D8.4 First version of MiniStor promotional activities towards standardization and other relevant bodies

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D8.4 First version of MiniStor promotional activities towards standardization and other relevant bodies

<table>
<tr><th colspan="4">Summary</th></tr>
<tr><td colspan="4">The objective of this deliverable is to outline the activities done for project promotion to relevant standardization technical committees, professional bodies and trade associations, due to the system novelty and the gap that exists in the standards to characterize it properly as a thermal storage system for residential use. The purpose of contacting these stakeholders is to generate interest in the subject, inform them of the project advances, and to start the process of building consensus that will lead to future standardisation activities, helping bridge the identified gaps found in the regulations, facilitating future commercialization of the system.
The deliverable describes activities done so far, mentioning contacts made with stakeholders, surveys carried out and the analysis of results from those contacts. Mention is made of the networking events and conferences in which the consortium has participated to promote the project in the area of standardisation. Of particular interest is the relationship stablished with sister projects, which face similar challenges in the area.
The structure of the Product Audit Programme (PAP) is introduced, which serves to checks the quality of the product or service to determine whether it meets the specifications or needs of the customer. The type of preliminary performance test using established methodologies is also described. These elements help to establish a dialogue with the standardisation bodies by showing the challenges and advances that can be achieved.
The steps to continue with the promotional activities that will lead to standardisation of the product are established, with a description of the strategies that need to be followed to achieve this aim.</td></tr>
<tr><th colspan="2">Deliverable Number</th><th colspan="2">Work Package</th></tr>
<tr><td colspan="2">D8. 4</td><td colspan="2">WP. 8</td></tr>
<tr><th colspan="2">Lead Beneficiary</th><th colspan="2">Deliverable Author(S)</th></tr>
<tr><td colspan="2">SGS</td><td colspan="2">Estefania Lopez (SGS)
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Eszter Hajdu (EMI)
Károly Matolcsy (EMI)</td></tr>
<tr><th colspan="2">Beneficiaries</th><th colspan="2">Deliverable Reviewer (S)</th></tr>
<tr><td colspan="2">FEUGA
CERTH</td><td colspan="2">Carmen Cotelo, Oscar Bernardez
Athanasios Nesiadis</td></tr>
<tr><th colspan="2">Planned Delivery Date</th><th colspan="2">Actual Delivery Date</th></tr>
<tr><td colspan="2">31/10/2021</td><td colspan="2">08/06/2022</td></tr>
<tr><th rowspan="2">Type of deliverable</th><td>R</td><td>Report</td><td>X</td></tr>
<tr><td>D</td><td>Demonstrator, pilot, prototype, plan designs</td><td></td></tr>
<tr><th rowspan="2">Dissemination Level</th><td>CO</td><td>Confidential, only for members of the consortium (including the Commission)</td><td></td></tr>
<tr><td>PU</td><td>Public</td><td>X</td></tr>
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List of abbreviations

Abbreviation	Definition
CE	Conformity label with European health, safety, and environmental protection standards
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
Dx.x	Deliverable number
DSO	Distribution System Operator
ECTP	European Construction, built environment and energy efficient building Technology Platform
EEA	European Economic Area
EN	European Norm
EeB PPP	Energy Efficient Buildings Public-Private Partnership
ETSI	European Telecommunications Standards Institute
EU	European Union
ICT	Information and Communications Technology
IEA	International Energy Agency
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
PAP	Product Audit Program
PCM	Phase Change materials
PVT	Photovoltaic thermal panels
RES	Renewable Energy Sources
Tx.x	Task
TCM	Thermo-chemical Materials
TRL	Technology Readiness Level
WP	Work Package

1 Introduction

1.1 Scope and objectives of the Deliverable

The Deliverable 8.4 "First version of MiniStor promotional activities towards standardization and other relevant bodies", presents a summary of the activities carried out is to facilitate the acceptance and utilisation by the market of project outcomes. Additionally, the approach to standardization bodies will be used as a tool for dissemination of project results and interaction with market stakeholders.

This first deliverable is a summary of what has been done up to month 24 of the project. It also establishes a roadmap to be carried out during the rest of the project to kickstart, after project finalisation, the standardisation of the new products developed in the project.

This Deliverable is a first version, which will be updated towards the end of the project, as D8.5 "Final version of MiniStor promotional activities towards standardisation and other relevant bodies", which will consist of a Final report on results of activities done to promote the project according to task objectives, overall recommendations, and will contain the results and work for further research.

1.2 Structure of the Deliverable

The report is structured according to the following sections:

- Section 2 includes the activities done during the first period included in this report. Includes contacts made with stakeholders, surveys carried out and analysis of the results of these contacts. The conferences and events in which the Consortium has participated are also mentioned with a view towards standardisation activities, and the sister projects that have been contacted are also presented.
- Section 3 summarizes the analysis done on relevant legislation and standards for system operation in the European framework applicable to the MiniStor project.
- Section 4 provides an overview of the future Product Audit Programme (PAP), establishes the different phases and highlights the benefits of the PAP that will serve to commercialize the system.
- Section 5 presents the preliminary performance tests that are planned for the prototype, in an environmental chamber that will help to define the working parameters under a series of simulated weather conditions for a typical Hungarian household.
- Section 6 explains some of the difficulties encountered to carry out the contacts and how they were overcome. It also establishes the next steps for contact and promotion of the project towards standardisation bodies.

1.3 Relation to other tasks and Deliverables

This Deliverable corresponds to T8.3 “Networking with standardization & professional bodies to address common challenges with respect to standardization, certification and safety”. It is the first version of the MiniStor promotional activities towards standardization and other relevant bodies. It will have a final version at the end of the project. In this Deliverable, the activities carried out during the life of the project to promote it through standardisation are reviewed.

This activity is closely linked to the results from the task 2.1. Identification of stakeholders’ requirements, market needs and barriers for implementation, and the analysis made in T2.3 Analysis of relevant European & national legislation and standards related to HVAC systems relevant to system operation, jointly with the Dissemination Strategy defined in T8.1 Communication and dissemination planning and set-up and implemented in T8.2 MiniStor communication and dissemination activities and material.

2 Outline of activities performed during the first period

2.1 What is a Standard?

A standard is a technical document designed to be used as a rule, guideline or definition. It is a consensus-built, repeatable way of doing something. Standards are created by bringing together all interested parties such as manufacturers, consumers and regulators of a particular material, product, process or service. All parties benefit from standardization through increased product safety and quality as well as lower transaction costs and prices.

In Europe there are three different categories of standards:

- International standard – adopted by an international standardization organization.
- European standard – adopted by a European standardization body.
- National standard – adopted by a national standardization body and made available to the public.

European Standards (ENs) are documents that have been ratified by one of the three European Standards Organisations (Standardisation bodies such as CEN, CENELEC or ETSI). They are the result of a consensual process between the actors involved in their development.

On the other side a **Harmonised standard** is a European standard, drafted and adopted by one of the European Standardisation Organisations, following a mandate issued by the European Commission after consultation with Member States. This standard has the same validity and denomination of a national standard although the content is the same in different countries. Each country is responsible for ratifying a harmonised standard for national adoption.

2.2 Standardisation Bodies

The Standardisation bodies at the **European level** are the following:

2.2.1 CEN (European Committee for Standardisation)

CEN, the European Committee for Standardization, is an association that brings together the National Standardization Bodies of 34 European countries. CEN provides a platform for the development of European Standards and other technical documents in relation to various kinds of products, materials, services and processes.

CEN supports standardization activities in relation to a wide range of fields and sectors including: air and space, chemicals, construction, consumer products, defence and security, energy, the environment, food and feed, health and safety, healthcare, ICT, machinery, materials, pressure equipment, services, smart living, transport and packaging.

The standardization system in Europe is based on the national pillars, which are the National Standardization Bodies or the members of CEN. A National Standardization Body is the one stop shop for all stakeholders and is the main focal point of access to the concerted system, which comprises regional (European) and international (ISO) standardization. It is the responsibility of the CEN National Members to implement European Standards as national standards. The National Standardization Bodies distribute and sell the implemented European Standard and have to withdraw any conflicting national standards. The CEN Members are shown in Annex II.

2.2.2 CENELEC (European Committee for Electrotechnical Standardisation)

CENELEC, the European Committee for Electrotechnical Standardization, is an association that brings together the National Electrotechnical Committees of 34 European countries. It prepares voluntary standards in the electrotechnical field, which help facilitate trade between countries, create new markets, cut compliance costs and support the development of a Single European Market.

CENELEC supports standardization activities in relation to a wide range of fields and sectors including: Electromagnetic compatibility, Accumulators, primary cells and primary batteries, Insulated wire and cable, Electrical equipment and apparatus, Electronic, electromechanical and electrotechnical supplies, Electric motors and transformers, Lighting equipment and electric lamps, Low Voltage electrical installations material, Electric vehicles railways, smart grid, smart metering, solar (photovoltaic) electricity systems, etc. CENELEC members are national organizations entrusted with electrotechnical standardization, recognized both at National and European level as being able to represent all standardization interests in their country. Only one organization per country may be member of CENELEC. The list of the Members can be found in Annex III.

Its Members include the National Committees of the 27 European Union countries, United Kingdom, the Republic of North Macedonia, Serbia and Turkey plus three countries of the European Free Trade Association (Iceland, Norway and Switzerland). There is one member per country.

The European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) are two distinct private international non-profit organizations.

The Members of CEN and CENELEC are 43 different National Standardization Bodies/National Committee located in 34 different European countries – including all the Member states of the European Union (EU) and other countries that are part of the European Single Market. CEN and CENELEC work with their Members to develop and define European Standards in response to specific needs that have been identified by businesses and other users of standards. European standards are developed by teams of experts who have particular knowledge of the specific sector or topic that is being addressed. The members of Technical Committees of CEN and CENELEC as well as sub-committees and working groups are nominated by the national standardization organizations.

Each National Standardization Body/National Committee that is part of the CEN and CENELEC system is obliged to adopt each European Standard as a national standard and make it available to customers in their country. They also have to withdraw any existing national standard that conflicts with the new European Standard. Therefore, one European Standard (EN) eventually becomes the national standard in all 34 countries covered by CEN and CENELEC members. However, in practice the process for adoption and harmonisation can take many years, depending on the internal processes followed in each Member State.

CEN, CENELEC and their national Members and Committees work jointly to develop and define standards that are considered necessary by market actors and/or to support the implementation of European legislation. A majority of European Standards are initiated by stakeholders and developed in partnership with all interested parties. Around 30% are mandated by the European Commission and the European Free Trade Association (EFTA) in the framework of EU legislation.

2.2.3 ETSI (European Telecommunications Standards Institute)

ETSI provides members with an open, inclusive and collaborative environment. This environment supports the timely development, ratification and testing of globally applicable standards for ICT-enabled systems, applications and services. They are at the forefront of emerging technologies across all sectors of industry and society that make use of ICT. They have more than 900 members, which are drawn from over 60 countries and five continents.

At the international level, the most important standardisation bodies are:

2.2.4 ISO (International Organisation for Standardisation)

ISO is an independent, non-governmental international organization with a membership of 165 national standardization bodies. Through its members, it brings together experts to share knowledge and develop International Standards that are voluntary, consensus-based, market relevant and that support innovation and provide solutions to global challenges.

The work of preparing International Standards is normally carried out through the ISO technical committees. Each member body interested in a subject for which a technical committee has been established, has the right to be represented on that committee. International organizations, governmental and non-governmental bodies, in liaison with ISO, also take part in the work required to develop a standard. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

ISO has put together groups of experts that represent a very large array of topics related to standardization. In fact, there are more than 250 technical committees.

2.2.5 IEC (International Electrotechnical Commission).

The IEC (International Electrotechnical Commission) is the world's leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies. Close to 20,000 experts from industry, commerce, government, test and research labs, academia and consumer groups participate in the IEC Standardization work.

2.3 Definition of stakeholder requirements, market demands and application challenges

Due to the nature of the standardisation bodies, which includes representation from different sectors of society, stakeholders from outside the initial project scope need to be taken into account. Previous work was done in Task 2.1 "Identification of stakeholder requirements, market needs and barriers for implementation", resulting in D2.1. "Definition of stakeholder requirements, market demands and application challenges".

Stakeholders were identified with interests in residential energy storage (thermal and electrical). They are generally drawn from the thermal or electric energy sector, as well as from providers of energy efficiency and energy flexibility management. Their needs and requirements were identified, in relation to the market demands and other parameters (technological, economic, and environmental).

The target groups of the residential thermal energy sector can be classified in several categories:

- Producers/Manufacturers of thermal equipment (storage, management, etc)
- Installers of thermal equipment
- Energy services providers
- End-Users (dwelling inhabitants, as well as owners and administrators)
- Public bodies for policy and regulation
- Innovation and Research
- External Services and consultancy

Similarly, the target groups for the electric energy sector can be classified in the following categories:

- Transmission/Distribution Operators
- Trading/Selling Players/Producers
- End-Users/Prosumers
- Public bodies for policy and regulation
- Innovation and Research
- External Services and consultancy

Those categories are related and interact with each other according to the following supply chains as shown in Figure 1 for the electric energy sector and Figure 2 for the thermal energy sector correspondingly.

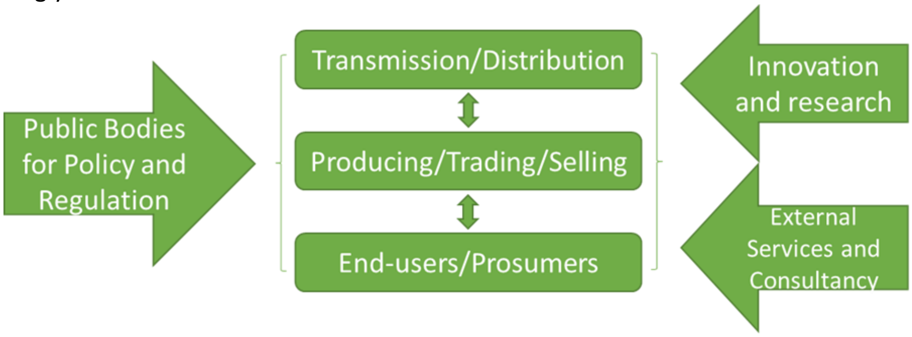

Figure 1- Supply chain of the thermal energy sector. Source: D2.1

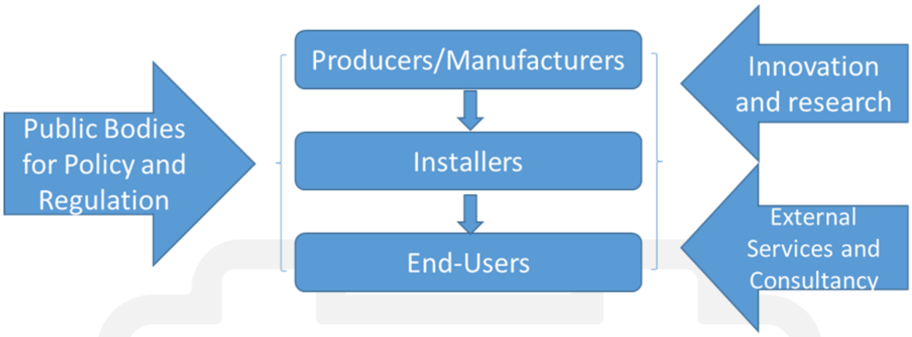

Figure 2 - Supply chain of the thermal energy sector. Source: D2.1

Interested parties were identified to provide inputs that could be used to gauge market expectations and that could have a role in future product introduction. For this reason, the MiniStor stakeholder group was divided in two parts:

1. The *developers' stakeholder group*, represented by the MiniStor consortium partners: they provide an advantage by being early adopters of the concept. They also can share information from related stakeholders in the same category. They bring together expertise and know-how from different aspects of the energy market.

2. The *external stakeholder group*: represents institutions that could show interest in the project after its conclusion. The list has been created within the activities of WP8 "Dissemination and Communication" and is explained in the section "2.6 Creation of the Trackers Communication activities".

2.4 Identification of external stakeholders' characteristics

A survey was done in order to identify expectations and requirements for a residential thermal storage system, helping to gauge the distance between its current and target state. A needs assessment is most commonly conducted to determine which features should be included.

The expertise of the stakeholders and their interest in the project was assessed in D2.1. The external stakeholder requirements and expectations were collected through a questionnaire divided into four sections with 22 questions in total. The questions were identified and expressed in such way as to understand if stakeholders had personal experience with thermal storage systems, renewable energy systems and the application of energy flexibility. It also collected information on possible market dynamics such as future price and investment outlook. Figure 3 shows the expertise of the external contacts that participated in the survey, and Figure 4 their expressed interest in the MiniStor system:

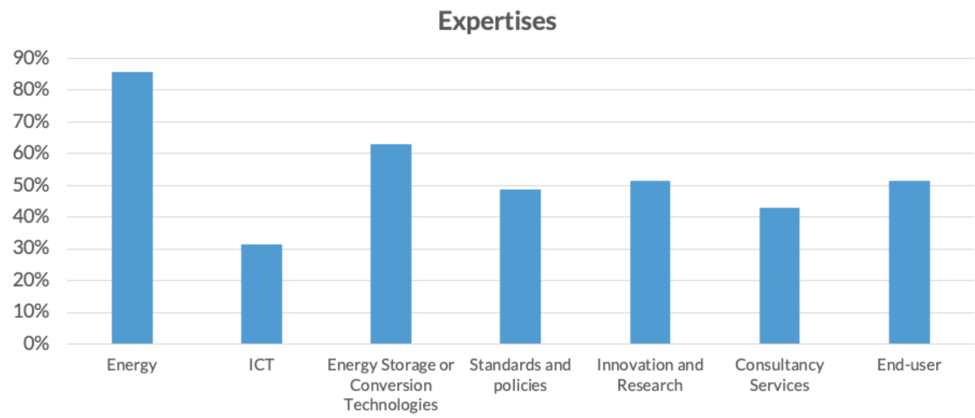

Figure 3- Expertise of the external stakeholders contact. Source: D2.1.

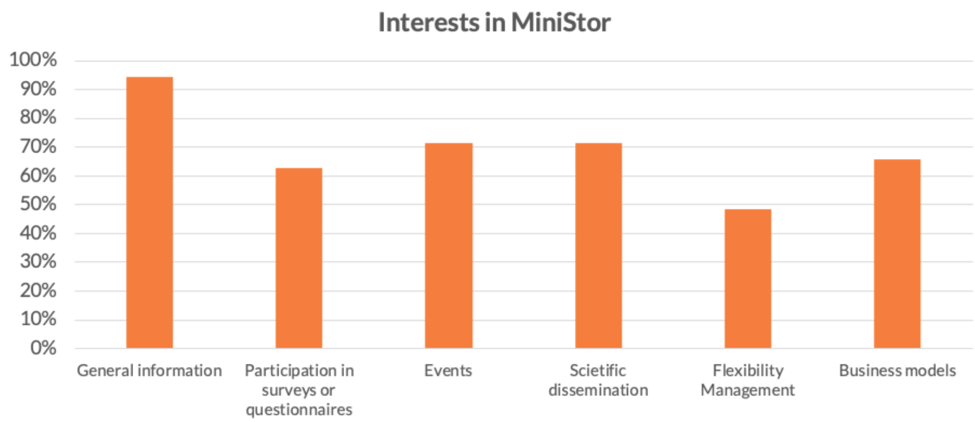

Figure 4-Interests in the MiniStor project. Source: D2.1.

2.5 Identification of external stakeholder's requirements

Outcomes from the survey were used in project activities as a guideline, in order to define effective strategies for successfully addressing pre-identified needs required for achieving the set targets. In addition to the needs analysed in the planned topics (Technology, Market, Business/Economical/Financial, and Environment), other issues were also identified, which relate to:

- Legislation and the institutional framework;
- Operation and design;
- Quality and strengths of the project.

Regarding the legislative and standardization framework, it was recognized that the MiniStor system must abide by the existing safety and operative regulations and standards of each country. Other by-laws and regulations, such as local planning requirements in countries where the system will be installed, must be considered before implementation and operation of the system. They affect its placement on site, its safety classification and operation.

However, most of the defining standards are directed for application in industrial facilities and have an indirect relationship to thermal energy storage due to commonality of components (e.g. reactive gases, use of cycling compressors, etc). Therefore, there is the necessity for a clearer framework that can be applied in the EU residential sector and that incorporates new technologies such as PCM and TCM materials.

For the electrical storage component, other issues regarding the institutional framework must be addressed since the system can generate electricity from PVT panels. Although electrical storage technology is relatively more mature when compared to thermal storage, market challenges remain. They involve the need for improved billing structures for the small electricity providers, as well as involving the DSOs to make the electrical storage component more attractive by allowing better prices to sell of excess energy to the grid. At the moment this is not possible in every EU country, which hinders the widespread incorporation of RES as electricity sources. An in-depth analysis is carried out in D2.3.

2.6 Creation of Tracker for Communication activities

In order to keep an updated document, a list with activities and contacts has been created for internal use. Each partner contributed to the creation of the list that can be found **in Annex I**, with their Relevant Stakeholders.

The list currently has more than 90 contacts from different countries: Ireland, Hungary, Spain, Italy, Austria, Greece, Poland, Netherlands, France, Germany, Belgium, Denmark and Finland. The consortium searched for all kinds of profiles that could be related or are interested in the project objectives.

The list includes Universities, Technological Institutes, Energy Consultancies, Research Bodies, Companies or Associations.

2.7 Promotional materials for outreach

In the context of WP8, D8.1 "First version of the communication and dissemination plan" details the efforts to maximize, and to extend as much as possible, the outreach of the project among the target group of stakeholders.

It has 4 processes: define a clear set of objectives and messages to be disseminated; identify and address the target stakeholder groups; identify and correctly use the best channels and tools at the correct timing; evaluate, report, analyse and adapt to the conditions at each given time. The following elements were developed in the context of D8.1 and are used in communications with stakeholders. They include:

- **MiniStor visual identity:** A homogeneous visual identity, developed by professionals in the area allows to promote stakeholder recognition, enhance credibility of the project´s actions and results, ensure quality and reliability of the project and inspire a sense of belonging to a group with shared interests. The tools designed and used to achieve excellence in the use of MiniStor brand consist of:
    - MiniStor project logo (used in conjunction with the EU emblem following the Grant guidelines).
    - MiniStor templates for use in project reports, stationery, etc.
    - Brochure and Poster.
    - Infographics.
    - Newsletters.
    - Social media accounts.
    - YouTube channel.

  Their contents are updated according to the technical advances of the project, and are designed for a wider audience but without oversimplifying.
- **MiniStor website:** The MiniStor website is accessible at https://ministor.eu/ and is the main communication tool to disseminate information related to the project. The MiniStor website is a single gateway to access available results. Stakeholders are directed to the website for further information and as a point of reference.

2.8 Promotion of the project at events and conferences related to standardisation

Project partners have attended different events and conferences that have helped to promote the project and provide networking in the area of standardisation. Outreach has been done with stakeholders that are usually involved in standardisation committees and decision-making bodies. The events are the following:

The 9th ECTP Conference (European Construction, built environment and energy efficient building Technology Platform)[1] 2-3 December 2021.

The ECTP gathers a very large number of European and associated countries organisations and companies in the fields of building research, construction, dissemination, standardisation, etc. It is usually involved with the EU in research partnerships such as "Built4People". Several members of the consortium are members of ECTP, such as IERC, EMI and FEUGA.

The 9th ECTP Conference was organised as a hybrid event, with physical attendance in Madrid, and with an online broadcast. Stakeholders from the whole construction value-chain and representatives of the European Commission shared their experience and outlined how the EU Construction Industry is at the heart of the Built Environment green and digital transitions.

MiniStor was also featured in the ECTP compilation of EeB PPP Project Review.

Sustainable Places 2021 - 9th edition 28th September to 1st October

The 9th annual edition of Sustainable Places (SP2021) was a hybrid event, hosted in Rome, Italy. It gathered more than 150 European projects representing €850 million in R&D and 1500 research performing organizations. Sustainability targets and climate change objectives cannot be met without addressing buildings and the built environment at the building, district and urban scale to include our transport and energy infrastructures. Renowned for showcasing results coming out of the EU Horizon 2020 Framework Programme via the participation of cutting-edge research and innovation projects, the scope of Sustainable Places is captured directly in its name. It involves designing, building and retrofitting the places we live and work in a more sustainable way.

Sustainable Places 2020-8th Edition 27-30 October

SP2020 explored sustainability themes such as: circular economy, digital twins, BIPV, local energy communities, sustainable digital infrastructure, and more. Sustainable Places prides itself on being an ideal platform for the dissemination of research, the conduct of workshops, EU project clustering and networking between stakeholders of all types. SP2020 was held over four days in digital event format. Between opening and closing keynote sessions, parallel technical sessions and project-organized workshops were held on conference topic areas.

IEA - Solar Heating and Cooling (SHC) Program, Task 60, PVT Systems 25 March 2020

On 25th March 2020, partner ENDEF attended the International Energy Agency (IEA) - Solar Heating and Cooling (SHC) Program, Task 60, PVT Systems.

This IEA Task focused on the application of PVT collectors with the aim to assess existing solutions and to develop new system solution principles in which the PVT technology really offers advantages over the

[1] http://www.ectp.org/index.php

classical "side by side installations" of solar thermal collectors and PV modules. Energy production, competitive cost, safety, and reliability of systems were in the scope of the Task.

CISBAT 2021 8-10 September

Focused on the built environment's transition to carbon neutrality, CISBAT 2021 offered a scientific platform for the presentation of research that pushes the boundaries of energy efficiency and renewable energy technologies. The conference united scientist from around the world in a hybrid event promoting interdisciplinary dialogue and a visionary approach to the shaping of our future buildings and districts.

CISBAT was organised by the Solar Energy and Building Physics Lab (LESO-PB) of the Swiss Federal Institute of Technology Lausanne (EPFL). Academic partners of the conference were renowned scientists from University of Cambridge and MIT as well as the Swiss chapter of the International Building Performance Simulation Association IBPSA, backed by a strong international scientific committee and a specialised pool of reviewers.

Galicia Innovation Days, 25 October 2021

Keynote speakers, Horizon Europe info days, inspirational ideas, round tables, project workshops and targeted meetings to learn from key European organizations and start collaborations with key partners to take the most of the new Horizon Europe Programme.

The match-making event brought together companies, researchers, universities, investors, consulting firms from different European countries and abroad. This was an excellent opportunity to hold bilateral meetings aimed at establishing new project agreements.

CONSTRUMA 2022 (6 April 2022) and Planet Budapest 2021 (3 December 2021)

These national events were attended by partner EMI, which is a notified body. The main advances of the project were presented in both events to national and EU industry.

2.9 Publications

Publications in journals and conferences, as well as inclusion of the project in the same, are a conventional and effective way to disseminate project outcomes and attract the attention of scientific, business and public stakeholders. These are summarized in the following table:

Title	Authors	Link
Researchers Engaging with the Community	Brian Casidy, Patricia Dino	https://www.interregeurope.eu/intensify/news/news-article/9957/researchers-engaging-with-the-community/
MiniStor: Creating Europe's Sustainable Future	Brian Casidy, Patricia Dino	https://www.interregeurope.eu/intensify/news/news-article/9974/ministor-creating-europe-s-sustainable-future/
MiniStor	Matolcsy Károly	Hungarian Building Engineering Coordination Association - offline
From consumer to prosumers	Alberto Belda	https://blog.cartif.com/en/de-consumidor-a-prosumidor/

MiniStor: The €8.6m Irish project to heat homes efficiently with salt and wax	Colm Gorey, from Silicon Republic	https://www.siliconrepublic.com/machines/homes-heating-salt-wax-ministor
MiniStor, un proyecto que investiga el almacenamiento de energía térmica para ahorrar hasta un 44% en calefacción	Eseficiencia	https://www.eseficiencia.es/2020/01/28/minister-proyecto-investiga-almacenamiento-energia-termica-ahorrar-44-calefaccion
MiniStor project	Build Up Editor	https://www.buildup.eu/en/explore/links/minister-project
Minimal Size Thermal and Electrical Energy Storage System for In-Situ Residential Installation	RHC-platform	https://www.rhc-platform.org/project/minimal-size-thermal-and-electrical-energy-storage-system-for-in-situ-residential-installation/
MiniStor (Minimal Size Thermal and Electrical Energy Storage System for In-Situ Residential Installation)	Cork city Council	http://www.corksmartgateway.ie/portfolio/minister-minimal-size-thermal-and-electrical-energy-storage-system-for-in-situ-residential-installation/
Horizon 2020 – MiniStor – supporting the development of clean and efficient energy	Enterprise Ireland	https://globalambition.ie/h2020-minister/
CERTH: Technology innovation in MiniStor	Thanasis Nesiadis, Zoi Boutopoulou	http://minister.eu/certh-technology-innovation-in-minister/
CNRS-PROMES: innovation for TCM energy storage	Driss Stitou	http://minister.eu/cnrs-promes-innovation-for-tcm-energy-storage/
Interview with Philipp Schütz from HSLU	Robert Gandía	http://minister.eu/interview-with-philipp-schutz-from-hslu/
IERC: collaborative research for sustainability	Carlos Ochoa	http://minister.eu/ierc-collaborative-research-for-sustainability/
2021 MiniStor Highlights	Andreea Leonte	http://minister.eu/2021-minister-highlights/
Yearbook of Building Engineering	Claudia Neira	https://minister.eu/minister-in-hungarian-yearbook-building-engineering/
MiniStor Project (2019 –2024)	Plataforma Tecnológica Española de Eficiencia Energética (PTE-EE)	https://static.pte-ee.org/media/files/documentacion/estudio-de-prospectiva-2030-2050-de-tecnologias-de-eficiencia-energetica-fSF.pdf
A new heating system based in salts and phase change materials that will save users money	ENDEF	https://endef.com/en/a-new-heating-system-based-in-salts-and-phase-change-materials-that-will-save-users-money/
2022 Brochure on Smart Buildings EU-funded Innovations	R2M Solution: Régis Decorme, Kathleen Quinn Steeves	https://smartbuilt4eu.eu/publications/
2021 EeB PPP Project Review - portfolio of 103 projects co-funded within the EeB PPP under the Horizon 2020 programme between 2014 and 2020	ECTP	http://ectp.ectp.org/cws/params/ectp/download_files/36D4584v1_EeB_PPP_Project_Review.pdf

Table 1- MiniStor publications and mentions used for outreach towards standardisation

2.10 Clustering and other activities

In addition to attending events and conferences, the consortium has carried out other types of activities as described in the table below:

Type of activity	Action developed	Link
Stakeholder Questionnaire	Questionnaire for stakeholders focussing on the design of the MiniStor system	http://ministor.eu/ministor-design-questionnaire/
Organization of a workshop and participation at the Sustainable Places Conference	90 minutes workshop to the objective target. Project involved: Heat-Insyde, HYBUILD, INTEGRIDDY	https://www.sustainableplaces.eu/home/sp20-workshops-events/sp20-integrated-storage-for-residential-buildings-workshop/
List of EU sister Projects on the MiniStor website	List of EU project regularly updated	http://ministor.eu/links/
Publications on Social Media (LinkedIn and Twitter)	Tweets and Post about highlighting other EU projects	MiniStor Social Media: https://www.linkedin.com/company/ministorh2020/ https://twitter.com/ministorh2020
Organization of a workshop with Renaissance project	Joint workshop with Renaissance project at Galicia Innovation Days	https://galicia-innovation-days-2021.b2match.io/agenda?session=c2Vzc2lvbjo5NjgxOQ%3D%3D&track_id=15754

Table 2- Other clustering and networking activities

2.11 Sister projects

MiniStor has also initiated networking activities with other research projects that have common relevant objectives. At the start of the project, an official request for collaboration was made to the lead partners of the relevant projects that were identified based on their published summary in the EU website CORDIS. This will help to recognise common challenges that have been found in the area of standardisation. The common networking will highlight the gaps that need to be addressed by standardisation bodies in potential future normatives related to thermal energy storage in general, and their use in the residential sector in particular.

Work experience and knowledge gained within similar projects will be a valuable tool to guide actions and enhance the expertise of the MiniStor project team. Due to the early stage of the project results, contacts have been at the initial stage. It is envisioned to organise both a specific round of 1:1 contacts between researchers in the projects, as well as a joint webinar for the second half of the MiniStor project to discuss standardization issues (identified barriers, analysis of EU legislation and in different countries, knowledge exchange, etc). The following is a list of sister projects which the consortium keeps in contact with:

Heat Insyde – Bringing Advanced Heat Batteries in Residential Heat and Electric Systems Closer to Market through Real Life Demonstration in Different Climates

Sustainable energy generation through solar panels or wind turbines has a major disadvantage: no energy is generated on a cloudy day or when it is not windy. Sometimes, more than needed energy is produced. The EU-funded HEAT-INSYDE project is addressing this through a ground-breaking compact heat battery. The prototype will use a thermochemical material to store renewable energy in an inexpensive and lossless way. It will be able to connect to various energy systems, such as the electricity grid and heat networks, as well as in heat pumps and solar panels. Offering an alternative

This project has received funding from the European Union´s Horizon 2020 research and innovation programme under the grant agreement No 869821

pathway for storing renewable energy, the new heat battery prototype delivers a new grid flexibility solution across the energy value chain.

HYBUILD – Innovative compact HYbrid electrical/thermal storage systems for low energy BUILDings

HYBUILD will develop two innovative hybrid storage concepts: one for the Mediterranean climate primarily meant for cooling energy provision, and one for the Continental climate primarily meant for heating and DHW production.
HYBUILD action is a systematic approach for developing operationally integrated thermal and electric components and systems from TRL4 to TRL6 and beyond. The hybrid storage concepts are based on: a compact sorption storage, based on a patented way to integrate an innovative adsorbent material within an efficient high surface heat exchanger, a high density latent storage, based on a high performance aluminum micro-channel heat exchanger with additional PCM layers, and an efficient electric storage.

PANTERA – European forum of Research & Innovation stakeholders active in the fields of smart grids, storage and local energy systems

PAN European Technology Energy Research Approach (PANTERA) is a EU H2020 project aimed at setting up a European forum composed of Research & Innovation stakeholders active in the fields of smart grids, storage and local energy systems, including policy makers, standardisation bodies and experts in both research and academia, representing the EU energy system.

COMSOS – validate and demonstrate fuel cell based combined heat and power solutions

ComSos – Commercial-scale SOFC systems – is an EU funded project aimed to validate and demonstrate fuel cell based combined heat and power solutions in the mid-sized power ranges of 10-12 kW, 20-25 kW, and 50-60 kW, referred to as Mini FC-CHP. The outcome gives proof of the superior advantages of such systems, underlying business models, and key benefits for the customer. The technology and product concepts, in the aforementioned power range, has been developed in Europe under supporting European frameworks such as the FCH-JU.

INTEGRIDY – Integrated Smart GRID Cross-Functional Solutions for Optimized Synergetic Energy Distribution, Utilization Storage Technologies (finalized in 2021)

inteGRIDy aims to integrate cutting-edge technologies, solutions and mechanisms in a Framework of replicable tools to connect existing energy networks with diverse stakeholders, facilitating optimal and dynamic operation of the Distribution Grid (DG), fostering the stability and coordination of distributed energy resources and enabling collaborative storage schemes within an increasing share of renewables. inteGRIDy follows a pilot-driven approach as its overall goal concentrates on the fulfilment of actual need and requirements. A set of innovative methods/mechanism integration will be targeted by inteGRIDy activities that will results to exploitable products with a high commercialization potential.

3 Activities regarding analysis of relevant legislation and standards for system operation

Since the final TRL of the project is 7, the consortium aims to produce and demonstrate the operation of a system that can obtain in the future the CE marking, which will allow its commercialization throughout the EU. To obtain this marking, the product must comply with a series of European legislation and standards. These standards also form the core of the discussion to be held with stakeholders and standardisation bodies regarding their applicability to residential thermal storage.

D2.3 "Analysis of relevant legislation and standards for system operation" identifies the relevant standards and legislation applicable to the design and operation of the system. If improperly assessed, they can become a regulatory barrier for full application of the system. This section provides a brief summary of the assessment done for that Deliverable.

3.1 Review of European Directives applicable to MiniStor

The analysis of the Directives and their resulting standards is done due to the definition of the CE Marking. According to the European Commission, the letters ´CE´ "signify that products sold in the EEA have been assessed to meet high safety, health, and environmental protection requirements"[2].

It must be noted that not all products sold in the EU need to be CE-marked, but a manufacturer can only place a product on the EU market after meeting all the applicable requirements. Certain products are subject to several EU requirements, since the same product can present different risks that are dealt with in different directives. If a product is within the scope of one or more directives, it must comply with the set of essential requirements that apply to it before being placed on the market. A unique marking will be necessary to certify the conformity of the product with the directives that apply to it.

The conformity assessment leads to a "declaration of conformity", which needs to satisfy the following:

- The conformity of a product is assessed before it is placed on the market. The assessment is carried out by the manufacturer of the product. The legislation of the procedure includes if an assessment must be carried out by someone different than the manufacturer.
- It needs to demonstrate that all legislative requirements are met.
- It includes testing, inspection and certification. This is carried out by a notified body. All notified bodies in the EU have the same standing.
- The procedure for each product is specified in the applicable product legislation

The New Approach Directives are those that legislate the requirement for a CE marking. Those provisions revoke national provisions that contradict them. They are addressed to the Member States that have the obligation to transpose them into their national legislation. Directives do not include a list of products to which they apply, so it is needed to consult each directive to see if it applies in full or in part to the product to be commercialized.

As mentioned previously, a harmonised standard is a European standard developed by a recognised European Standards Organisation: CEN, CENELEC, or ETSI. It is created following a request from the European Commission to one of these organisations. Manufacturers, other economic operators, or conformity assessment bodies can use harmonised standards to demonstrate that products, services, or processes comply with relevant EU legislation. The references of harmonised standards must be published in the Official Journal of the European Union. The use of these standards remains voluntary and the manufacturers are free to choose another technical solution to demonstrate compliance with the mandatory legal requirements.

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[2]https://ec.europa.eu/growth/single-market/ce-marking_en

In D2.3, an analysis was made of the directives applicable to the project. The standards that can be considered applicable, due to the characteristics of the system, and that must be taken into account as conditioning factors in the development of the components, are contained in the directives shown below:

1. Construction products - Regulation (EU) Nº 305/2011.
2. Ecodesign of energy related products - Directive 2009/125/EC.
3. Electromagnetic compatibility – Directive 2014/30/EU.
4. Equipment and protective systems intended for use in potentially explosive atmospheres – Directive 2014/34/EU.
5. Low voltage – Directive 2014/35/EU.
6. Machinery – Directive 2006/42/EC.
7. Pressure equipment – Directive 2014/68/EU.
8. Restriction of Hazardous Substances in Electrical and Electronic Equipment – Directive 2011/65/UE.
9. Simple pressure vessels – Directive 2014/29/EU.

These directives mandate different harmonised standards that apply to the safe design and operation of the system. D2.3 and D2.5 provide an exhaustive analysis of them. One of the most significant ones for system design and operation, however, is EN 378 which deals with refrigerating systems and heat pumps. Part 1 of the standard defines the amount that is allowed according to the refrigerant (gas) being used in the system and its components. According to EN 378MiniStor is classified as a double indirect system. Following the calculations in the standard using the refrigerant ammonia, resulted in a system that needs to be placed outdoors in a dedicated enclosure. The standard also defines the safety equipment that is needed to operate the system.

The analysis has revealed that standards are directed primarily towards industrial refrigeration systems both in the scope and safety measures. MiniStor is a residential thermal storage that provides backup to the existing heating system. This type of category is still lacking in the standards, and needs to be defined from several other ones according to individual components.

A second layer of examination was done at the level of local legislation in the demonstration countries. It defines how the system is considered for planning permits or authorization by local bodies. For example, in Ireland, the research nature of the project makes it to be defined by its Health and Safety Authority as a “workplace” for the duration of the project. This definition dictates who can enter the space, type of labelling required, and what type of protective gear should be worn.

This second layer of examination provides insights on the relationships that both standards and local legislation have between themselves, which is not always straightforward due to the interpretations of the standards and the application of local laws for operation of refrigeration systems (which is the closest category to thermal storage).

4 Product Audit Program

A product audit checks the quality of the product or service to determine whether it meets the specifications or needs of the customer. Thus, specifications, customer requirements and customer complaints are the focus of the auditor's attention. This approach will be necessary to document the conformance of the MiniStor system to the required standards. Due to the novelty of thermal storage within the standards, such product audit needs to be proposed for discussion with standardisation bodies.

The "Product Audit Program" (PAP) is a set of activities that allow certifying, on a voluntary basis, certain characteristics of a product such as: product properties, tests done, and regulations used as reference. The PAP will serve as proof of the product characteristics, with the aim to increase its marketability. Of interest for the consortium are features related to performance, safety, efficiency, etc. These characteristics, as well as the control over them, is agreed beforehand by the consortium, in order to put the focus on the most relevant specifications of the product. This involves making the following questions that can be demonstrated using the PAP:

- What are the best qualities of the MiniStor product?
- What characteristics make the MiniStor product stand out from other similar ones?

The final list of specifications that are wished to be certified is detailed through a document including all the pertinent specifications and tests. The process of evaluating a product within the PAP consists of different phases:

a) Phase 1. Initial period

This includes:

- Definition of the characteristics to be certified: At first, the characteristics and technical conditions of the product to be certified must be stipulated. In this way, consensus is generated on the decision-making scope of the PAP. Likewise, the control to be carried out on the characteristics of the product is defined, providing:

- Product properties
- Tests that must be passed
- Normative (or part of it) of reference to use
- In case of lacking regulations, a self-reference must be defined.

- Production Verification: An assurance of the quality of the production will be carried out by implementing the pertinent tests. These will depend in each case on the Quality System used by the client.

- Inspection: A process inspection will be carried out, supervising the performance of on-site product tests.

- Sampling: Sampling will be carried out in the manufacturer's production process, in order to obtain the stability of the process with a good degree of reliability.

- Tests: Of the mentioned product samples taken, tests will be carried out in accredited external laboratories as required in each case.

- Audit reports: With the results of the aforementioned tests, the audit reports will be prepared that will make it possible to discern if the company meets the level of compliance and therefore if it is a beneficiary of the seal and registration number.

Depending on the product, not all the steps are always necessary. However, in general to be able to start with the first phase it is necessary to have a completely finished product that can be inspected, tested and sampled.

b) Phase 2. Obtaining the PAP

If compliance is met, a certificate will be issued. This certificate will include:

- Name of the organization that owns the product
- Product name
- General mention of the certified characteristic(s)
- Documentary control: certificating body, date, edition, etc.

In addition to the Certificate, a relevant logo will be generated with the unique Registration number associated with the PAP. The Participant may use the logo in accordance with the certification body trademark rules of use, and may publish said certificate on its website as long as the PAP is current. In parallel, the Participant will be included in the certification body database, where the description of the certification granted will be displayed.

c) Phase 3. Continuity

The validity of the "Product Audit Program" is initially 3 years, as long as the beneficiary passes the annual follow-ups satisfactorily. The periodicity of follow-ups are stipulated in the PAP document, the minimum required being 1 annual visit. After 3 years the product needs to be re-certified. In case of not obtaining a satisfactory result in any inspection, the granted PAP will be withdrawn.

The benefits of the PAP certification

The main benefits of providing a Product Audit Program certification are the following:

- Differentiation of the product from competitors
- Increase control over the production chain
- Promotion of specific qualities of the product to the market
- Increase in brand reputation and product quality
- Add value to a product

5 Planning of preliminary performance test

The preliminary performance test is an important component for both certifying system efficiency and to discuss with other standardisation bodies about how energy storage systems should be evaluated. Partner ÉMI (a notified body) is responsible for carrying out the preliminary performance tests on the prototype as stated in Task 6.2. A draft version is described in this section. The purpose of the tests is to control the main design performance values and compare them to the calculated values. The main design performance values reflect if the system will perform in ideal conditions and fulfil the initial requirements as set in the proposal call. These performance values will include the electrical power used by MiniStor, and the achieved heating and cooling performance for thermal storage.

5.1 Description of the test setup

The parts of the test and their modes are referred in capital letters in order to present them in a logical step matrix. The connection diagram in Figure 5 shows a schematic draft of the testing facility located at the ÉMI laboratories in Szentendre, Hungary. Figure 6 shows how this testing facility looks like.

The prototype will be placed within a **CLIMATE CHAMBER,** where EMI is able to reproduce several types of comfort and weather conditions. In the produced comfort conditions, the temperature of the boundary walls can be modified, as well as the supply air and the room air. By modifying the environmental parameters, different outdoor temperature conditions are created corresponding to each season of the year. Trying to meet comfort conditions will produce a response from the prototype. The space parameters (geometric, mechanical electrical, etc.) are compiled according to the values provided by the consortium:

- Total calculated electric current consumption of the prototype: 6212 [W].
- Approximate Dimensions: 2.44x2.99x ~ 2.5 [m].

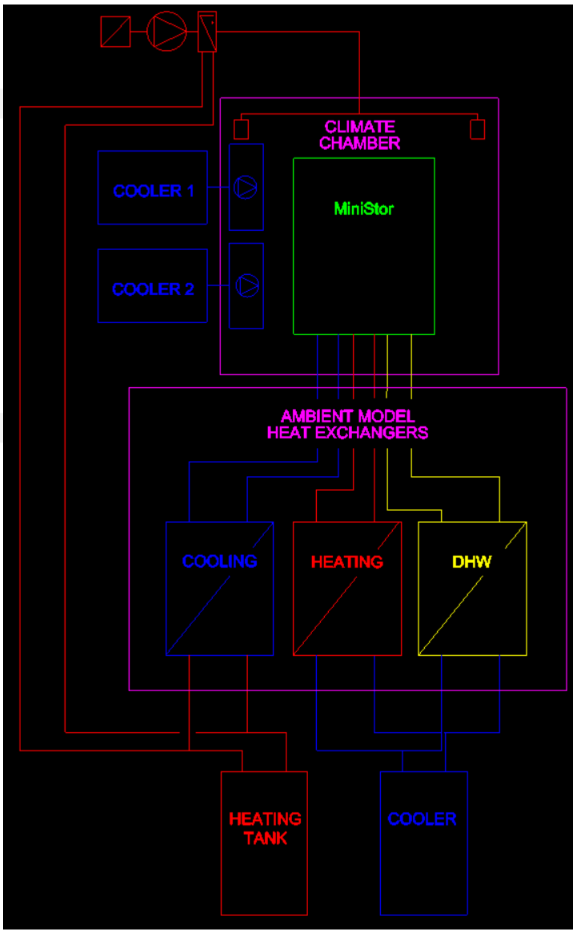

Figure 5-Connection Diagram of the climate chamber at EMI

Inputs for testing:

A water-to-water heat exchanger will be connected to the cooling, heating and domestic hot water outputs of MiniStor. (CLIMATE HEAT EXCHANGERS).

The primary side of the heat exchangers is supplied with positive heat or cold output from MiniStor, and the secondary side is set to a negative value of the heat or cold quantities declared by the design calculations as a deficiency. (See test's operating matrix). Thermodynamically, in this model the prototype must be able to produce the amount of heat or cold declared in the calculations.

On the secondary side of the heat exchanger, the climate chamber at EMI can produce positive or negative heat quantities according to the given winter, transient and summer operating conditions. Figure 5 shows the hydraulic circuits that supply the room. These circuits are used to set the negative value of the heat quantities declared by the prototype calculations.

This space will be simulating outdoor temperature conditions (WINTER, AUTUMN-SPRING and SUMMER). The climate chamber's winter is designed to be produced with inverter chillers (COOLER 1, COOLER 2 with cold store technology, modelling WINTER). The summer conditions are produced by heating the supply air (modelling SUMMER).

The model of the residential building served by MiniStor is defined as AMBIENT MODEL HEAT EXCHANGERS. The inverse of the heat quantity for each operating condition (WINTER, AUTUMN-SPRING and SUMMER) is generated on the secondary side of the heat exchangers. The primary side heat is provided by the MiniStor prototype.

5.2 Description of the tests

The performance values are measured by simulating in the chamber different operative and extreme outdoor climate conditions as expected in real circumstances (the system is exposed to winter, autumn-spring and summer environments). The parameters for the extreme operating conditions are also based on the data provided by the consortium. The test is based on the technical data for thermal performance of a typical family house in Hungary, since it is the location of the EMI test. Factors considered in determining the typology of the single-family house in Hungary are the following:

- Climatic conditions, meteorological average sunny hours, average outdoor temperatures according to the seasons.
- Solar radiation conditions and outdoor temperatures taken into account when designing the new building.
- Building structure of the house, including materials and thermal insulation.
- The age of its heating system.
- The age of the control system.

Thermal parameters of the modelled average family house:

- Heat demand: 10 [kW].
- Cooling heat loss / heat gain: 10 [kW].
- DHW consumption 150 [litres / day] (2x75 litres morning and evening) at about 60 ° C ~ 2 [kW].

During our foreseen measurements, it is planned to change the temperature in the surroundings of the prototype (inside the CLIMATE CHAMBER) and the heat requirements in the residential building supplied by the prototype (CLIMATE HEAT EXCHANGERS).

The operating matrix of the test is as follows:

Operating condition: WINTER

- CLIMATE CHAMBER= COOLING
  - COOLER 1; COOLER 2 = ON
  - AIR HEATING = OFF
- CLIMATE HEAT EXCHANGERS:
  - COOLING HEAT EXCHANGERS: OFF
  - HEATING HEAT EXCHANGERS: ON
    - primary (MiniStor) = HEAT (+)10 [kW]
    - secondary (COOLER) = COOLING (-)10 [kW]

  - DHW HEAT EXCHANGERS: ON
    - primary (MiniStor) = HEAT (2x75 liter °60C ~ (+)2 [kW]
    - secondary (COOLER) = COOLING (-)2 [kW]

Operating condition: SUMMER

- CLIMATE CHAMBER= HEATING
  - COOLER 1; COOLER 2 = OFF
  - AIR HEATING = ON
- CLIMATE HEAT ECHANGERS:
  - COOLING HEAT EXCHANGERS: ON
    - primary (MiniStor) = COOLING (-)10 [kW]
    - secondary (COOLER) = HEAT (+)10 [kW]
  - HEATING HEAT EXCHANGERS: OFF
  - DHW HEAT EXCHANGERS: ON
    - primary (MiniStor) = HEAT (2x75 liter °60C ~ (+)2 [kW]
    - secondary (COOLER) = COOLING (-)2 [kW]

Operating condition: AUTUMN – SPRING: (cyclically changing operating conditions)

- CLIMATE CHAMBER= HEATING (DAY) – COOLING (NIGHT)
  - COOLER 1; COOLER 2 = OFF (DAY) ON (NIGHT)
  - AIR HEATING = ON (DAY) OFF (NIGHT)
- CLIMATE HEAT ECHANGERS:
  - COOLING HEAT EXCHANGERS: ON (DAY) OFF (NIGHT)
    - primary (MiniStor) = COOLING (-)10 [kW]
    - secondary (COOLER) = HEAT (+)10 [kW]
  - HEATING HEAT EXCHANGERS: OFF (DAY) ON (NIGHT)
    - primary (MiniStor) = COOLING (+)10 [kW]
    - secondary (COOLER) = HEAT (-)10 [kW]
  - DHW HEAT EXCHANGERS: ON (DAY-NIGHT)
    - primary (MiniStor) = HEAT (2x75 liter °60C ~ (+)2 [kW]
    - secondary (COOLER) = COOLING (-)2 [kW]

5.3 Measurement and Test processes

In winter mode, the negative value of the heating output is set as declared by the design calculations to the secondary side of the heat exchanger in the heating circuit. A negative heat output value is also set for the secondary side of the domestic hot water extraction heat exchanger, based on the design calculations' data. The cooling heat output does not operate in winter mode, no heat output values are set here.

The ambient air temperature of the prototype corresponding to the winter condition is also set according to the design calculations' data. In the event of a steady state, the electrical power used by the prototype is measured, the heat output of the delivered heating and domestic hot water at an ambient temperature corresponding to the winter state.

In summer mode, the positive value of the cooling heat output is set as declared by the design calculations' data to the secondary side of the heat exchanger in the cooling circuit. A negative heat output value is also set for the secondary side of the domestic hot water extraction heat exchanger based on the calculations for the prototype. The heating heat output does not operate in summer mode, no heat output values are set here.

The ambient air temperature of the MiniStor corresponding to the summer condition is also set according to the design calculations' data. In the event of a steady state, the electrical power used by the prototype is measured, the heat output of the cooling and domestic hot water delivered at an ambient temperature corresponding to the summer state.

In the case of the transient weather condition, a negative value of the heating-cooling heat output is set according to that declared by the design calculations' data of the secondary side of the heat exchanger in the heating-cooling circuit. In this case, assuming an extreme state, the cooling and heating demand are modelled alternately. We consider the practical extreme case of heating minimally in the evening and cooling minimally during the day.

A negative heat output value is set for the secondary side of the domestic hot water extraction modelling heat exchanger based on the design calculations' data. The ambient temperature of the prototype is also set according to design calculations' data. In the event of a steady state, we measure the electrical power used by the prototype, the heat output of the heating-cooling and domestic hot water delivered at an ambient temperature corresponding to a transient state.

The measurement data

Each data based on the design calculations of the prototype are measured with two instruments operating on different principles. The electrical power used by the prototype is measured using a manual instrument and a built-in electric meter. The heating, cooling and domestic hot water heat outputs delivered by the prototype are measured by a sealed heat meter, and by a "TA-SCOPE" measuring device by manufacturer IMI[3], integrated into the primary circuits of each system. The ambient temperature of the prototype will be measured by a mercury laboratory thermometer and a digital thermocouple thermometer.

Figure 6-Hydraulic connection of the testing facility (EMI labs Sopron Hungary). Source: EMI

Emergency ventilation:

Due to the presence of the ammonia reservoir, the internal space where the prototype is placed (CLIMATE CHAMBER) must be equipped with appropriate safety devices. Signalling and emergency ventilation are required to prevent damage from a possible leakage of the ammonia reservoir during testing. The space is equipped with the following additional safety elements:

- 1x1 [m] explosion-proof surface on the wall of the (CLIMATE CHAMBER) space (explosive surface).

[3] https://www2.imi-hydronic.com/products-solutions/balancing-and-control/2010/1/TA-SCOPE/

- Ammonia gas sensors placed on the inner wall of the space (CLIMATE CHAMBER).

If a gas sensor goes off the following events occur:

- light and sound signal
- power switch off to the chamber (except emergency ventilation)
- emergency ventilation starts (operates until a positive signal of the gas sensor is obtained)

The emergency ventilation is a separate system in the test room (CLIMATE CHAMBER). The emergency fan must remove any leaked ammonia from the internal space through a suction air duct. A section of the duct for emergency ventilation and the extraction heads are located in the (CLIMATE CHAMBER) space, with the exhaust being placed at a safe distance outdoors. The emergency ventilation fan is located outside which ensures that no harmful substances escape from the air duct into the inside section of the hall.

Operating principle of emergency ventilation: During operation it creates depression in the (CLIMATE CHAMBER) internal space, and fresh air flows into internal space through ventilation dampers that open automatically. The design of the fan must be explosion-proof.

Testing conditions simulating monthly environments

The system will be tested according to typical meteorological and extreme conditions for the months of the year. The performance of each component (TCM, PCM, heat pump, solar field) will be recorded. This strategy will be defined in full for T6.2.

6 Next steps to promote standardization and contact with relevant stakeholders

6.1 Difficulties found

During the first period covered by this report, the main difficulties faced when establishing the first contacts with stakeholders consisted in little or no initial response due to the early stage of the project, when system components were still being defined. They also included the restrictions imposed by the Covid-19 emergency situation, which hampered participation in person on different events that could have been used towards networking, and in some cases, led to their cancellation.

As an alternative, online events were sought, giving rise to hybrid events and the creation of unexpected networks, and this is how the consortium have been acting in the last stage prior to this Deliverable. A register of future events to attend has been created in T8.3, where the different partners of the Consortium will be able to promote the project and its results, providing evidence towards the conversations to be held with standardisation bodies.

At the same time, during work carried out for D2.3, it was seen that every country has its own regulatory system not only related to standards but also to legislation. This influences development of the research subject through the involvement of aspects such as the requirements to operate the system in certain countries. Regulations for planning permissions might have a different path to that of harmonisation with international standards, as they can be unrelated or respond to other aspects of legislation. To have an improved view of the situation, the stakeholders were contacted, who are specialist colleagues in this topic around Europe. The stakeholders' contacts can be found in Annex I. The demonstration sites also conducted their own search and feedback about national / local regulations in their respective countries. They researched on the hierarchy of regulations and the possible barriers that can be encountered when implementing the project.

Another challenge found is that the development of high capacity thermal storage for residential use is still carried out by a relatively small number of companies worldwide, when compared to established thermal systems such as water tanks. Even fewer companies have developed commercial systems that use thermochemical storage. Research projects such as this one advance the subject and help to identify standardisation gaps and opportunities that can help grow the market.

6.2 Next steps for activities towards standardization and contact with relevant stakeholders

In line with the objectives of T8.3, and the expected final Technical Readiness Level (TRL) of the prototype, results achieved by the project will be promoted with standardisation bodies and other relevant stakeholders to facilitate future acceptance and market introduction of the system.

Immediate next steps for the second half of the project include contacts and collaboration with relevant technical standardisation committees within bodies such as CEN, CENELEC, ETSI or ISO. At this stage in time, system design of the MiniStor prototype has advanced. A comprehensive analysis of standards and definition of requirements has been performed. Both elements allow specific discussions with stakeholders and standardisation committees.

System features will be promoted through the Product Audit Program approach. The PAP will be followed on those components that are novel (i.e. not off-the-shelf) and that are key for the prototype to function. These include, for example, the TCM reactor, which uses the high capacity thermal storage material.

A roadmap towards standardization of thermal storage systems for residential use will be provided. All partners will be invited to collaborate in this task, contributing to the future commercialization efforts of the system. The steps to be followed will be done by answering the following questions:

- What outcomes are relevant to be brought to standardization? The PAP will be used to answer this part. For that, SGS and EMI will design questionnaires to be distributed to the partners. A Consortium-wide meeting will be held to discuss the outcomes to be standardised.

- Does a standard exist? The consortium must make sure that the system in its essence is not covered by one or several standards, since it must be something new. At the moment, standards such as EN 378, geared for refrigeration and air conditioning, have been identified as relevant through approximation of components and reactive gas.

- Does a Technical Committee (TC) exist on the subject in Europe but also internationally? If they exist, project representation should be suggested for participation in technical committees (TC), subcommittees (SC) and working groups in CEN/CELENEC, ETSI, ISO or IEC. If they do not exist, suggestions should be made to these bodies for the creation of TCs and SCs for residential thermal storage.

- Is a Workshop Agreement a suitable approach? A CEN Workshop Agreement (CWA) is a document agreed by the participants of a CEN Workshop, which is designed to meet an immediate need and form the basis for future standardisation activity.

- How? Using dissemination materials developed in WP8 and templates and guidelines in T8.3, partners will be invited to contact National Bodies of Standardisation in their respective countries with the assistance of EMI and SGS for the initial contact. The objective is to know if there are national standardization procedures that are different from those established by bodies such as CEN and ISO. It also helps to build networking contacts for the consensus building towards residential thermal storage activities.

- When? These activities will be developed during the second half of the project until its end.

One of the main features to be highlighted from these activities, is that standardisation is an external activity based on consensus with other stakeholders outside the consortium. The activities are designed to build this consensus through generating interest in project activities. In this way, traction is gained towards future development of standards that are specific to the system principles of thermal energy storage that also includes electrical storage.

7 Conclusions

Future commercialization of the system will be facilitated through compliance with current standards and the development of future ones, which reflect better the principles of the system as a combined thermal and electrical energy storage. Technical developments that necessitate the new standards involve heat storage materials such as thermochemical compounds with high thermal output. In the case of MiniStor, media such as ammonia is used to trigger a reversible reaction avoiding corrosion of the containing vessel. Although ammonia is part of the "natural refrigerants" that will replace hydrofluorocarbons (HFCs) as expressed through regulation (EU) No 517/2014, updated regulations and standards are needed in order to make this viable.

Initial activities towards standardisation and other relevant bodies included analysis of relevant legislation and norms. It has been found that, except for France, there is no uniform national legislation in the Member States based on the type and size of the ammonia system. Standard EN-378 is the most influential standard for the design of MiniStor. However, although it has been approved and is valid for all the European Union, it still needs specific transposition to the national level of standards of each Member State.

This reflects the fact that there is a lack of standards and directives specifically related to thermal energy storage systems. An additional gap identified is that standards and risk mitigation measures have in mind primarily industrial applications, which contrast with residential requirements. State-of-the-art manufacturing and operation measures for these storage systems are incorporated in the design and application of novel systems, but are not always reflected in the standards.

To address these gaps, several activities have been carried out to promote the project and to establish initial contacts with interested stakeholders. Relevant bodies and stakeholders for standardisation at the European and global level have been identified. This is an important step in order to build momentum and future consensus that will evolve into the establishment of a standard for thermal storage systems in residential settings. Dissemination activities carried out by the consortium partners have also been used to promote the project through outreach of its objectives and results.

Specific steps such as definition of the system performance tests and the proposed Product Audit Program will serve to initiate direct conversations with the national, regional and global standardisation bodies to present the challenges and solutions that have been developed towards testing, which can be used for future certification such as obtaining the CE mark. The activities become part of the wider roadmap for the strategy that is also presented.

This document is a living document, which will be updated at the end of the project as D8.5 "Final version of MiniStor promotional activities towards standardization and other relevant bodies", showing the evolution and the results of the activities carried out in T8.3.

8 Annexes

8.1 Annex I: Stakeholders list

	Organization	Country	Type	Contact Name
1	Energy Cork	Ireland	Representative body	Kieran Lettice
2	Irish Green Building Council	Ireland	Association	Pat Barry
3	Contract Research Unit, IT sligo	Ireland	RTO	Stevie Donnelly
4	Construction Industry Federation	Ireland	Representative body	Aidan Mangan
5	Budapest District Heating Co	Hungary	LE	Tibor Orban
6	Energy Consulting Kft	Hungary	SME	Géza Matuz
7	AERECO	Hungary	LE	Tamás Király
8	Technical University of Budapest	Hungary	University	Norbert Harmanthy PhD
9	EndeF	Spain	SME	Isabel Guedea
10	University of Pisa	Italy	University	Aldo Bischi
11	Austrian Institute of Technology	Austria	University	Zauet Chritoph
12	MIDAC	Italy	LE	Matteo Cavalletti
13	HORBER Kft.	Hungary	SME	Sarolta Horváth PhD
14	VESTA Energie	Italy	SME	Paolo Marchini
15	GBC Spain	Spain	Association	Raquel Diaz
16	GBC Spain	Spain	Association	Emilio Miguel Mitre
17	Instituto Tecnológico de Galicia	Spain	RTO	Félix Rodríguez
18	Instituto Tecnológico de Galicia	Spain	RTO	Javier Torralba
19	La Asociación de Empresas de Eficiencia Energética	Spain	Association	Antonio López-Nava Gerente
20	La Asociación de Empresas de Eficiencia Energética	Spain	Association	Penélope López
21	E.T.S.I. Aeronàutica y del Espacio	Spain	Association	Cristobal Jose G. Castillo
22	INSTITUTO TECNOLÓGICO DE LA ENERGÍA	Spain	RTO	Marta García Pellicer
23	ENERGETIA S.L	Spain	SME	Ignacio Pérez del Pozo
24	VEOLIA España	Spain	LE	Javier Martín
25	RINA-C	Italy	LE	Francesco Peccianti
26	VIVA	Spain	Representative body	C. Ovadonga
27	VIVA	Spain	Representative body	Domingo González
28	VISESA	Spain	Representative body	David Grisaleña
29	VISESA	Spain	Representative body	Alberto Ortiz
30	Hellenic Passive House Institute	Greece	Association	Stefan Pallantzas
31	Hellenic Passive House Institute	Greece	Association	Dimitris Pallantzas
32	Greenstruct	Greece	SME	Eleftherios Filios
33	NAPE	Poland	SME	Katarzyna Rajkiewicz

34	InHolland	Netherlands	LE	Petra Bijvoet
35	Neotec	Austria	SME	Werner Pink
36	Heat Insyde	n/a	Project	
37	HYBUILD	n/a	Project	
38	NOVICE	n/a	Project	
39	Superhomes	n/a	Project	
40	PANTERA	n/a	Project	
41	COSMOS	n/a	Project	
42	SPIRE 2	n/a	Project	
43	INTEGRIDY	n/a	Project	
44	Heat4Cool	n/a	Project	
45	STOREF	n/a	Project	
46	OptSais	n/a	Project	
47	Sensopt	n/a	Project	
48	Latent cold storage backup	n/a	Project	
49	Heat pump & thermal storage unit	n/a	Project	
50	Novel Services for Heat Pumps	n/a	Project	
51	InDeal	n/a	Project	
52	LowUP	n/a	Project	
53	SunHorizon	n/a	Project	
54	Integrated RES actions in Greneva	n/a	Project	
55	IRIS	n/a	Project	
56	ENERGEIA	n/a	Project	
57	PLUG-N-HARVEST	n/a	Project	
58	BRESAER	n/a	Project	
59	RECO2ST	n/a	Project	
60	REUNI	n/a	Project	
61	ELIH-MED	n/a	Project	
62	Community Grid	n/a	Project	
63	CENTS Project	n/a	Project	
64	SMILE	n/a	Project	
65	QualyGridS	n/a	Project	
66	M-Benefits	n/a	Project	
67	MUSEGrids	n/a	Project	
68	Smart analytics for communities	n/a	Project	
69	Eco-shopping	n/a	Project	
70	AMADEUS	n/a	Project	
71	CREATE	n/a	Project	
72	BuildHeat	n/a	Project	
73	EASE - European Association for Storage of Energy	Belgium	Association	
74	UIPI - International Union of Property Owners	Belgium	Association	
75	BPIE - Buildings Performance Institute EU	Belgium	Think Tank	
76	SO WHAT	n/a	Project	
77	Housing Executive	Northern Ireland	Representative body	Andrew Frew
78	SGS	France	LE	Christophe Poisson
79	SGS	Hungary	LE	Julia Csizmadia

80	SGS	Germany	LE	Andreas Sondergeld
81	SGS	Belgium	LE	Bob Van Doorsselaere
82	SGS	Denmark	LE	Camila Obling
83	SGS	Finland	LE	Jani Malin
84	SGS	Germany	LE	Christin Struck
85	SGS	Greece	LE	Vicky Liatsou
86	SGS	France	LE	Paul Chayeb
87	SGS	France	LE	Audrey Piechocki
88	SGS	Greece	LE	Ersi Zacharopoulou
89	Université de Perpignan	France	University	Driss Stitou
90	Renaissance	n/a	Project	
91	Compile	n/a	Project	

8.2 Annex II: Members of CEN

Acronym	Country	Organization	Website
ASI	Austria	Austrian Standards International - Standardization and Innovation	www.austrian-standards.at
NBN	Belgium	Bureau de Normalisation/Bureau voor Normalisatie	www.nbn.be
BDS	Bulgaria	Bulgarian Institute for Standardization	www.bds-bg.org
HZN	Croatia	Croatian Standards Institute	www.hzn.hr
CYS	Cyprus	Cyprus Organization for Standardisation	www.cys.org.cy
UNMZ	Czech Republic	Czech Office for Standards, Metrology and Testing	www.unmz.cz
DS	Denmark	Dansk Standard	www.ds.dk
EVS	Estonia	Non-profit Association Estonian Centre for Standardisation and Accreditation	www.evs.ee
SFS	Finland	Suomen Standardisoimisliitto r.y.	www.sfs.fi
AFNOR	France	Association Française de Normalisation	www.afnor.org
DIN	Germany	Deutsches Institut für Normung	www.din.de
NQIS/ELOT	Greece	National Quality Infrastructure System	www.elot.gr
MSZT	Hungary	Hungarian Standards Institution	www.mszt.hu
IST	Iceland	Icelandic Standards	www.stadlar.is
NSAI	Ireland	National Standards Authority of Ireland	www.nsai.ie
UNI	Italy	Ente Italiano di Normazione	www.uni.com
LVS	Latvia	Latvian Standard Ltd.	www.lvs.lv
LST	Lithuania	Lithuanian Standards Board	www.lsd.lt
ILNAS	Luxembourg	Organisme Luxembourgeois de Normalisation	www.portail-qualite.lu
MCCAA	Malta	The Malta Competition and Consumer Affairs Authority	www.mccaa.org.mt
NEN	Netherlands	Nederlands Normalisatie-instituut	www.nen.nl
SN	Norway	Standards Norway	www.standard.no/
PKN	Poland	Polish Committee for Standardization	www.pkn.pl
IPQ	Portugal	Instituto Português da Qualidade	http://www1.ipq.pt/

ISRSM	Republic of North Macedonia	Standardization Institute of the Republic of North Macedonia	http://www.isrsm.gov.mk/en
ASRO	Romania	Romanian Standards Association	www.asro.ro
ISS	Serbia	Institute for Standardization of Serbia	www.iss.rs
UNMS SR	Slovakia	Slovak Office of Standards Metrology and Testing	www.unms.sk
SIST	Slovenia	Slovenian Institute for Standardization	www.sist.si
UNE	Spain	Asociación Española de Normalización	www.une.org
SIS	Sweden	Swedish Institute for Standards - SIS	www.sis.se
SNV	Switzerland	Schweizerische Normen-Vereinigung	www.snv.ch

8.3 Annex III: Members of CENELEC

Acronym	Country	Organization	Website
OVE	Austria	Austrian Electrotechnical Association	www.ove.at
CEB-BEC	Belgium	Comité Electrotechnique Belge/Belgisch Elektrotechnisch Comité	www.ceb-bec.be
BDS	Bulgaria	Bulgarian Institute for Standardization	www.bds-bg.org
HZN	Croatia	Croatian Standards Institute	www.hzn.hr
CYS	Cyprus	Cyprus Organization for Standardisation	www.cys.org.cy
UNMZ	Czech Republic	Czech Office for Standards, Metrology and Testing	www.unmz.cz
DS	Denmark	Dansk Standard	www.ds.dk
EVS	Estonia	Non-profit Association Estonian Centre for Standardisation and Accreditation	www.evs.ee
SESKO	Finland	Finnish Electrotechnical Standards Association	www.sesko.fi
AFNOR-CEF	France	AFNOR-Comité Electronique Français	www.afnor.org
DKE	Germany	German Commission for Electrical, Electronic and Information Technologies of DIN and VDE	www.dke.de
NQIS/ELOT	Greece	National Quality Infrastructure System	www.elot.gr
MSZT	Hungary	Hungarian Standards Institution	www.mszt.hu
IST	Iceland	Icelandic Standards	www.stadlar.is
NSAI	Ireland	National Standards Authority of Ireland	www.nsai.ie
CEI	Italy	Comitato Elettrotecnico Italiano	www.ceinorme.it
LVS	Latvia	Latvian Standard Ltd.	www.lvs.lv
LST	Lithuania	Lithuanian Standards Board	www.lsd.lt
ILNAS	Luxembourg	Organisme Luxembourgeois de Normalisation	www.portail-qualite.lu
MCCAA	Malta	The Malta Competition and Consumer Affairs Authority	www.mccaa.org.mt
NEC	Netherlands	Nederlands Electrotechnisch Comité	www.nen.nl
NEK	Norway	Norsk Elektroteknisk Komite	www.nek.no
PKN	Poland	Polish Committee for Standardization	www.pkn.pl
IPQ	Portugal	Instituto Português da Qualidade	http://www1.ipq.pt/
ISRSM	Republic of North Macedonia	Standardization Institute of the Republic of North Macedonia	http://www.isrsm.gov.mk/en

ASRO	Romania	Romanian Standards Association	www.asro.ro
ISS	Serbia	Institute for Standardization of Serbia	www.iss.rs
UNMS SR	Slovakia	Slovak Office of Standards Metrology and Testing	www.unms.sk
SIST	Slovenia	Slovenian Institute for Standardization	www.sist.si
UNE	Spain	Asociación Española de Normalización	www.une.org
SEK	Sweden	Svensk Elstandard	www.elstandard.se
Electrosuisse	Switzerland	Association for Electrical Engineering, Power and Information Technologies	www.electrosuisse.ch
TSE	Turkey	Turkish Standards Institution	www.tse.org.tr
BSI	United Kingdom	British Standards Institution	www.bsigroup.com

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