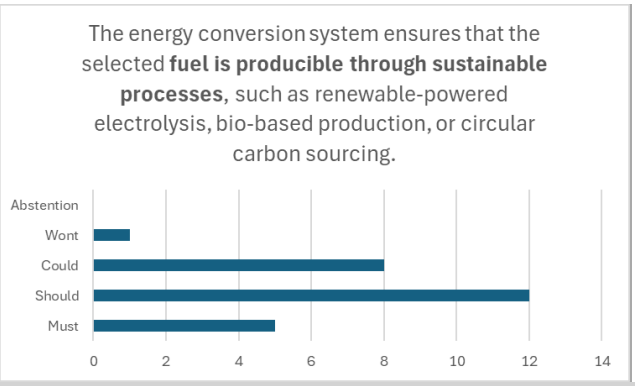


Figure 45 Statement on fuel from sustainable processes

While at least half of participants still see a must in commercially available fuel, also 4% won't. Offering the selectable fuel to be produced in sustainable processes is only seen as should / could from more than 75% of respondents.

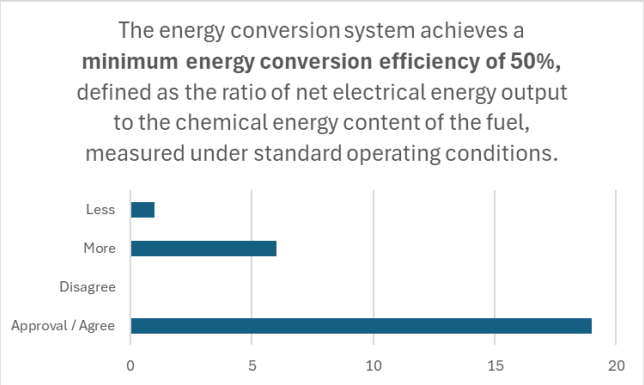


Figure 46 Definition of energy conversion efficiency minimum 50%

That the energy conversion system needs to reach a minimum level of 50% efficiency was approved by almost three quarters of participants in the survey.

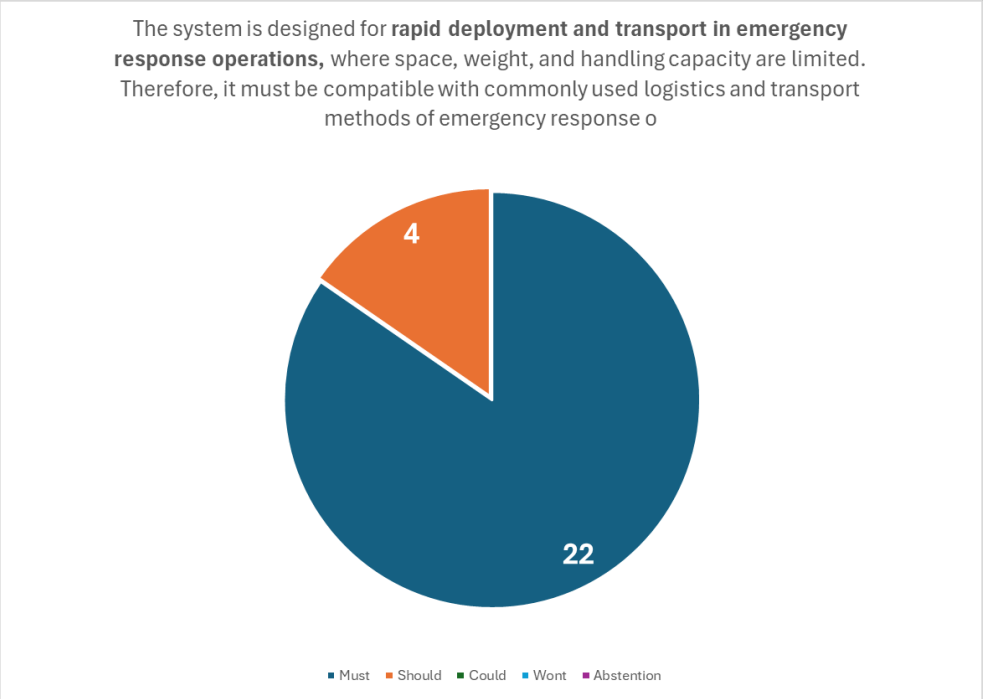


Figure 47 Main statement no 6 on deployment

Rapid deployment and transport are crucial for emergency operations. Therefore, less surprising that 85% voted for a design to be compatible with commonly used logistics. Furthermore, EU pallet size and system to be carried by 4 persons have been agreed by majority, while still some participants would even vote for carriable by two persons maximum (see figure 48 and 49).

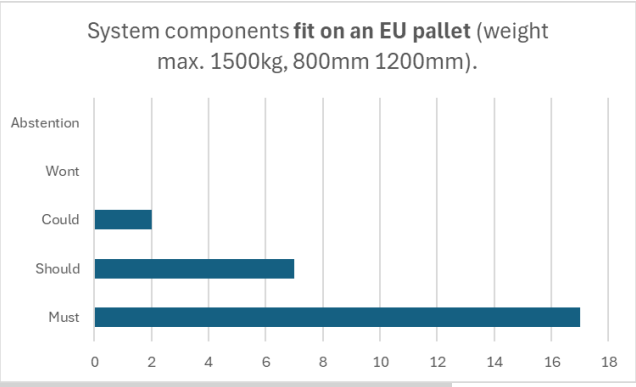


Figure 48 Definition of size and weight

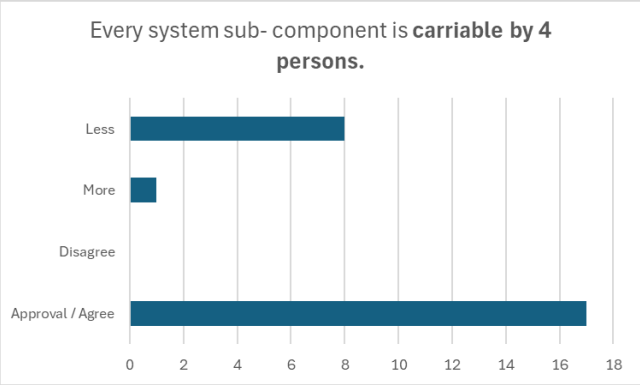


Figure 49 Statement on transportation by persons

Given the fact of deployments beyond borders, air transportation needs to be taken into account with its restrictions. More than 60% see cargo aircraft to be must, while almost same amount would aim for should and could even go on commercial aircrafts (see figure 50 and 51).

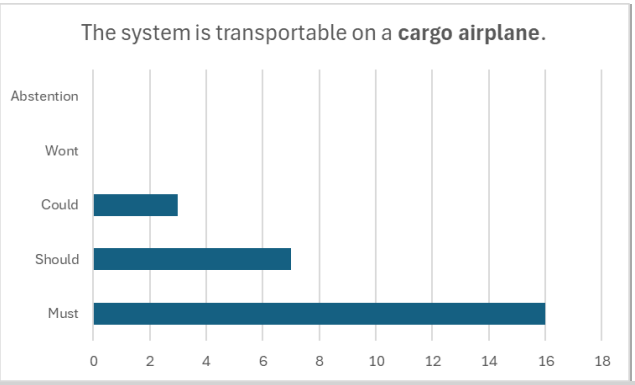


Figure 50 Definition of transportation by cargo airplane

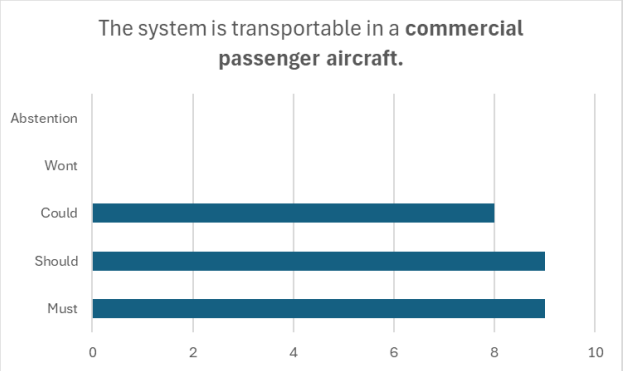


Figure 51 Statement on transportation on commercial aircraft

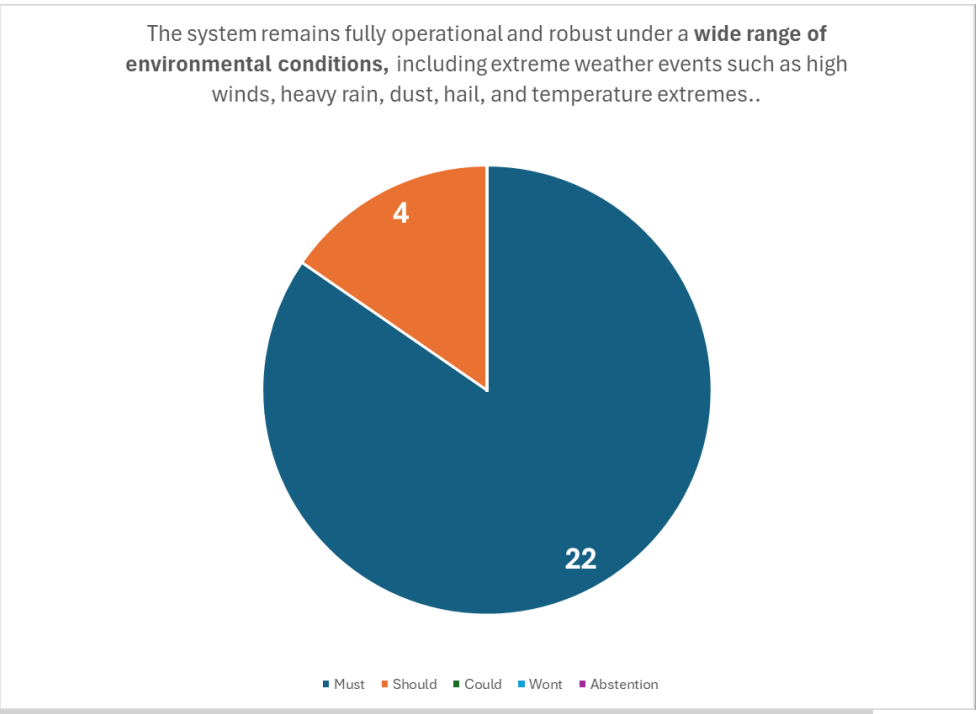


Figure 52 Main statement no 7 on environmental conditions of deployment

Emergency operations and related modules such as Bases of Operations and Emergency (Temporary) Shelter need to operate in a big variety of conditions, this is reflected by 85% saying it is must to operate in adverse conditions, almost all approving that IP65 standards are minimum requirement and same amount voting for a broad range of operating temperatures (-40 up to +80°C).

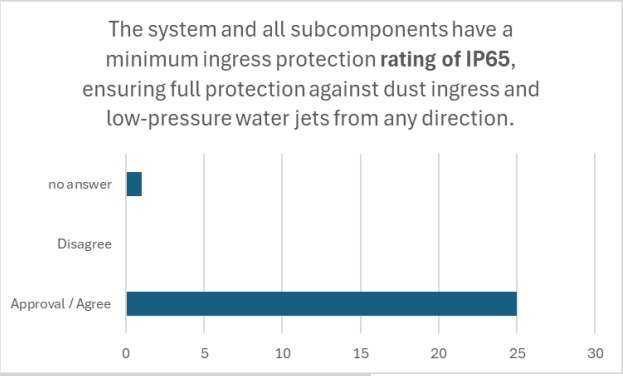


Figure 53 Definition of IP rating

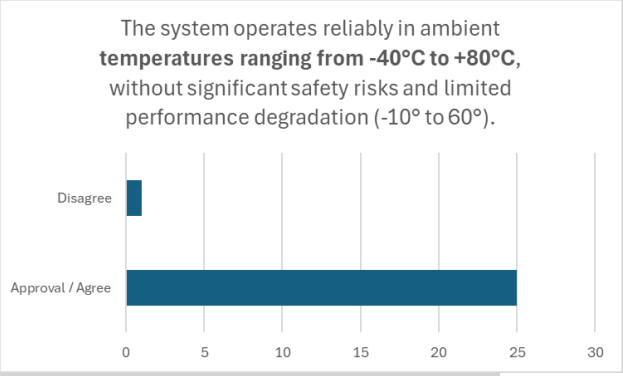


Figure 54 Statement on temperature range

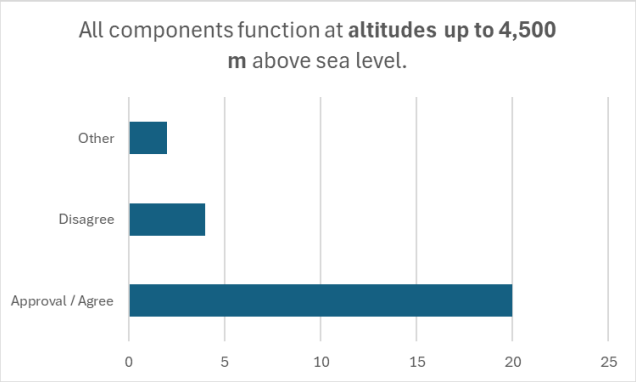


Figure 55 Statement on altitudes

Regarding altitudes for operations a big majority would see operational conditions given up to 4.00 m above sea level, some would be satisfied by 2.500 m above sea level and others would limit "as high as reasonably achievable".

Taking a look into wind speeds, those have been approved to cover operational conditions, as far as 120km/h can be covered without loss of structural integrity.

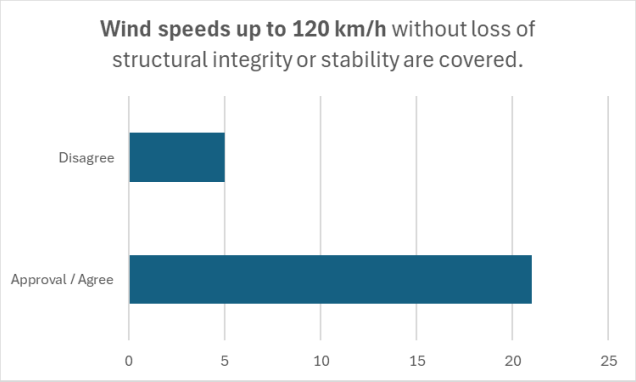


Figure 56 Statement on maximum wind speeds

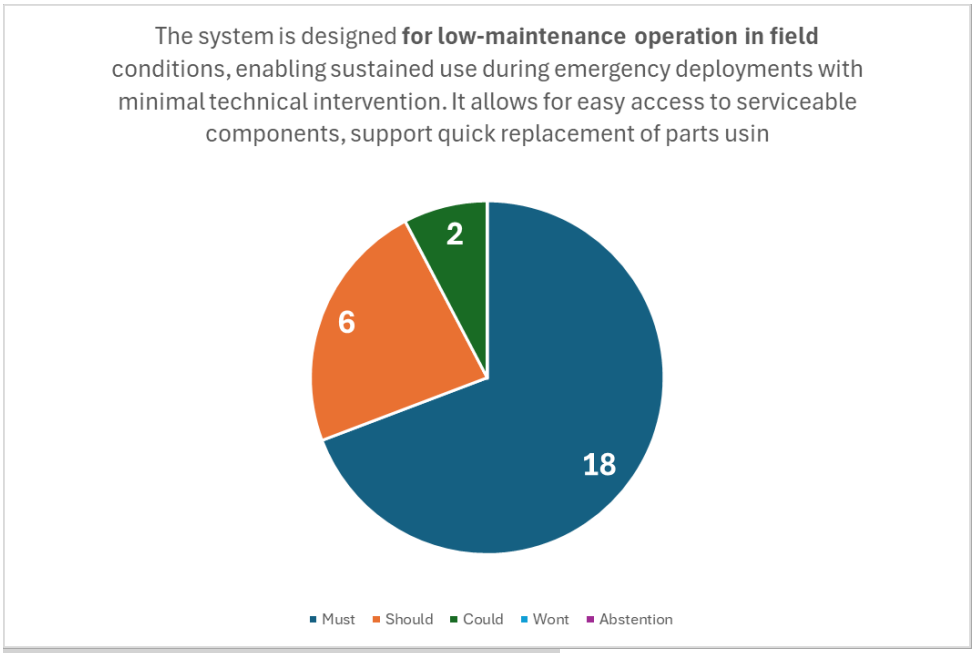


Figure 57 Main statement no 8 on maintenance

Challenging conditions in the field and on mission do not offer a lot of flexibility for resource investment, also being reflected in the agreements and approvals on low-maintenance in field conditions (>69%).

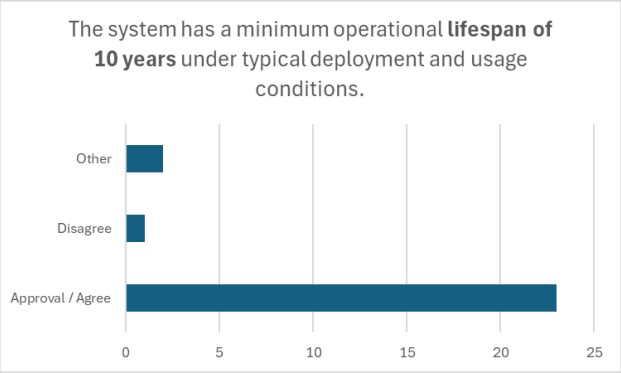


Figure 58 Definition on requested lifespan

Planning for the long run, the life span should be at least 10 years, for some even 20 years or being covered by "*or cradle to cradle sustainable and economical viable*".

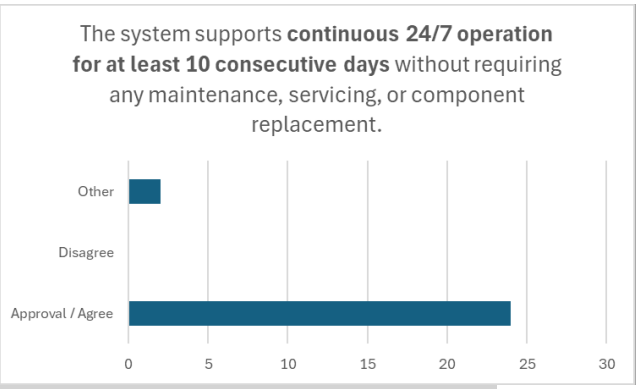


Figure 59 Statement on operational period

Without any maintenance the system is expected to operate at least 10 consecutive days for 24/7 for more than 90% of respondents, still some would aim for 14 days in a row.

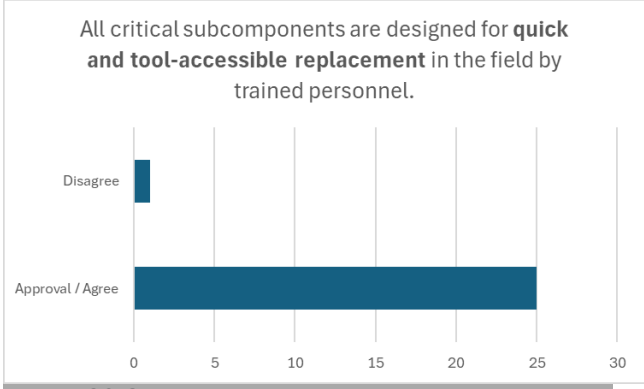


Figure 60 Statement on replacement of components

Spare parts need to be available for at least 10 years for more than 88% of participants, some even claim for building plans and 20 years of availability. Additionally quick replacement in the field is approved by almost all respondents.

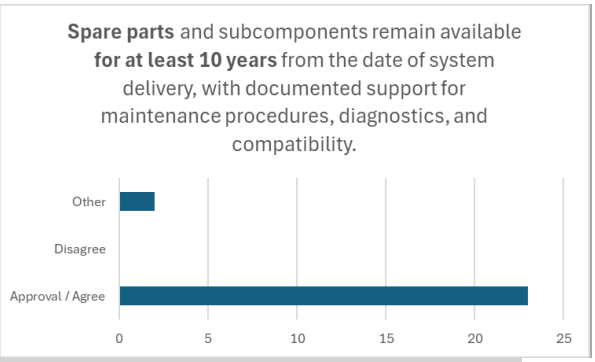


Figure 61 Duration of spare parts availability

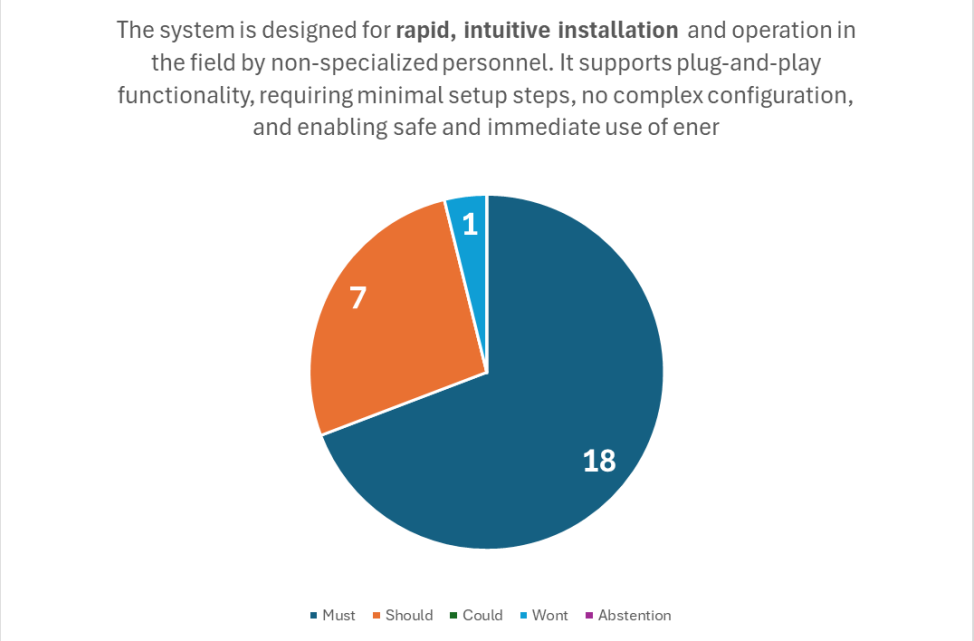


Figure 62 Main statement no 9 on plug and play

Being deployed on a mission with a module or to support others requires a lot of resources, therefore rapid and intuitive installation is set as must by more than 69% of participants, even being ready within 1 minute of activation (one respondent even 1 minute of deployment) are important to the majority of experts.

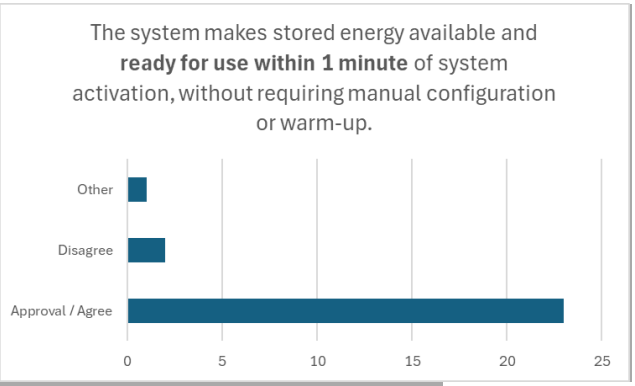


Figure 63 availability of stored energy

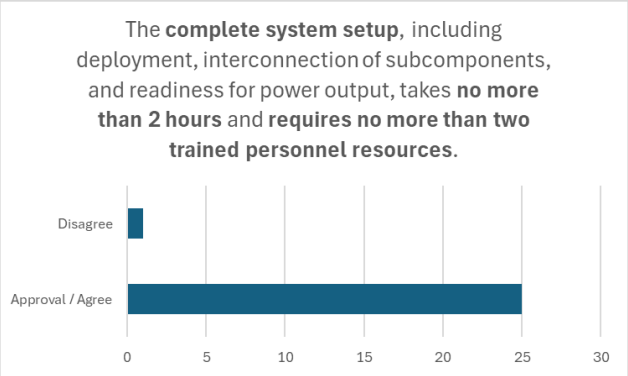


Figure 64 Need for set up resources

For the complete setup of the system 2 trained personnel resources should not need more than 2 hours.

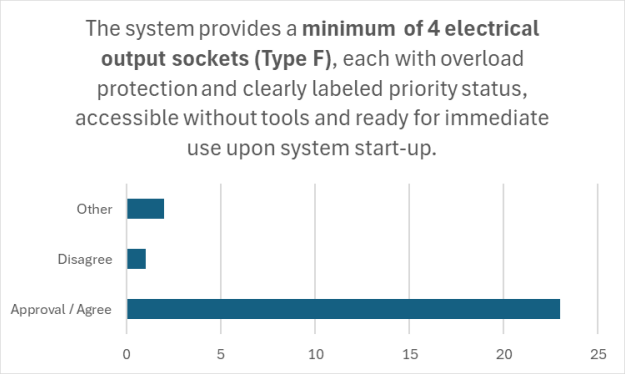


Figure 65 Statement on sockets Type F

While almost 90% approve 4 sockets Type F as minimum standard with the system, some even vote for 8 sockets.

Additionally, majority of respondents see a must for color-coded data connections and visual labels, as well as safety interlocks (see figures 66 to 67).

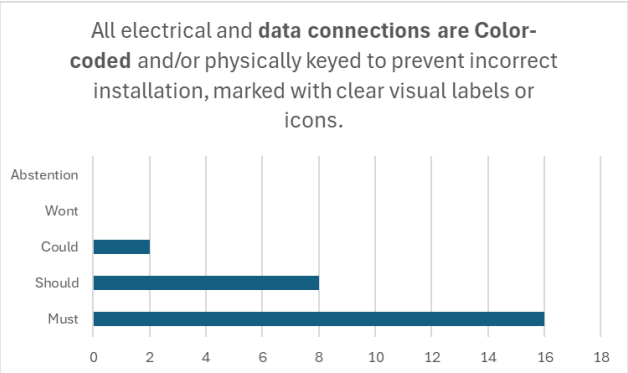


Figure 66 Prevention measures for incorrect installations

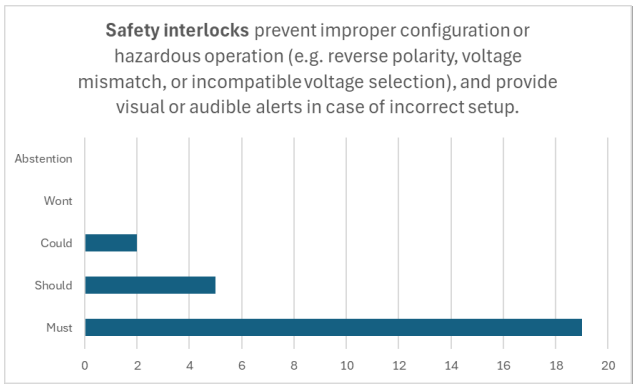


Figure 67 Statement on safety interlocks

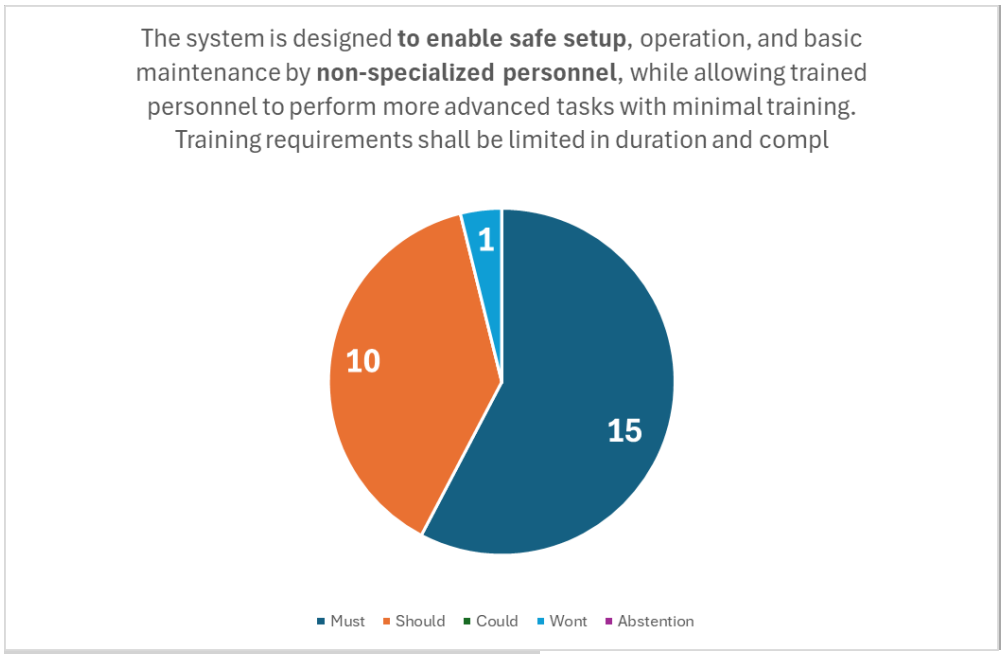


Figure 68 Main statement no 10 on personnel

Staff resources mainly fulfill other subject matter tasks, therefore setup, operation and maintenance need to be covered by non-specialized team members, referred to as must by half of participants, while almost all approve that trained personnel should be able to set up the system in less than 3 hours.

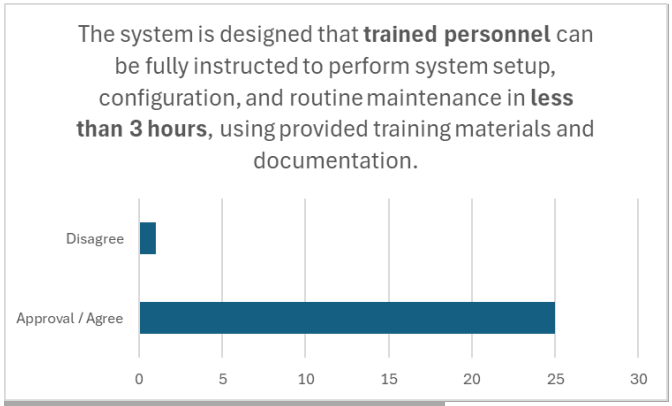


Figure 69 Set up by trained personnel

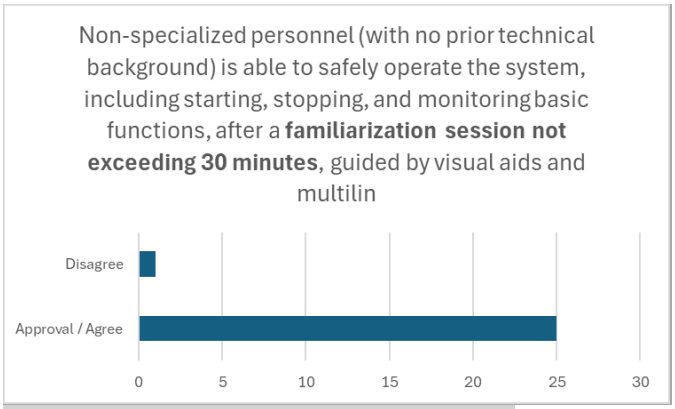


Figure 70 Statement on familiarization time

More than 75% appreciate step-by-step guides and almost all participants agree that non-specialized personnel can familiarize themselves within 30 minutes given visual aids and supporting materials.

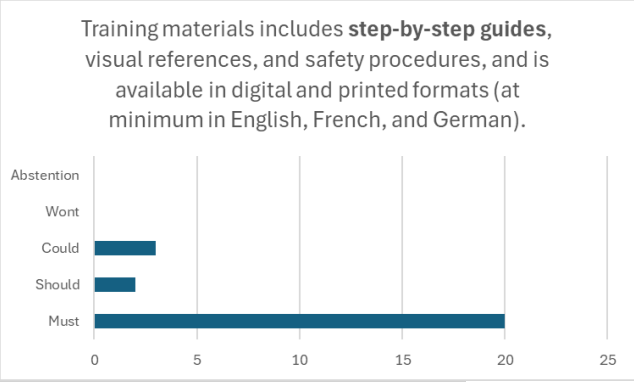


Figure 71 Definition of training material

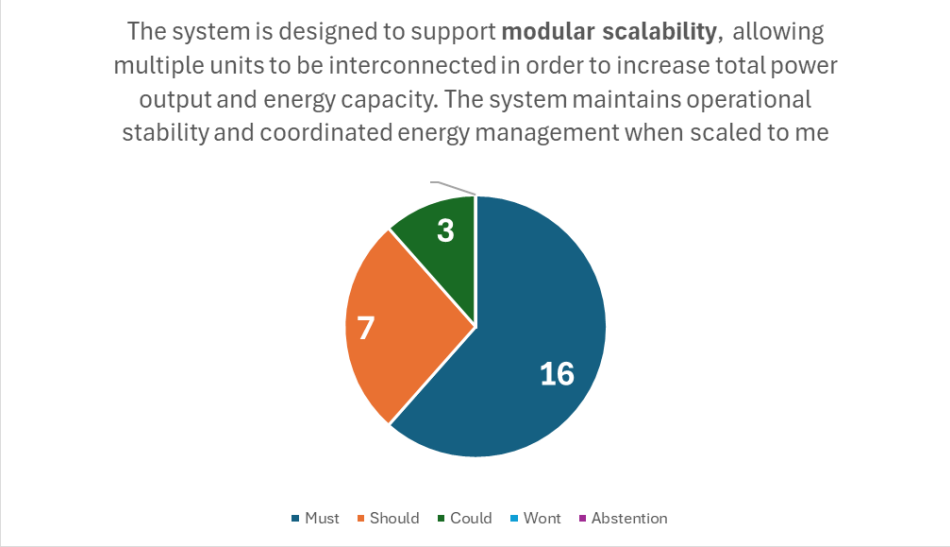


Figure 72 Main statement no 11 on modular scalability

Camp sites for Bases of Operations and Emergency (Temporary) Shelters may grow during operations, therefore modular scalability is must for more than 60% of respondents, approving that interconnections shall be done within 30 minutes (some would vote for 10, others for 60 minutes). Total nominal output of interconnected systems should aim for at least 50 kW (individuals even aiming for 250 kW).

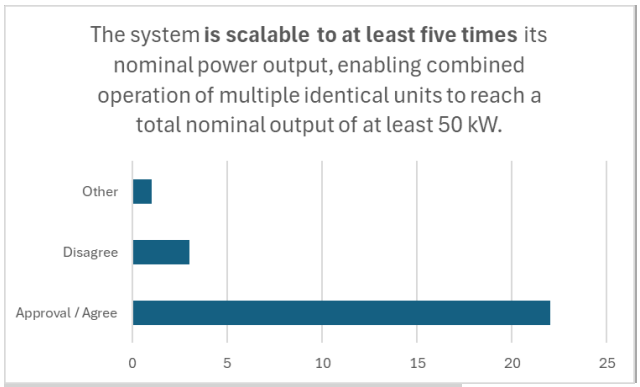


Figure 73 Scalability to nominal output

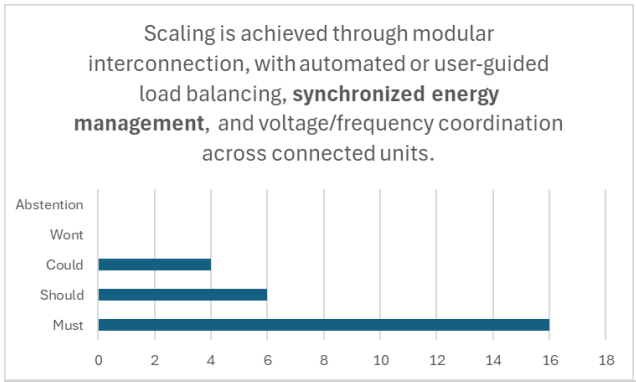


Figure 74 Statement on synchronized energy management

Interconnections to be set within 30 minutes per additional unit and offering synchronized energy management were approved by at least 60% of participants.

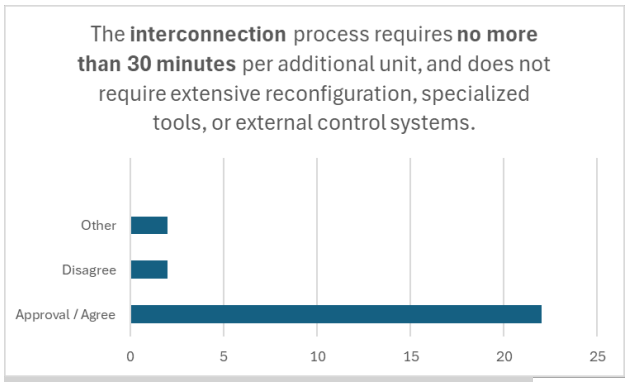


Figure 75 Additional time for interconnection

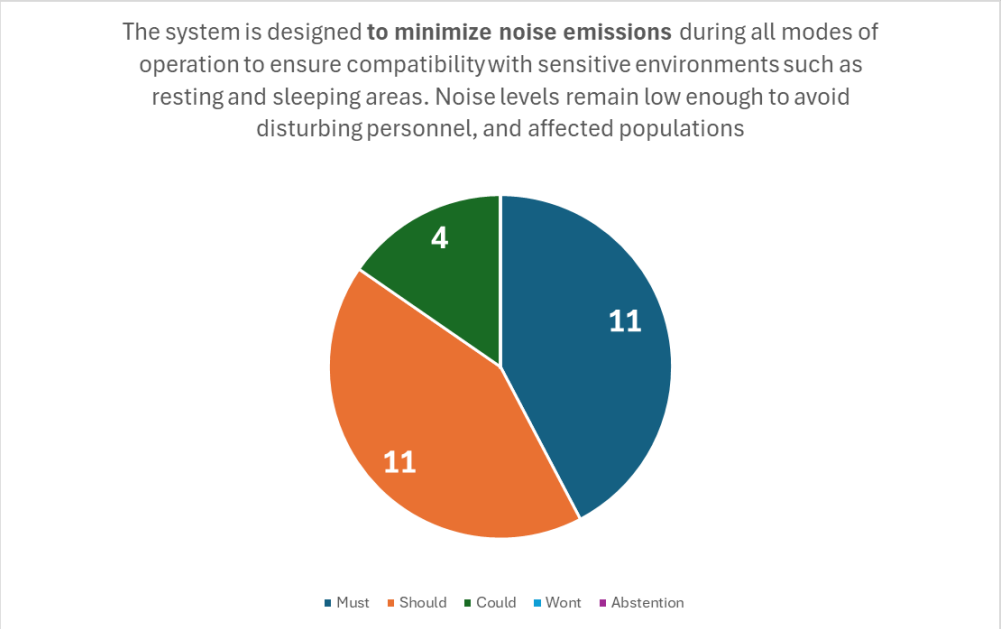


Figure 76 Level of noise emissions

Taking care of the conditions in Bases of Operations and Emergency (Temporary) Shelters for present persons, noise emissions should or could be minimized for more than half of participants.

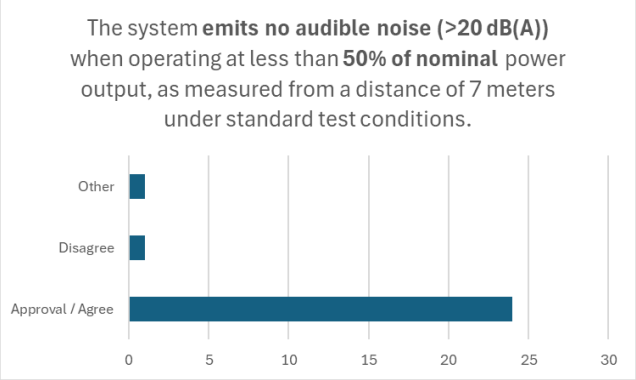


Figure 77 Noise level at 50% nominal output

Noise emission levels presented in different output percentage ranges from 20dB(A) for 50 % nominal output up to 90 dB(A) for 100% nominal output have been approved by the majority of respondents, whereas one specified for *"≤ 35 db(A) at 7 meters. While 20 dB(A) is nearly silent, it's technically unrealistic for most active systems with ventilation or inverters. A realistic target for near-silent operation is ≤ 35 db(A), comparable to a quiet residential room."* Additionally, some participants mentioned, that *"since 100% margin is reached often in real-world deployments, the threshold should be a bit lower, e.g. around 80 dB max (acceptable noise level)"* and others wanted *"60dB(A) at most for 100% output"*.

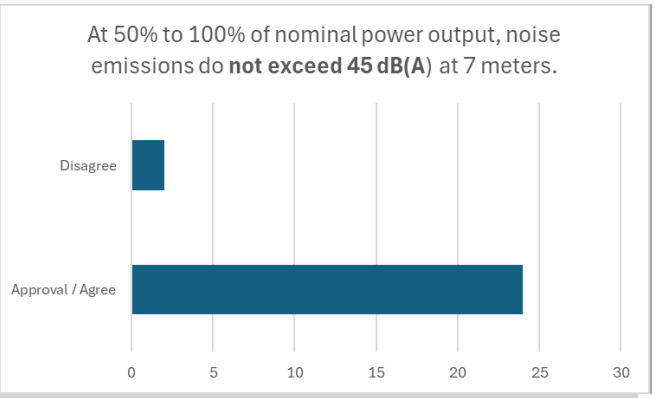


Figure 78 Noise emission on 50-100% nominal output

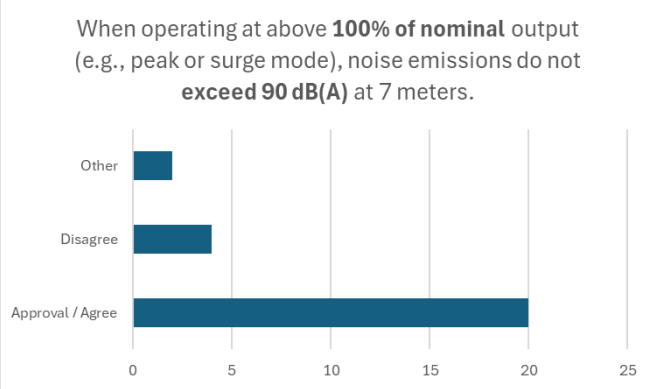


Figure 79 Noise emission at 100% nominal output

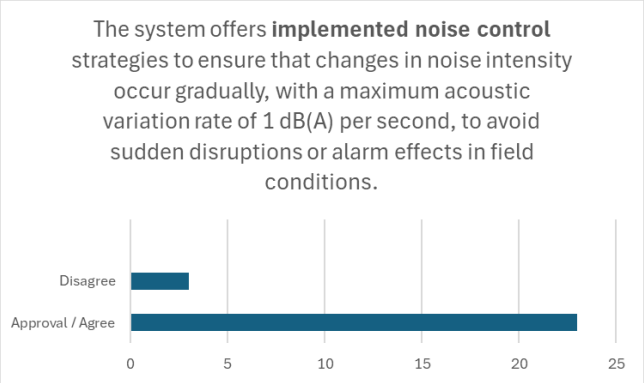


Figure 80 Statement on noise control

Implemented noise control was approved by majority of participants, in comparison to ISO classification that has been validated rather 50% of must.

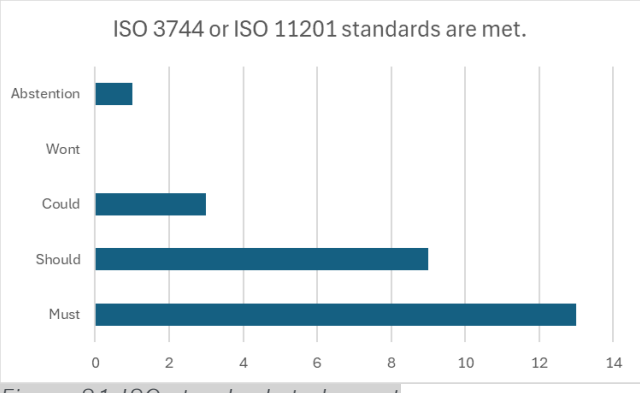


Figure 81 ISO standards to be met

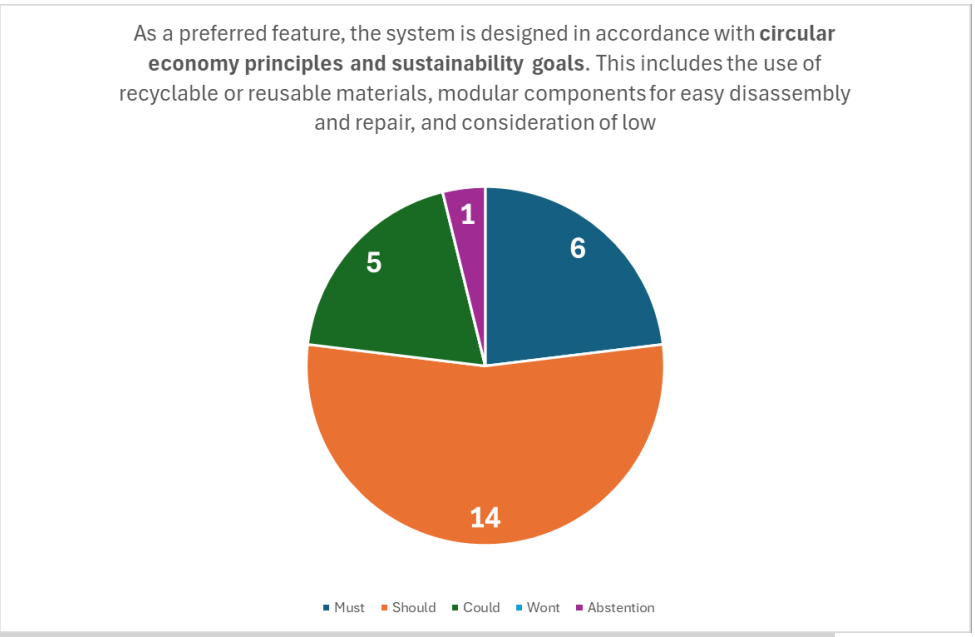


Figure 82 Main statement no 13 on circular economy and sustainability

As POWERBASE is also taking into account sustainability, circular economy principles have been rated as rather should / could than must, but recycling rate should and could be valued for the Bill of Materials (BoM), almost the same percentage sees a need for accordance with the EU Waste Framework Directive and a recycling rate of 80% (see figures 82 to 84).

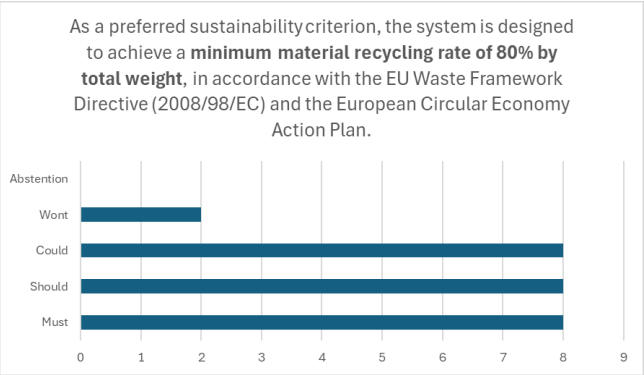


Figure 83 Minimum recycling rate

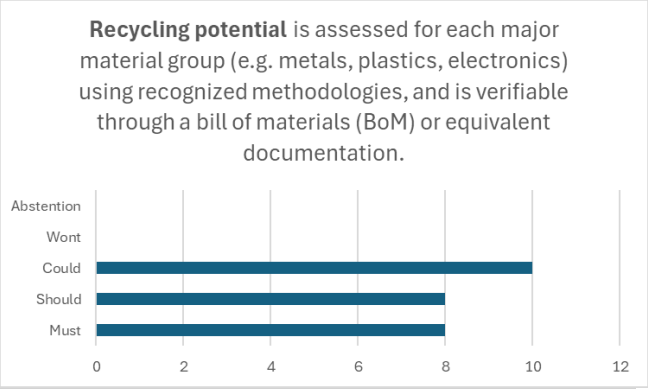


Figure 84 Recycling potential through Bill of Materials

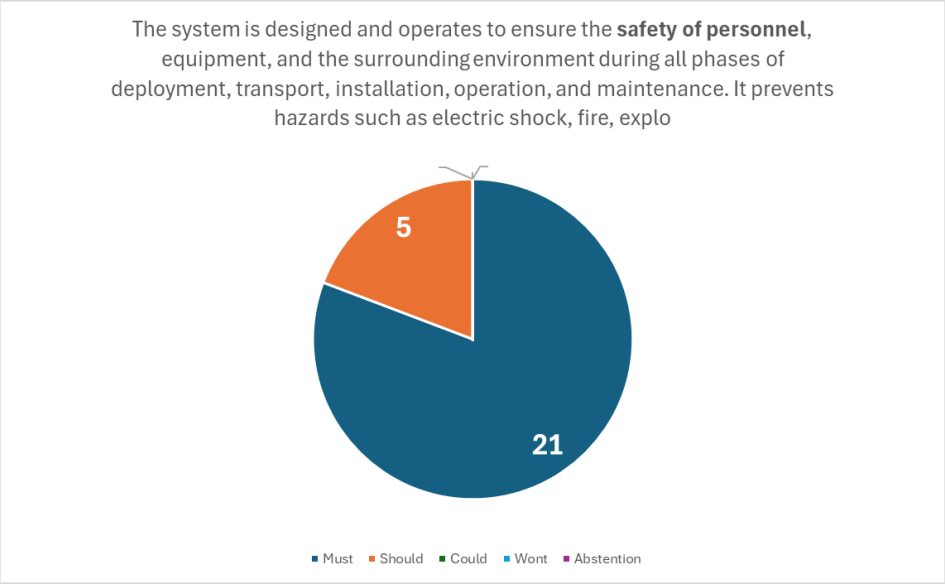


Figure 85 Main statement no 14 on safety of personnel

Preventive measures are important for participating experts and more than 80% see must for safety prevention, especially for electrical protection mechanisms and emergency stop functions. The system also is expected to have safety labels and safe-touch thresholds during operations (see figures 85 to 89).

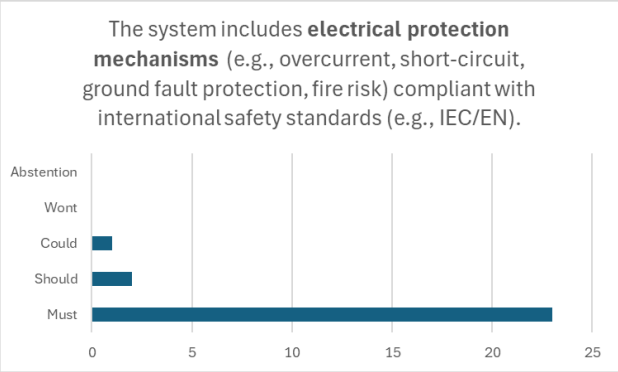


Figure 86 Inclusion of electrical protection mechanism

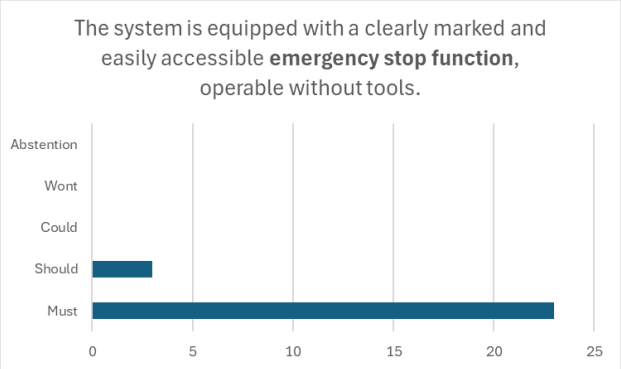


Figure 87 Necessity of emergency stop function

Figure 88 Required safety labeling

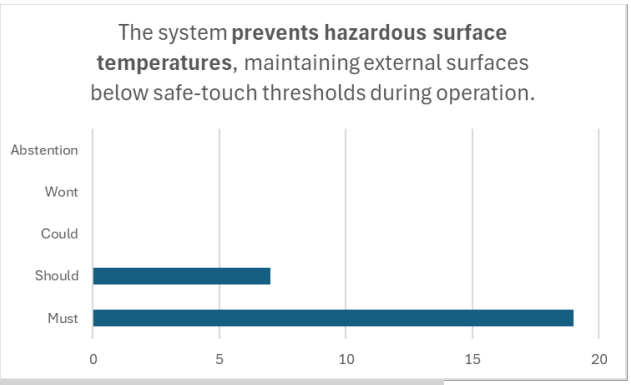


Figure 89 Statement on surface safety

Additionally, three requirements were listed by survey participants to be taken into account for technology selection or development:

- At least cable, better wireless connection for the control system should be applied.
- As a less crucial, but still important aspect, the determination of required and expected balance between eco-friendly parts of the solution versus the pure efficiency in the field should be taken into account. This refers especially to Search and Rescue (SAR) operations, that are recognized as high priority.
- For bigger solutions, the option of a frame and hook to be lifted by crane was named as relevant.

3.4. NEW! Additional experience from "BULGARIA 2025"

We discussed with mainly civilian (and few military teams) specialized in search and rescue (urban, water, mountain) of Greece, Romania, Italy, Azerbaijan, Montenegro, North Macedonia and Croatia, focusing to the team commander and/or logistician of the team, where possible. The teams of the different countries that were participating to the exercise were of different size, as well as their BoO and services for which energy was required. Their energy requirements and experience sharing were beyond the current needs in the exercise. Some of the teams are deploying in standard size and format, especially if they have an INSARAG certified module (LUSAR/MUSAR/HUSAR = Light – Medium – Heavy Urban Search and Rescue) while some others, in a more flexible and light format, have the possibility to deploy according to the requested need for assistance, with the corresponding team size, services and energy requirements. In principle, teams deployed for international intervention travel with less equipment and thus with lower energy demands; the latter can often be a matter of culture and professional habits.

In overall, all of the interlocutors – not only the direct respondents of the teams but many other professionals learning about POWERBASE · expressed their sincere interest in the vision of the project and, although some may be satisfied with the performance of the diesel generators (in particular the new generation, low noise/low emission ones especially when operating in small per centage of their capacity), they all recognize that green transition should be sooner or later adopted by mobile energy systems too. The main characteristics that all teams requested are the optimum combination of **small volume/size** and **large storage** capacity. In particular for the storage sub-component of the proposed integrated system a special request to operate as supercharger was made, with the possibility for **fast charging** and parallel charging of equipment and charging of the sub-system itself. This is important as nowadays in the BoO there is often the need to charge USAR equipment, which are more and more electrical rather than hydraulic, rather than having them attached to the generator at the operations site.

Although the teams had a variety of energy requirements varying from 5kW to ultimately 200kW depending on the BoO size but mainly on the services included in the BoO (kitchen, heaters/coolers, water boiler), they all agree on the need for big energy reserves. Some state that a bigger **generator**, operating in low-capacity percentage, is safer and more efficient, as **less maintenance** and manpower for carrying is needed, while others prefer smaller (size and capacity) generators with more units for **backup**.

As a general observation, it can be concluded that the teams of higher energy requirements do not opt for a system highly **modular**, i.e. with multiple units attached, while the teams of lower demands seem very satisfied with an **integrated** generation/conversion/storage system of low to moderate performance 5-50kW. Furthermore, the statement that an oversized generator running under partial load is inherently more efficient or safer contradicts other expert opinions shared during consultations. In fact, this approach often stems from the desire to avoid power shortages by oversizing the generator – seemingly a simpler solution. Yet, operating far below the optimal load range causes fuel inefficiency, excess emissions, and long-term damage such as wet stacking and carbon buildup. A better strategy is to adopt **hybrid** and adaptable systems that adjust to real load demands, improving **efficiency**, extending equipment **lifespan**, and reducing environmental impact.

A couple of recommendations were shared by highly motivated respondents, suggesting the development and employment of the generation-conversion-storage subsystems individually and not in an integrated system, possibly containerized, what may give flexibility in **transportation** as well as when maintenance and reparation is required. An

alternative idea about keeping the diesel generator as the back-up **conversion** system was also introduced. Last but not least, some concerns for **safety** issues were expressed mainly as far as the storage systems (at least to the knowledge of the current commercial technologies) as they might be vulnerable to high temperatures possibly met during transportation, set-up as well as operation. Moreover, putting down a fire at existing storage systems is often demanding and thus their use in BoO could require special attention.

4. Updated! Conclusion

Formulating unmet needs and requirements turns out to be a challenge as the human factor drains our minds to known solutions and their potential for adaptation. Strong moderative skills and previous training on best placed innovation procurement methods are key to successful results in brainstorming and clustering.

Collaboratively during the iterations of Workshop 2 and Workshop 3 series practitioners and stakeholders still managed to excavate a long list of indicators to make future low-emission power supply tools more valuable and impactful than current options for deployment. Though the attributes of future tools could be named, finding reference values (metrics) to narrow the framing for the requirements showed the challenge of common ground for needs.

Within Workshop 4 - focused on prioritization - discussions were re-opened and common agreements on high importance in relation to high operational impact turned out to being subject of deviations within the different stakeholders of PERO and Advisory Board members. Still a top five agreed for all given scenarios of POWERBASE could be extracted. Therefor the golden thread provided by THW as project coordinator on performance and functional requirements by offering statements including metrics to being approved and evaluated by Emergency Response Organizations and subject matter experts initiated a more focused list of requirements.

The initial collected unmet needs and predominantly functional requirements from a broad range of diverse stakeholders in European Emergency Response Organisation network listed in D2.2 “Functional Requirements Report V1” were hard to be condensed further, still the given results of two survey iterations show overall tendency on agreements for main and crucial performance metrics as well as prioritized specifications for technologies in future deployment to supply power in the field for Bases of Operations and Emergency (Temporary) Shelters.

Especially criteria regarding deployment, operational period, safety - in operation and for staff members – as well as maintenance offer highest rate of agreements, whereas metrics for nominal outputs and its scalability vary.

Additional requirements listed by survey participants show the potential for use in other purpose focused modules, such as Search and Rescue (SAR) and the potential for scaling to bigger solutions, to be transported by crane / lorries.

The results can serve as basis for further refinement in a potential follow up Pre-Commercial-Procurement project.

Compared to the market analysis conducted in T2.3 (see D2.5) and the Open Market Consultation in WP3, Emergency Response Organization requirements result in a framework for technic providers and suppliers to further develop existing or currently under development solutions to cover the majority of requirements expressed in POWERBASE.

In its overall process from WIGBI method and process internal reflections during Lessons Learned workshops showed that for short term projects as POWERBASE a less open set up of creating a swift and clear common vision in regards of framing for requirements would enable faster tangible results. Accompanied and followed by ensuring good understanding and basic knowledge on technical aspects for practitioners could support future requirements development.

Close to the end of the POWERBASE CSA project additional insights were gained at the NATO exercise “Bulgaria 2025”, where KEMEA researchers found indisputable benefits in their participation and interviews regarding deeper understanding, complementary data collection including currently in use equipment presentations in near-real operational conditions. Overall, the discussed requirements - mainly for SAR modules in the exercise - offered interesting comparison for different cases and showed particular country perspectives are rather diverse regarding size and dimension of power supply tools.

Concluding, all main parts of POWERBASE requirements collection including add-on report of NATO exercise show the common ground for new technologies in the field and given opportunity to create a low-emission and even more sustainable deployment for disaster operations.

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NEW! ANNEX (PUBLIC)

This Annex includes documents classified as public.

ANNEX I: PERO Survey Results Raw

Statistics:
POWERBASE_PERO_Requirements_WP2

The system generates electrical energy from renewable or renewable-based sources (e.g., solar, wind, bio-based, or hybrid combinations) in proximity to the base of operation or emergency shelter.

		Answers	Ratio
Must have		5	62.5 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system produces a minimum of 120 kWh of usable electrical energy per 24 hours, regardless of prevailing local weather conditions, when deployed in representative operational environments. Performance to be verified through simulated or field tests across diverse climate zones and during different seasons.

		Answers	Ratio
Less (>80 kWh/day)		1	12.5 %
Approval of proposal		7	87.5 %
More (> 150 kWh/day)		0	0 %
No Answer		0	0 %

The system includes an integrated solution for storing energy at the base of operation or emergency shelter to ensure reliable power availability for required use.

		Answers	Ratio
Must have		5	62.5 %
Should have		3	37.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system provides at least 20 kWh of usable electrical energy storage, measured as net energy available for consumption after internal conversion losses.

		Answers	Ratio
Less (>10 kWh)		0	0 %
Approval of proposal		5	62.5 %
More (> 50kWh)		3	37.5 %
No Answer		0	0 %

The storage supports variable energy input and output profiles and function in standalone and hybrid generation setups.

		Answers	Ratio
Must have		5	62.5 %
Should have		3	37.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system includes a smart integrated energy management and distribution solution capable of coordinating energy generation, storage, and output in real-time, ensuring optimized operation according to varying energy demands, being remotely controlled and enabling monitoring.

		Answers	Ratio
Must have		6	75 %
Should have		2	25 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system supports at least two configurable operation modes: - ECO Mode (default): Optimize for fuel savings and greenhouse gas (GHG) emissions by minimizing generator runtime and energy losses. - Power Mode: Prioritize uninterrupted delivery of peak loads up to the system's maximum rated capacity.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other (Please specify below)		0	0 %
No Answer		0	0 %

The system includes energy monitoring, data logging and data communication/remote control.

		Answers	Ratio
Must have		5	62.5 %
Should have		3	37.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The systems power converter (such as inverters, DC/DC, AC/DC units) always operates in a way that maximizes energy efficiency, with an average electrical conversion efficiency of ≥92%,

		Answers	Ratio
Must have		2	25 %
Should have		5	62.5 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system offers automatic or user-selectable energy output distribution at 230V or 400V, maintaining voltage within ±5% of nominal values, with frequency stability .

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other (Please specify below)		0	0 %
No Answer		0	0 %

Socket prioritization is included with automatic emergency shutdown of low priority sockets, during overload or low energy conditions.

		Answers	Ratio
Must have		3	37.5 %
Should have		3	37.5 %
Could have		2	25 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

One system provides sufficient electrical power output for an entire Base of Operation or Emergency Shelter for at least 15 persons at all times during the ongoing operation with different demands.

		Answers	Ratio
Must have		5	62.5 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system has a nominal output 10 kW (Nominal output=power that can be delivered 24h/7days).

		Answers	Ratio
Less (5kW nominal)		0	0 %
Approval of proposal		3	37.5 %
More (20 kW nominal)		5	62.5 %
No Answer		0	0 %

The system can deliver 300% of it`s nominal output for at least one hour (10 kW nominal -> 30 kW for one hour).

		Answers	Ratio
Less (200%)		1	12.5 %
Approval of proposal		5	62.5 %
More (400%)		2	25 %
No Answer		0	0 %

The system includes energy conversion components e.g. chemical to electrical energy with a low-emission and efficient approach.

		Answers	Ratio
Must have		2	25 %
Should have		2	25 %
Could have		4	50 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The energy conversion system supports the use of at least one commercially available fuel, including but not limited to bio-based fuels, hydrogen, methanol, or sustainably produced synthetic fuels.

		Answers	Ratio
Must have		5	62.5 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The energy conversion system ensures that the selected fuel is producible through sustainable processes, such as renewable-powered electrolysis, bio-based production, or circular carbon sourcing.

		Answers	Ratio
Must have		2	25 %
Should have		5	62.5 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The energy conversion system achieves a minimum energy conversion efficiency of 50%, defined as the ratio of net electrical energy output to the chemical energy content of the fuel, measured under standard operating conditions.

		Answers	Ratio
Less (> 25%)		0	0 %
Approval of Proposal		7	87.5 %
More (> 70%)		1	12.5 %
No Answer		0	0 %

The system is designed for rapid deployment and transport in emergency response operations, where space, weight, and handling capacity are limited. Therefore, it must be compatible with commonly used logistics and transport methods of emergency response organizations (modularity).

		Answers	Ratio
Must have		8	100 %
Should have		0	0 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

System components fit on an EU pallet (weight max. 1500kg, 800mm 1200mm).

		Answers	Ratio
Must have		5	62.5 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

Every system sub- component is carriable by 4 persons.

		Answers	Ratio
Less persons (>2)		2	25 %
Approval of proposal		5	62.5 %
More persons (>6)		1	12.5 %
No Answer		0	0 %

The system is transportable on a cargo airplane.

		Answers	Ratio
Must have		5	62.5 %
Should have		3	37.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is transportable in a commercial passenger aircraft.

		Answers	Ratio
Must have		3	37.5 %
Should have		3	37.5 %
Could have		2	25 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system remains fully operational and robust under a wide range of environmental conditions, including extreme weather events such as high winds, heavy rain, dust, hail, and temperature extremes..

		Answers	Ratio
Must have		7	87.5 %
Should have		1	12.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system and all subcomponents have a minimum ingress protection rating of IP65, ensuring full protection against dust ingress and low-pressure water jets from any direction.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other (Please specify below)		0	0 %
No Answer		0	0 %

The system operates reliably in ambient temperatures ranging from -40°C to +80°C, without significant safety risks and limited performance degradation (-10° to 60°).

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other Range (Please specify below)		0	0 %
No Answer		0	0 %

All components function at altitudes up to 4,500 m above sea level.

		Answers	Ratio
Agree		7	87.5 %
Disagree		0	0 %
Other Altitude (Please specify below)		1	12.5 %
No Answer		0	0 %

Wind speeds up to 120 km/h without loss of structural integrity or stability are covered.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other Range (Please specify below)		0	0 %
No Answer		0	0 %

The system is designed for low-maintenance operation in field conditions, enabling sustained use during emergency deployments with minimal technical intervention. It allows for easy access to serviceable components, support quick replacement of parts using standard tools, and enable maintenance tasks to be performed by non-specialized personnel on site without the need for specialized infrastructure.

		Answers	Ratio
Must have		6	75 %
Should have		1	12.5 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system has a minimum operational lifespan of 10 years under typical deployment and usage conditions.

		Answers	Ratio
Agree		7	87.5 %
Disagree		0	0 %
Other range (please specify below)		1	12.5 %
No Answer		0	0 %

The system supports continuous 24/7 operation for at least 10 consecutive days without requiring any maintenance, servicing, or component replacement.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

All critical subcomponents are designed for quick and tool-accessible replacement in the field by trained personnel.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other (please specify below)		0	0 %
No Answer		0	0 %

Spare parts and subcomponents remain available for at least 10 years from the date of system delivery, with documented support for maintenance procedures, diagnostics, and compatibility.

		Answers	Ratio
Agree		6	75 %
Disagree		0	0 %
Other period (please specify below)		2	25 %
No Answer		0	0 %

The system is designed for rapid, intuitive installation and operation in the field by non-specialized personnel. It supports plug-and-play functionality, requiring minimal setup steps, no complex configuration, and enabling safe and immediate use of energy outputs. The design facilitates deployment under time pressure and in challenging conditions, with clear visual indicators, standardized connections, and an interface that supports error-free operation.

		Answers	Ratio
Must have		6	75 %
Should have		2	25 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system makes stored energy available and ready for use within 1 minute of system activation, without requiring manual configuration or warm-up.

		Answers	Ratio
Agree		6	75 %
Disagree		1	12.5 %
Other time period (please specify below)		1	12.5 %
No Answer		0	0 %

The complete system setup, including deployment, interconnection of subcomponents, and readiness for power output, takes no more than 2 hours and requires no more than two trained personnel resources.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other reference values (please specify below)		0	0 %
No Answer		0	0 %

The system provides a minimum of 4 electrical output sockets (Type F), each with overload protection and clearly labeled priority status, accessible without tools and ready for immediate use upon system start-up.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other time period (please specify below)		0	0 %
No Answer		0	0 %

All electrical and data connections are Color-coded and/or physically keyed to prevent incorrect installation, marked with clear visual labels or icons.

		Answers	Ratio
Must have		7	87.5 %
Should have		1	12.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

Safety interlocks prevent improper configuration or hazardous operation (e.g. reverse polarity, voltage mismatch, or incompatible voltage selection), and provide visual or audible alerts in case of incorrect setup.

		Answers	Ratio
Must have		6	75 %
Should have		2	25 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed to enable safe setup, operation, and basic maintenance by non-specialized personnel, while allowing trained personnel to perform more advanced tasks with minimal training. Training requirements shall be limited in duration and complexity to ensure rapid onboarding during emergency deployments.

		Answers	Ratio
Must have		5	62.5 %
Should have		3	37.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed that trained personnel can be fully instructed to perform system setup, configuration, and routine maintenance in less than 3 hours, using provided training materials and documentation.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other (please specify below)		0	0 %
No Answer		0	0 %

Non-specialized personnel (with no prior technical background) is able to safely operate the system, including starting, stopping, and monitoring basic functions, after a familiarization session not exceeding 30 minutes, guided by visual aids and multilingual quick-start instructions.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other (please specify below)		0	0 %
No Answer		0	0 %

Training materials includes step-by-step guides, visual references, and safety procedures, and is available in digital and printed formats (at minimum in English, French, and German).

		Answers	Ratio
Must have		5	62.5 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed to support modular scalability, allowing multiple units to be interconnected in order to increase total power output and energy capacity. The system maintains operational stability and coordinated energy management when scaled to meet the demands of larger micro-grids.

		Answers	Ratio
Must have		7	87.5 %
Should have		1	12.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is scalable to at least five times its nominal power output, enabling combined operation of multiple identical units to reach a total nominal output of at least 50 kW.

		Answers	Ratio
Agree		7	87.5 %
Disagree		0	0 %
Other range (please specify below)		1	12.5 %
No Answer		0	0 %

Scaling is achieved through modular interconnection, with automated or user-guided load balancing, synchronized energy management, and voltage/frequency coordination across connected units.

		Answers	Ratio
Must have		7	87.5 %
Should have		0	0 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The interconnection process requires no more than 30 minutes per additional unit, and does not require extensive reconfiguration, specialized tools, or external control systems.

		Answers	Ratio
Agree		8	100 %
Disagree		0	0 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

The system is designed to minimize noise emissions during all modes of operation to ensure compatibility with sensitive environments such as resting and sleeping areas. Noise levels remain low enough to avoid disturbing personnel, and affected populations.

		Answers	Ratio
Must have		2	25 %
Should have		3	37.5 %
Could have		3	37.5 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system emits no audible noise (>20 dB(A)) when operating at less than 50% of nominal power output, as measured from a distance of 7 meters under standard test conditions.

		Answers	Ratio
Agree		7	87.5 %
Disagree		1	12.5 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

At 50% to 100% of nominal power output, noise emissions do not exceed 45 dB(A) at 7 meters.

		Answers	Ratio
Agree		7	87.5 %
Disagree		1	12.5 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

When operating at above 100% of nominal output (e.g., peak or surge mode), noise emissions do not exceed 90 dB(A) at 7 meters.

		Answers	Ratio
Agree		7	87.5 %
Disagree		1	12.5 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

The system offers implemented noise control strategies to ensure that changes in noise intensity occur gradually, with a maximum acoustic variation rate of 1 dB(A) per second, to avoid sudden disruptions or alarm effects in field conditions.

		Answers	Ratio
Agree		7	87.5 %
Disagree		1	12.5 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

ISO 3744 or ISO 11201 standards are met.

		Answers	Ratio
Must have		4	50 %
Should have		2	25 %
Could have		1	12.5 %
Won't have		0	0 %
Abstention		1	12.5 %
No Answer		0	0 %

As a preferred feature, the system is designed in accordance with circular economy principles and sustainability goals. This includes the use of recyclable or reusable materials, modular components for easy disassembly and repair, and consideration of low environmental impact across the entire lifecycle—from production and deployment to end-of-life disposal. Solutions that minimize resource consumption and promote long-term environmental performance are highly valued.

		Answers	Ratio
Must have		2	25 %
Should have		3	37.5 %
Could have		2	25 %
Won't have		0	0 %
Abstention		1	12.5 %
No Answer		0	0 %

As a preferred sustainability criterion, the system is designed to achieve a minimum material recycling rate of 80% by total weight, in accordance with the EU Waste Framework Directive (2008/98/EC) and the European Circular Economy Action Plan.

		Answers	Ratio
Must have		3	37.5 %
Should have		2	25 %
Could have		2	25 %
Won't have		1	12.5 %
Abstention		0	0 %
No Answer		0	0 %

Recycling potential is assessed for each major material group (e.g. metals, plastics, electronics) using recognized methodologies, and is verifiable through a bill of materials (BoM) or equivalent documentation.

		Answers	Ratio
Must have		2	25 %
Should have		2	25 %
Could have		4	50 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed and operates to ensure the safety of personnel, equipment, and the surrounding environment during all phases of deployment, transport, installation, operation, and maintenance. It prevents hazards such as electric shock, fire, explosion, mechanical injury, and environmental contamination under both normal and foreseeable fault conditions.

		Answers	Ratio
Must have		6	75 %
Should have		2	25 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system includes electrical protection mechanisms (e.g., overcurrent, short-circuit, ground fault protection, fire risk) compliant with international safety standards (e.g., IEC/EN).

		Answers	Ratio
Must have		7	87.5 %
Should have		1	12.5 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is equipped with a clearly marked and easily accessible emergency stop function, operable without tools.

		Answers	Ratio
Must have		8	100 %
Should have		0	0 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

All components have proper safety labeling and instructions for safe operation.

		Answers	Ratio
Must have		8	100 %
Should have		0	0 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system prevents hazardous surface temperatures, maintaining external surfaces below safe-touch thresholds during operation.

		Answers	Ratio
Must have		6	75 %
Should have		2	25 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

Did you face any challenges on filling the survey?

		Answers	Ratio
Yes (please add below)		1	12.5 %
No		6	75 %
No Answer		1	12.5 %

Is the terminology explained comprehensively and in a supportive way?

		Answers	Ratio
Yes		7	87.5 %
No (please add below)		0	0 %
No Answer		1	12.5 %

Are you missing a crucial requirement?

		Answers	Ratio
Yes (please add below)		1	12.5 %
No		6	75 %
No Answer		1	12.5 %

Which PERO partner are you representing? (Short name according to Grant Agreement)

		Answers	Ratio
ASSR		1	12.5 %
Arttic		0	0 %
AutRC		1	12.5 %
CNVVF		1	12.5 %
GB		1	12.5 %
Answer 6		0	0 %
HCSOM		0	0 %
Answer 7		0	0 %
FhG		0	0 %
Answer 8		0	0 %
KEMEA		0	0 %
MoI-F/CIVIPOL		1	12.5 %
MSB		1	12.5 %
THW		1	12.5 %
VIEIRA		0	0 %
No Answer		1	12.5 %

Whose perspective does your response represent?

		Answers	Ratio
Individual Answer		2	25 %
Joint / Collaborative Answer (by organizations team)		5	62.5 %
No Answer		1	12.5 %

Remark by partners (yellow / comment): HCSOM filled by choosing MSB, MSB confirmed participation without naming organization.

ANNEX II: EERO Survey Accompanying document

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FUNCTIONAL REQUIREMENTS SURVEY FOR EMERGENCY RESPONSE ORGANISATIONS "LOW EMISSION POWER SUPPLY IN BASES OF OPERATIONS AND EMERGENCY SHELTERS"

June – July 2025

V06.2025

Dear Expert / Emergency Response Organization Team,

Thanks for taking the time and effort to support research and the future of low-emission power supply in emergency operations / missions.

In this document you will find **accompanying information** about the ongoing **"Functional Requirements Survey for Emergency Response Organizations"**:

- How to fill the survey (MoSCoW)
- Terminology and Definitions survey
- About the survey
- Standard Abbreviations POWERBASE

We kindly invite you to **fill the survey** not later than **July 8th, 2025, EOB**.

How to fill the survey

Here you can find most important and relevant information on the survey set up and supportive aspects of replying / rating the given statements.

How to access the survey?	• https://ec.europa.eu/eusurvey/runner/POWERBASE_FunctionalRequirements_2025 • No Passkey or LogIn to EU portal needed
Is the survey anonymous?	• Yes, this survey is set "anonymous" and will not track IP or similar • You do not need login credentials. • We will only ask you to categorize your organization and provide information on the country you represent.

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Are there additional definitions / information available?	• You may find **definitions and additional information** in this document (see here). • Please keep in mind that for **some topics / aspects** (e.g. scalability) there might occur details on **different / multiple statements.**
How much time will it take?	• 20-25 minutes to fill the survey • You might want to take some time to discuss with your team / internally on your agreed reply.
Which kind of rating / ranking is applied?	Different types of replies are used throughout the survey: • MoSCoW (Single Choice = only one reply possible to be ticked) ○ Must have ○ Should have ○ Could have ○ Won't have ○ Abstention • Single Choice from given list of potential answers (e.g. Yes / No or Agree / Disagree / Other,...) ○ Agree ○ Disagree ○ Other (Please specify below) In case you have chosen "other" pls. specify here:
Part 1 Questions on Requirements (mandatory)	• **Statements** on Functional requirements (each 1 section) • Including <5 **additional statements** on Functional requirements (included in above mentioned section) • This is set "**mandatory**" as we need to know those preferences from practitioners perspective: Fields marked with * are mandatory. • Still there is the option of "**abstention**" for most of the questions – as we can only build up the Requirements report on the overall results ranked we kindly ask you to choose one of the other options of MoSCoW.
Part 2 Questions on organization (mandatory)	• Question about the filling party / organization Which kind of Emergency Reponse Organziation are you representing? ○ Emergency Medical Services ○ Fire and Rescue Services ○ Civil Protection Organization ○ Civil Protection Authority ○ Civil Society Organization ○ Local Authority ○ Regional Authority ○ National Authority ○ Other (Please list below) • Information on filled as an individual or team Whose perspective does your response represent? ○ Individual Answer ○ Joint / Collaborative Answer (by organizations team) • • Information on the EU Member State (MS) or Participating State (PS) of the UCPM you are coming from: 

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Can I/we save a draft and change the answers?	• Yes, you are able to save a draft with the button in the right corner / frame of the survey and Save as Draft • you can also change your replies.
Can I/we download my/our replies?	• Yes, you can download a PDF. Download PDF version Save as Draft •
Can I/we change the language?	• The survey is set up in English language and preferable is filled in English. • You can change the language to automatically translated versions for French, German, Hungarian, Italian, Portuguese and Slovak language. • Please keep in mind, that the provided translations are automatic translations and that this will also apply for any text you reply to in open questions.
How to see the progress of the survey?	• You can switch the sections in the "Pages" part Questions on your organization / role • You can see the progress in the progress bar on top in % 0%

MoSCoW Rating

For the ranking of the main and some of the additional statements we have chosen the MoSCoW model. Additionally you can also choose for "Abstention", but we highly recommend to make use of one of the MoSCoW preferences.
Here you can find some further definition and explanation.

M = Must have	Listed requirement must be contained in the POWERBASE requirements report. Failure to deliver this requirement means the future solution would be recognized as not applicable in operations.
S = Should have	A high-priority requirement that is not critical to integrate the technology in operations, but supposed to be importantand of a high value to practitioners.
C = Could have	This is a desirable requirement but not the necessary one, it is less important than "should have".
W = Won't have	A requirement that will not be taken into account for the implementation at this stage, but may be included in a future / further development stage of the technology.
Abstention	Not choosing any of the rating. CAVE! This might lead to underrepresentation or missing representation of your needs.

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Terminology | Definitions for Functional Requirement survey

To understand terms and abbreviations used in this survey, particularly linked to POWERBASE subject, we have listed some definitions for you in this overview table:

Base of Operation - BoO	BoO is a centralized location from which activities, logistics, and personnel are coordinated and deployed to carry out specific missions or tasks. It serves as a hub for planning, communication, resource management, and operational execution.
Emergency (Temporary) Shelter - E(T)S	Emergency Shelter or Emergency Temporary Shelter is a short-term housing solution designed to provide immediate protection and relief for individuals displaced by disasters, conflicts, or crises. These shelters offer basic necessities such as safety, food, water, and medical aid while more permanent housing solutions are arranged.
(System) component	A (system) component is a self-contained, modular unit of the energy supply system that delivers a distinct and essential function (e.g. energy generation or storage type).
(system) subcomponent	A (system) sub-component is a functional part or module within a system component that contributes to the component's operation.
System	The system is the overall set of components and subcomponents or modules being deployed as a full set for serving operational needs.
Modular	Modular meaning system's (sub)components that may be separated and recombined offering the highest possible flexibility.
Unit	As a set of system(s) being recognized as one set for deployment.
Trained Personnel	Operational staff (laymen) with potential technical / electrical background trained to maintain simple parts.
Specialized Personnel	Subject matter experts for system or its (sub)components (technical / electrical).
Non-specialized personnel	Operational staff (laymen) without training / instructions and no technical / electrical background.
Bill of Materials (BOM)	Bill of Materials offering a list of raw materials, spare parts, components, sub-components and their individual quantities for manufacturing the product.
Storing / Storage	Preserving the energy for later use.
Consumption	Using the energy.
Conversion	Process of changing energy from one form to another.
Standalone	Able to function alone, by itself or separately.
Hybrid	Hybrid offering to combine different systems or elements.
Socket Prioritization	The sockets pre-set to serve the most important energy consumers are ranked for prioritization meaning a shut down according to their relevance from less to most important.
IP65	see: https://en.wikipedia.org/wiki/IP_code
ISO3744	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane.
ISO11201	Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a workstation and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections.

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About the survey

POWERBASE team is elaborating requirements and State-of-the-Art (SOTA) analysis to elaborate on the potential in the given market for low-emission power supply and the opportunities of development for operational deployment for Bases of Operations and Emergency Shelters.

Who is supposed to fill the survey?	• **Emergency Response Organizations** from Europe (European Member States and Participating States in the UCPM) and operating entities for Bases of Operations (BoO) and Emergency (Temporary) Shelters (ETS) are welcome to express their perspective of requirements. • The survey can be filled by **individuals or as joint / collaborative efforts.** We kindly invite you to reply for your **organization in accordance** with experts / team (**one** filled survey **per organization**).
What is the expected outcome for POWERBASE?	• Refined list of **requirements** for energy supply tools used in **E(T)S and BoO** representing the majority of PEROs. • The list to be create upon the majority
What is not part of the survey?	• Basic discussions and wish list creation about general requirements.
Who set up the statements and questions and how / why?	• Statements are set up **based** on the initial **D2.2** Functional requirements report, the results of **an internal project workshop for Prioritization** and an internal survey on Functional requirements (May 2025).
Why is participation by Emergency Response Organizations important?	• **Representation** of a broad community of potential users. • **Baseline for follow-up procurement** and its requirement list including potential involvement of other practitioners. • Input for **State-of-the-Art analysis** (by Fraunhofer INT).
When is the deadline for filling the survey?	• Tuesday, **July 8th, 2025** – EOB.
When and how are the results going to be presented?	• Project internally: July 2025 • **Publicly** available in "D2.3 Functional Requirements Report final version" **End of September 2025**
How to involve other Emergency Response Organizations?	• Sharing the link and invitiation to the survey • (Re-)Posting our Call4Action via LinkedIn and other Social Media channels
Whom to contact for questions?	• communications@powerbaseproject.eu • Your question will be forwarded to the survey experts and replied to asap.

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Standard Abbreviations in this document

To enable better understanding of this document we can offer a list of abbreviations used.

D	Deliverable
ERO	Emergency Response Organization(s)
EOB	End of Business Hours
EU	European Union
IP	Ingress Protection
ISO	International Organization for Standardization
MS	Member State(s)
PS	Participating State(s)
SOTA	State of the Art Analysis
UCPM	Union Civil Protection Mechanism
V	Version

Thanks for your cooperation!

ANNEX III: EERO Survey Results Raw

Statistics: POWERBASE_Emergency Response Organizations_Requirements

The system generates electrical energy from renewable or renewable-based sources (e.g., solar, wind, bio-based, or hybrid combinations) in proximity to the base of operation or emergency shelter.

		Answers	Ratio
Must have		3	16.67 %
Should have		9	50 %
Could have		5	27.78 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The system produces a minimum of 120 kWh of usable electrical energy per 24 hours, regardless of prevailing local weather conditions, when deployed in representative operational environments. Performance to be verified through simulated or field tests across diverse climate zones and during different seasons.

		Answers	Ratio
Less (>80 kWh/day)		4	22.22 %
Approval of proposal		9	50 %
More (> 150 kWh/day)		5	27.78 %
No Answer		0	0 %

The system includes an integrated solution for storing energy at the base of operation or emergency shelter to ensure reliable power availability for required use.

		Answers	Ratio
Must have		7	38.89 %
Should have		9	50 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system provides at least 20 kWh of usable electrical energy storage, measured as net energy available for consumption after internal conversion losses.

		Answers	Ratio
Less (>10 kWh)		3	16.67 %
Approval of proposal		11	61.11 %
More (> 50kWh)		4	22.22 %
No Answer		0	0 %

The storage supports variable energy input and output profiles and function in standalone and hybrid generation setups.

		Answers	Ratio
Must have		7	38.89 %
Should have		7	38.89 %
Could have		4	22.22 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system includes a smart integrated energy management and distribution solution capable of coordinating energy generation, storage, and output in real-time, ensuring optimized operation according to varying energy demands, being remotely controlled and enabling monitoring.

		Answers	Ratio
Must have		5	27.78 %
Should have		11	61.11 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system supports at least two configurable operation modes: - ECO Mode (default): Optimize for fuel savings and greenhouse gas (GHG) emissions by minimizing generator runtime and energy losses. - Power Mode: Prioritize uninterrupted delivery of peak loads up to the system's maximum rated capacity.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other (Please specify below)		0	0 %
No Answer		0	0 %

The system includes energy monitoring, data logging and data communication/remote control.

		Answers	Ratio
Must have		12	66.67 %
Should have		5	27.78 %
Could have		1	5.56 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The systems power converter (such as inverters, DC/DC, AC/DC units) always operates in a way that maximizes energy efficiency, with an average electrical conversion efficiency of ≥92%,

		Answers	Ratio
Must have		7	38.89 %
Should have		11	61.11 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system offers automatic or user-selectable energy output distribution at 230V or 400V, maintaining voltage within ±5% of nominal values, with frequency stability .

		Answers	Ratio
Agree		18	100 %
Disagree		0	0 %
Other (Please specify below)		0	0 %
No Answer		0	0 %

Socket prioritization is included with automatic emergency shutdown of low priority sockets, during overload or low energy conditions.

		Answers	Ratio
Must have		9	50 %
Should have		7	38.89 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

One system provides sufficient electrical power output for an entire Base of Operation or Emergency Shelter for at least 15 persons at all times during the ongoing operation with different demands.

		Answers	Ratio
Must have		8	44.44 %
Should have		8	44.44 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system has a nominal output 10 kW (Nominal output=power that can be delivered 24h/7days).

		Answers	Ratio
Less (5kW nominal)		1	5.56 %
Approval of proposal		8	44.44 %
More (20 kW nominal)		9	50 %
No Answer		0	0 %

The system can deliver 300% of it`s nominal output for at least one hour (10 kW nominal -> 30 kW for one hour).

		Answers	Ratio
Less (200%)		5	27.78 %
Approval of proposal		11	61.11 %
More (400%)		2	11.11 %
No Answer		0	0 %

The system includes energy conversion components e.g. chemical to electrical energy with a low-emission and efficient approach.

		Answers	Ratio
Must have		3	16.67 %
Should have		9	50 %
Could have		5	27.78 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The energy conversion system supports the use of at least one commercially available fuel, including but not limited to bio-based fuels, hydrogen, methanol, or sustainably produced synthetic fuels.

		Answers	Ratio
Must have		9	50 %
Should have		6	33.33 %
Could have		2	11.11 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The energy conversion system ensures that the selected fuel is producible through sustainable processes, such as renewable-powered electrolysis, bio-based production, or circular carbon sourcing.

		Answers	Ratio
Must have		3	16.67 %
Should have		7	38.89 %
Could have		7	38.89 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The energy conversion system achieves a minimum energy conversion efficiency of 50%, defined as the ratio of net electrical energy output to the chemical energy content of the fuel, measured under standard operating conditions.

		Answers	Ratio
Less (> 25%)		1	5.56 %
Approval of Proposal		12	66.67 %
More (> 70%)		5	27.78 %
No Answer		0	0 %

The system is designed for rapid deployment and transport in emergency response operations, where space, weight, and handling capacity are limited. Therefore, it must be compatible with commonly used logistics and transport methods of emergency response organizations (modularity).

		Answers	Ratio
Must have		14	77.78 %
Should have		4	22.22 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

System components fit on an EU pallet (weight max. 1500kg, 800mm 1200mm).

		Answers	Ratio
Must have		12	66.67 %
Should have		5	27.78 %
Could have		1	5.56 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

Every system sub- component is carriable by 4 persons.

		Answers	Ratio
Less persons (>2)		6	33.33 %
Approval of proposal		12	66.67 %
More persons (>6)		0	0 %
No Answer		0	0 %

The system is transportable on a cargo airplane.

		Answers	Ratio
Must have		11	61.11 %
Should have		4	22.22 %
Could have		3	16.67 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is transportable in a commercial passenger aircraft.

		Answers	Ratio
Must have		6	33.33 %
Should have		6	33.33 %
Could have		6	33.33 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system remains fully operational and robust under a wide range of environmental conditions, including extreme weather events such as high winds, heavy rain, dust, hail, and temperature extremes..

		Answers	Ratio
Must have		15	83.33 %
Should have		3	16.67 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system and all subcomponents have a minimum ingress protection rating of IP65, ensuring full protection against dust ingress and low-pressure water jets from any direction.

		Answers	Ratio
Agree		17	94.44 %
Disagree		0	0 %
Other (Please specify below)		1	5.56 %
No Answer		0	0 %

The system operates reliably in ambient temperatures ranging from -40°C to +80°C, without significant safety risks and limited performance degradation (-10° to 60°).

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other Range (Please specify below)		0	0 %
No Answer		0	0 %

All components function at altitudes up to 4,500 m above sea level.

		Answers	Ratio
Agree		12	66.67 %
Disagree		4	22.22 %
Other Altitude (Please specify below)		2	11.11 %
No Answer		0	0 %

Wind speeds up to 120 km/h without loss of structural integrity or stability are covered.

		Answers	Ratio
Agree		13	72.22 %
Disagree		5	27.78 %
Other Range (Please specify below)		0	0 %
No Answer		0	0 %

The system is designed for low-maintenance operation in field conditions, enabling sustained use during emergency deployments with minimal technical intervention. It allows for easy access to serviceable components, support quick replacement of parts using standard tools, and enable maintenance tasks to be performed by non-specialized personnel on site without the need for specialized infrastructure.

		Answers	Ratio
Must have		12	66.67 %
Should have		5	27.78 %
Could have		1	5.56 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system has a minimum operational lifespan of 10 years under typical deployment and usage conditions.

		Answers	Ratio
Agree		16	88.89 %
Disagree		1	5.56 %
Other range (please specify below)		1	5.56 %
No Answer		0	0 %

The system supports continuous 24/7 operation for at least 10 consecutive days without requiring any maintenance, servicing, or component replacement.

		Answers	Ratio
Agree		16	88.89 %
Disagree		0	0 %
Other range (please specify below)		2	11.11 %
No Answer		0	0 %

All critical subcomponents are designed for quick and tool-accessible replacement in the field by trained personnel.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other (please specify below)		0	0 %
No Answer		0	0 %

Spare parts and subcomponents remain available for at least 10 years from the date of system delivery, with documented support for maintenance procedures, diagnostics, and compatibility.

		Answers	Ratio
Agree		17	94.44 %
Disagree		0	0 %
Other period (please specify below)		1	5.56 %
No Answer		0	0 %

The system is designed for rapid, intuitive installation and operation in the field by non-specialized personnel. It supports plug-and-play functionality, requiring minimal setup steps, no complex configuration, and enabling safe and immediate use of energy outputs. The design facilitates deployment under time pressure and in challenging conditions, with clear visual indicators, standardized connections, and an interface that supports error-free operation.

		Answers	Ratio
Must have		12	66.67 %
Should have		5	27.78 %
Could have		0	0 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The system makes stored energy available and ready for use within 1 minute of system activation, without requiring manual configuration or warm-up.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other time period (please specify below)		0	0 %
No Answer		0	0 %

The complete system setup, including deployment, interconnection of subcomponents, and readiness for power output, takes no more than 2 hours and requires no more than two trained personnel resources.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other reference values (please specify below)		0	0 %
No Answer		0	0 %

The system provides a minimum of 4 electrical output sockets (Type F), each with overload protection and clearly labeled priority status, accessible without tools and ready for immediate use upon system start-up.

		Answers	Ratio
Agree		15	83.33 %
Disagree		1	5.56 %
Other time period (please specify below)		2	11.11 %
No Answer		0	0 %

All electrical and data connections are Color-coded and/or physically keyed to prevent incorrect installation, marked with clear visual labels or icons.

		Answers	Ratio
Must have		9	50 %
Should have		7	38.89 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

Safety interlocks prevent improper configuration or hazardous operation (e.g. reverse polarity, voltage mismatch, or incompatible voltage selection), and provide visual or audible alerts in case of incorrect setup.

		Answers	Ratio
Must have		13	72.22 %
Should have		3	16.67 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed to enable safe setup, operation, and basic maintenance by non-specialized personnel, while allowing trained personnel to perform more advanced tasks with minimal training. Training requirements shall be limited in duration and complexity to ensure rapid onboarding during emergency deployments.

		Answers	Ratio
Must have		10	55.56 %
Should have		7	38.89 %
Could have		0	0 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed that trained personnel can be fully instructed to perform system setup, configuration, and routine maintenance in less than 3 hours, using provided training materials and documentation.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other (please specify below)		0	0 %
No Answer		0	0 %

Non-specialized personnel (with no prior technical background) is able to safely operate the system, including starting, stopping, and monitoring basic functions, after a familiarization session not exceeding 30 minutes, guided by visual aids and multilingual quick-start instructions.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other (please specify below)		0	0 %
No Answer		0	0 %

Training materials includes step-by-step guides, visual references, and safety procedures, and is available in digital and printed formats (at minimum in English, French, and German).

		Answers	Ratio
Must have		15	83.33 %
Should have		1	5.56 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed to support modular scalability, allowing multiple units to be interconnected in order to increase total power output and energy capacity. The system maintains operational stability and coordinated energy management when scaled to meet the demands of larger micro-grids.

		Answers	Ratio
Must have		9	50 %
Should have		6	33.33 %
Could have		3	16.67 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is scalable to at least five times its nominal power output, enabling combined operation of multiple identical units to reach a total nominal output of at least 50 kW.

		Answers	Ratio
Agree		15	83.33 %
Disagree		3	16.67 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

Scaling is achieved through modular interconnection, with automated or user-guided load balancing, synchronized energy management, and voltage/frequency coordination across connected units.

		Answers	Ratio
Must have		9	50 %
Should have		6	33.33 %
Could have		3	16.67 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The interconnection process requires no more than 30 minutes per additional unit, and does not require extensive reconfiguration, specialized tools, or external control systems.

		Answers	Ratio
Agree		14	77.78 %
Disagree		2	11.11 %
Other range (please specify below)		2	11.11 %
No Answer		0	0 %

The system is designed to minimize noise emissions during all modes of operation to ensure compatibility with sensitive environments such as resting and sleeping areas. Noise levels remain low enough to avoid disturbing personnel, and affected populations.

		Answers	Ratio
Must have		9	50 %
Should have		8	44.44 %
Could have		1	5.56 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system emits no audible noise (>20 dB(A)) when operating at less than 50% of nominal power output, as measured from a distance of 7 meters under standard test conditions.

		Answers	Ratio
Agree		17	94.44 %
Disagree		0	0 %
Other range (please specify below)		1	5.56 %
No Answer		0	0 %

At 50% to 100% of nominal power output, noise emissions do not exceed 45 dB(A) at 7 meters.

		Answers	Ratio
Agree		17	94.44 %
Disagree		1	5.56 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

When operating at above 100% of nominal output (e.g., peak or surge mode), noise emissions do not exceed 90 dB(A) at 7 meters.

		Answers	Ratio
Agree		13	72.22 %
Disagree		3	16.67 %
Other range (please specify below)		2	11.11 %
No Answer		0	0 %

The system offers implemented noise control strategies to ensure that changes in noise intensity occur gradually, with a maximum acoustic variation rate of 1 dB(A) per second, to avoid sudden disruptions or alarm effects in field conditions.

		Answers	Ratio
Agree		16	88.89 %
Disagree		2	11.11 %
Other range (please specify below)		0	0 %
No Answer		0	0 %

ISO 3744 or ISO 11201 standards are met.

		Answers	Ratio
Must have		9	50 %
Should have		7	38.89 %
Could have		2	11.11 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

As a preferred feature, the system is designed in accordance with circular economy principles and sustainability goals. This includes the use of recyclable or reusable materials, modular components for easy disassembly and repair, and consideration of low environmental impact across the entire lifecycle—from production and deployment to end-of-life disposal. Solutions that minimize resource consumption and promote long-term environmental performance are highly valued.

		Answers	Ratio
Must have		4	22.22 %
Should have		11	61.11 %
Could have		3	16.67 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

As a preferred sustainability criterion, the system is designed to achieve a minimum material recycling rate of 80% by total weight, in accordance with the EU Waste Framework Directive (2008/98/EC) and the European Circular Economy Action Plan.

		Answers	Ratio
Must have		5	27.78 %
Should have		6	33.33 %
Could have		6	33.33 %
Won't have		1	5.56 %
Abstention		0	0 %
No Answer		0	0 %

Recycling potential is assessed for each major material group (e.g. metals, plastics, electronics) using recognized methodologies, and is verifiable through a bill of materials (BoM) or equivalent documentation.

		Answers	Ratio
Must have		6	33.33 %
Should have		6	33.33 %
Could have		6	33.33 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is designed and operates to ensure the safety of personnel, equipment, and the surrounding environment during all phases of deployment, transport, installation, operation, and maintenance. It prevents hazards such as electric shock, fire, explosion, mechanical injury, and environmental contamination under both normal and foreseeable fault conditions.

		Answers	Ratio
Must have		15	83.33 %
Should have		3	16.67 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system includes electrical protection mechanisms (e.g., overcurrent, short-circuit, ground fault protection, fire risk) compliant with international safety standards (e.g., IEC/EN).

		Answers	Ratio
Must have		16	88.89 %
Should have		1	5.56 %
Could have		1	5.56 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system is equipped with a clearly marked and easily accessible emergency stop function, operable without tools.

		Answers	Ratio
Must have		15	83.33 %
Should have		3	16.67 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

All components have proper safety labeling and instructions for safe operation.

		Answers	Ratio
Must have		14	77.78 %
Should have		3	16.67 %
Could have		1	5.56 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

The system prevents hazardous surface temperatures, maintaining external surfaces below safe-touch thresholds during operation.

		Answers	Ratio
Must have		13	72.22 %
Should have		5	27.78 %
Could have		0	0 %
Won't have		0	0 %
Abstention		0	0 %
No Answer		0	0 %

Are you missing a crucial requirement?

		Answers	Ratio
Yes (please add below)		3	16.67 %
No		15	83.33 %
No Answer		0	0 %

Which kind of Emergency Reponse Organization / Authority are you representing?

		Answers	Ratio
Emergency Medical Services		1	5.56 %
Fire and Rescue Services		4	22.22 %
Civil Protection Organization		3	16.67 %
Civil Protection Authority		4	22.22 %
Civil Society Organization		1	5.56 %
Local Authority		0	0 %
Regional Authority		1	5.56 %
National Authority		1	5.56 %
Other (Please list below)		3	16.67 %
No Answer		0	0 %

Whose perspective does your response represent?

		Answers	Ratio
Individual Answer		10	55.56 %
Joint / Collaborative Answer (by organizations team)		8	44.44 %
No Answer		0	0 %

Which EU Member State (MS) or Participating State (PS) in the UCPM are you coming from / representing?

		Answers	Ratio
Austria		5	27.78 %
Belgium		0	0 %
Bulgaria		0	0 %
Croatia		0	0 %

Czech Republic		0	0 %
Cyprus		2	11.11 %
Denmark		0	0 %
Estonia		0	0 %
Finland		0	0 %
France		0	0 %
Germany		2	11.11 %
Greece		3	16.67 %
Hungary		1	5.56 %
Ireland		0	0 %
Italy		2	11.11 %
Latvia		0	0 %
Lithuania		0	0 %
Luxembourg		0	0 %
Malta		0	0 %
Netherlands		0	0 %
Poland		0	0 %
Portugal		2	11.11 %
Romania		0	0 %
Slovenia		0	0 %
Slovakia		0	0 %
Spain		0	0 %
Sweden		0	0 %
Albania		0	0 %
Bosnia and Herzegovina		0	0 %
Iceland		0	0 %
Moldova		0	0 %
Montenegro		0	0 %
North Macedonia		0	0 %
Norway		0	0 %
Serbia		1	5.56 %

Türkiye		0	0 %
Ukraine		0	0 %
No Answer		0	0 %