

ThumbsUp



EFFICIENT COMPACT MODULAR
THERMAL ENERGY STORAGE SYSTEM

**Efficient
Buildings Europe**



Knowledge Exchange Forum on **TES in Buildings**

Thursday April 10, 2025

Online



THUMBS UP
project GA101096921
funded by the European Union



The sun does not always shine when we want it to...





On the spotlight



Romane Faure
Policy & Project Officer
Efficient Buildings Europe
Keynote Listener



Maria Chiesa
European Funding
Development Engineering
Warrant Hub



Rafael Nunes
Economic Analyst
Economic and Social
Research Institute (ESRI)



Ola Gustafsson
Project Manager
RISE
Co-Moderator



Emilia Pisani
Project Manager
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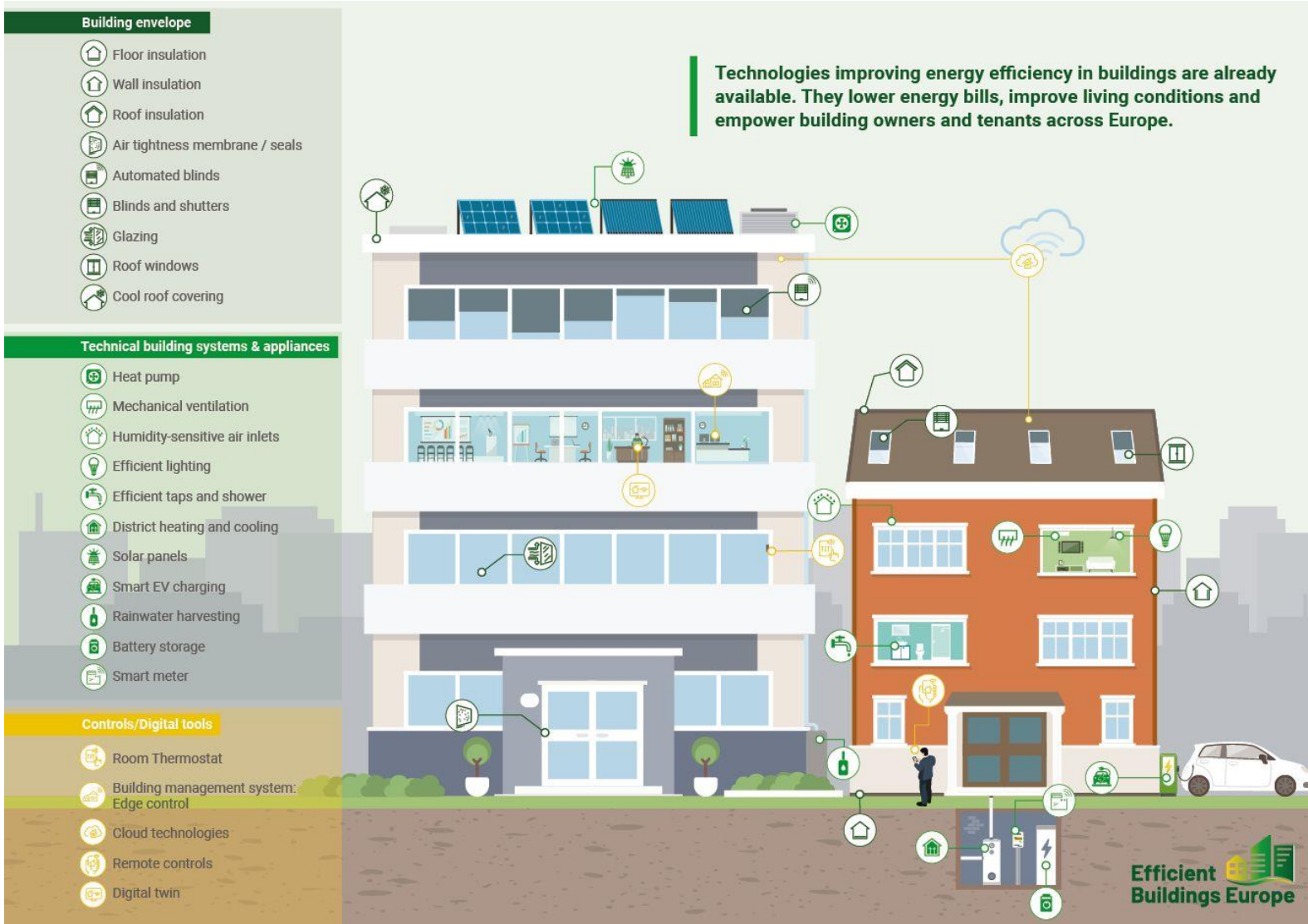
Thermal Energy Storage in Buildings – Knowledge Exchange Forum

Romane Faure, Policy and Project Officer

Efficient Buildings Europe



The Association in a nutshell



The Renovate Europe Campaign

Who are we?

- A **political communications campaign** beating the drum for deep energy renovation of the building stock in the EU
- Supported by **48 partners** from industry and civil society including **18 national partners**
- **Champions** from politics, businesses and communities
- Launched in **2011** as an initiative of **Efficient Buildings Europe**



National Partners



**Efficient
Buildings Europe**





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ECHO

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THERMAL ENERGY STORAGE SYSTEM

10 April 2025

Knowledge Exchange Forum: Why TES?

Awareness raising activities to evaluate the potential socio-economic barriers for the large-scale diffusion of ECHO TES solutions

Maria Chiesa (beWarrant s.r.l.)



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Project details

- *Project number* 101096368
- *Project title* Efficient Compact Modular Thermal Energy Storage System
- *Project Acronym* ECHO
- *Topic* HORIZON-CL5-2022-D3-01-14
- *Type of action* HORIZON-IA
- *Granting authority* CINEA
- *Duration* 01 January 2023 – 31 December 2026
- *EU Contribution* 6.169.498,00 €
- *UK Contribution* ~ 1 M€
- *Total cost* 8.169.948,00 €

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Technology/ Innovation	start TRL	end TRL	State of the Art	Ambition at the end of the project
ECHOTSS approach	4	6	Simulations of individual homes and houses acting in a grid (in terms of impact of their demand). Data from different municipalities (electric/energy consumption curves)	An agent-based simulation capable of emulating the operation of multiple buildings equipped with ECHO in a synergistic and aggregated market-oriented approach (to maximize economic return for the end user in parallel with the use of climate neutral energy sources)
TCMs formed by salt hydrates dispersed in matrix (SIM, salt in matrix)	4	6	Vermiculite/salt hydrate composite can have an energy storage density of 140~220 kWh/m ³ depending on the composition and fabrication conditions, and a charging/discharging efficiency around 80%	Improvement of SIM energy storage density (no less than 210 kWh/m ³) and charging/discharging efficiency (no less than 90%)
Ice-based PCMs storage	6	7	Ice and eutectic materials can have latent heat higher than 300 kJ/kg	New design of PCM and improvement in kinetic and reliability of PCM-based systems below 0°C applications, optimizing the conductivity of PCMs and the storage design
PCMs storage	6	7	Organic PCMs or salt hydrate can have latent heat higher than 200 kJ/kg and low thermal conductivity	Selection and modification of PCM to improve their thermal conductivity and reliability of PCM-based storage
Insulation	4	6	PU rigid foam-PCM composites and natural mineral-PCM composites can have a better thermal buffering and insulation properties depending on the composition and fabrication conditions	New design of PCM/insulating materials combined systems and improvement in kinetic and reliability of PCM-based systems both as insulating component for TCMs, or for below 0°C applications
Heat Pump	5	7	The heat pump technology is widely diffused and known as common device used in air-conditioning system. For temperatures below 0°C dedicated refrigeration systems are normally used.	A new concept of compact high temperature heat pump will be developed in the project; this device will operate also for the ice production in a special configuration. Low GWP refrigerants will be selected and used in the thermodynamic cycle.
ECHO TES final system design (closed loop reactor and final TES)	4	6	Closed-loop TCM reactor have been proposed, which need external thermal source to compensate the energy needs for water evaporation (discharging process).	The closed-loop solution will be optimised in terms of thermodynamic cycle, which will need just a PCMs thermal buffer to eventually compensate the energy needs. A heat pump will be devoted to convert and valorise grid power for charging the reactor. 1 m ³ TCMs can deliver 3 kW for 70 hours, 2 m ³ TCMs can provide 3 kW for 5 hours each day over 4 weeks.
Control system	4	6	Building automation controllers are dominated with rule-based or proportional-integrative-derivative (PID) controller approaches. Model predictive controller (MPC) approach is considered as the SoA with several limitations in building automation applications.	Utilization of data-driven techniques, such as deep reinforcement learning, to overcome MPC limitations deriving from insufficient accuracy of building and energy system models. Dedicated sensors for temperature, humidity and pressure will be monitored.



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Energy storage is one of the key factors to reach EU aims to be climate-neutral by 2050, with a net-zero greenhouse gas (GHG) emissions economy.

- decarbonization
- transition to clean energy sources
- improvement of the energy efficiency

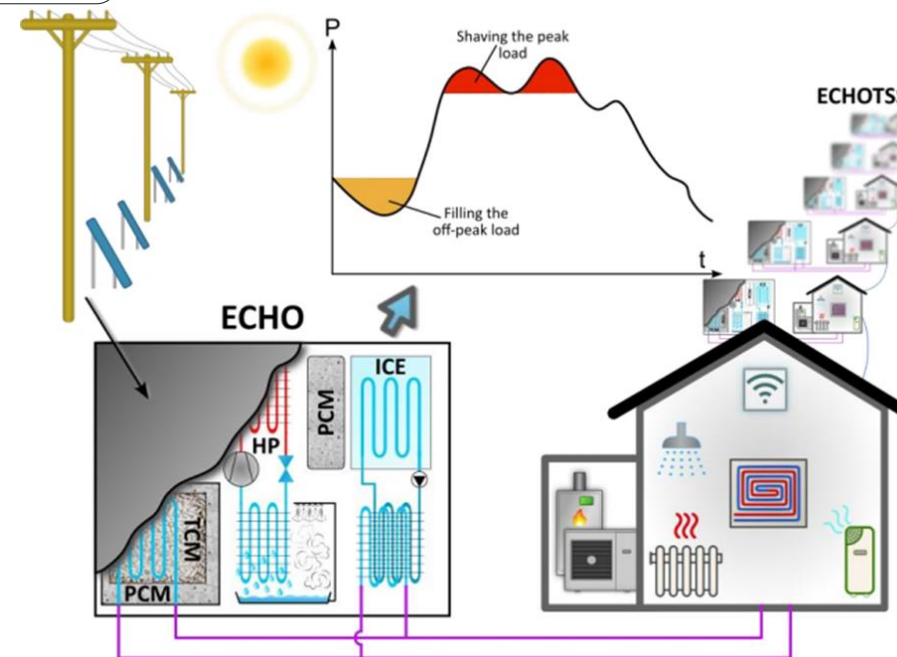


Severe changes in the employed energy systems

Potentialities of thermal energy storage (TES) systems:

- to provide electricity load shifting by means of energy conversion and storage
- to develop flexible energy systems, managing the intrinsically intermittent nature of renewable energy sources.

ECHO solutions will be flexible and adaptable to different end-user requests, in terms of charging (and discharging) power, dimension and types of energy sources.



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Stakeholder participation in the ECHO project

To ensure that different groups of stakeholders have been identified and their opinions and input have been considered while implementing the project and developing the ECHO framework, various types of stakeholder participation in different work packages and tasks have been envisaged in terms of:

INFORMATIVE PARTICIPATION (knowledge diffusion)



The stakeholders will be informed about the decisions, progress, status and results of the project. Knowledge diffusion will be a key component of the ECHO website and social media, as well as digital and physical conferences, several communication and dissemination activities that are planned in the frame of the project

COLLABORATIVE PARTICIPATION



The stakeholders will be directly involved in co-creation of knowledge. This will include stakeholders' participation in online webinars that will be organized, as well as their engagement in awareness raising campaigns.





Awareness raising activities to evaluate the potential socio-economic barriers for the large-scale diffusion of ECHO TES solutions

5 awareness raising campaigns with the **participation of interested ECHO stakeholders and general population** will be organized **in the Municipalities of the test case studies (Padua, Belgrade, Putte) and** the two Spanish case studies that will foresee ECHO TSS simulations (**Municipalities of Crevillente and Bilbao**).

Activity description

A **survey through questionnaires and/or a pool survey platform** will be conducted during the awareness raising campaigns **in order to evaluate the socio-economic barriers associated to the large-scale diffusion of ECHO TES solutions**.

Feedbacks from the surveys associated to socio-economic factors (like gender, age, level of instruction, type of job, role of energy communities, TES costs, engumbrance, maintenance,...) **could additionally improve the results of the ECHO TSS simulations at local level in** the cities investigated by the model (**Crevillente and Bilbao**).

Timing Start: 01/08/2024

End: 31/12/2026



Belgrade case study



Putte case study



Padua case study

Awareness raising events to evaluate socio-economic barriers

Month

Padua (Organiser: BEWH) Technical and logistics support: CNR	M23 (Oct 2024)
Crevillente (Organiser: BEWH) Technical and logistics support: UPV	M27 (Mar 2025)
Bilbao (Organiser: BEWH) Technical and logistics support: TEC	M31 (Jul 2025)
Belgrade (Organiser: BEWH) Technical and logistics support: IMP	M39 (Mar 2026)
Putte (Organiser: BEWH) Technical and logistics support: GREENCO	M43 (Jul 2026)



Questionnaires



Polls



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1st Stakeholder engagement activity: City Vision (Padua – Italy)



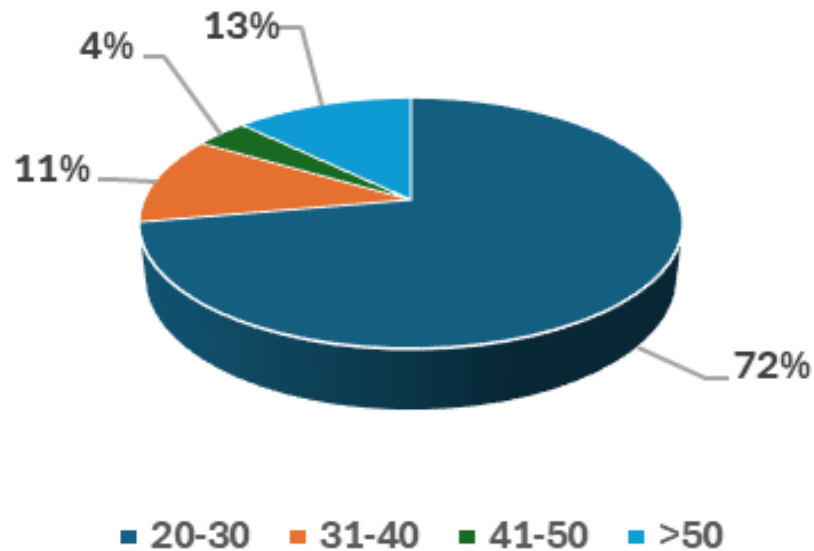
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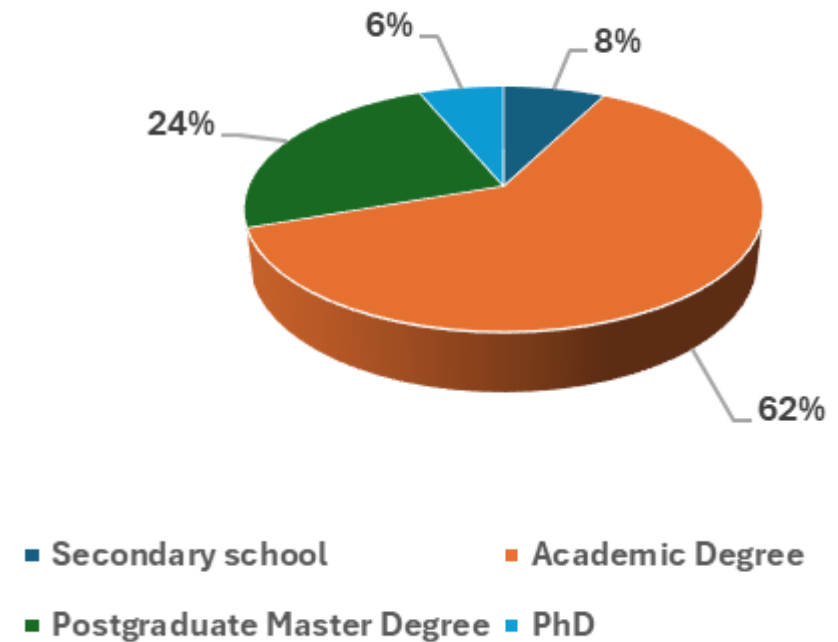


1st Stakeholder engagement activity: type of respondents to the questionnaire (N. 79 in total)

Age distribution of respondents

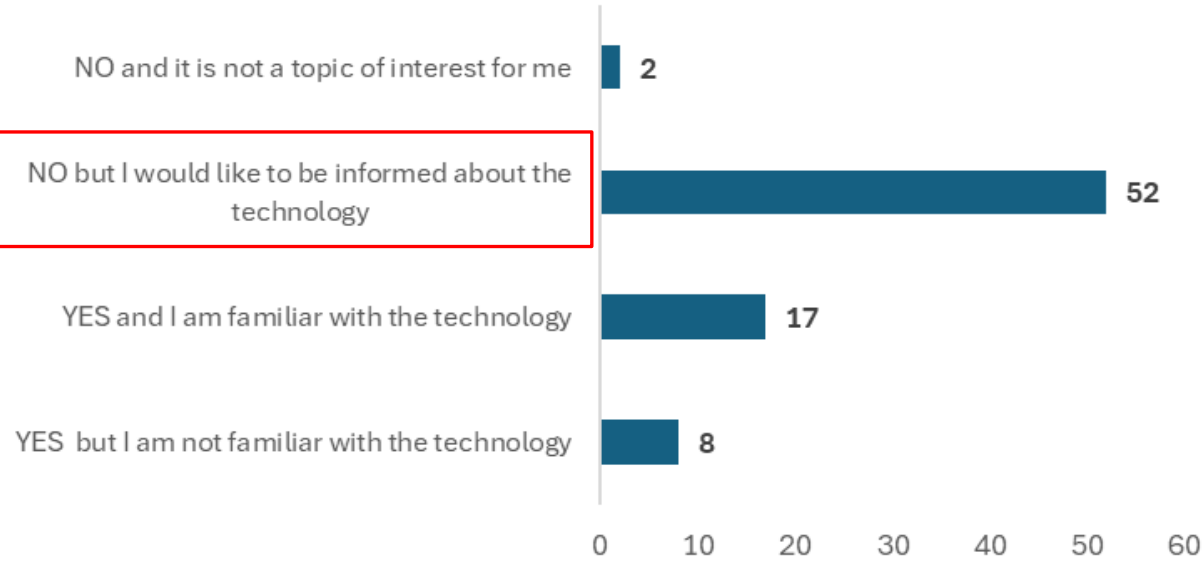


Education level of respondents

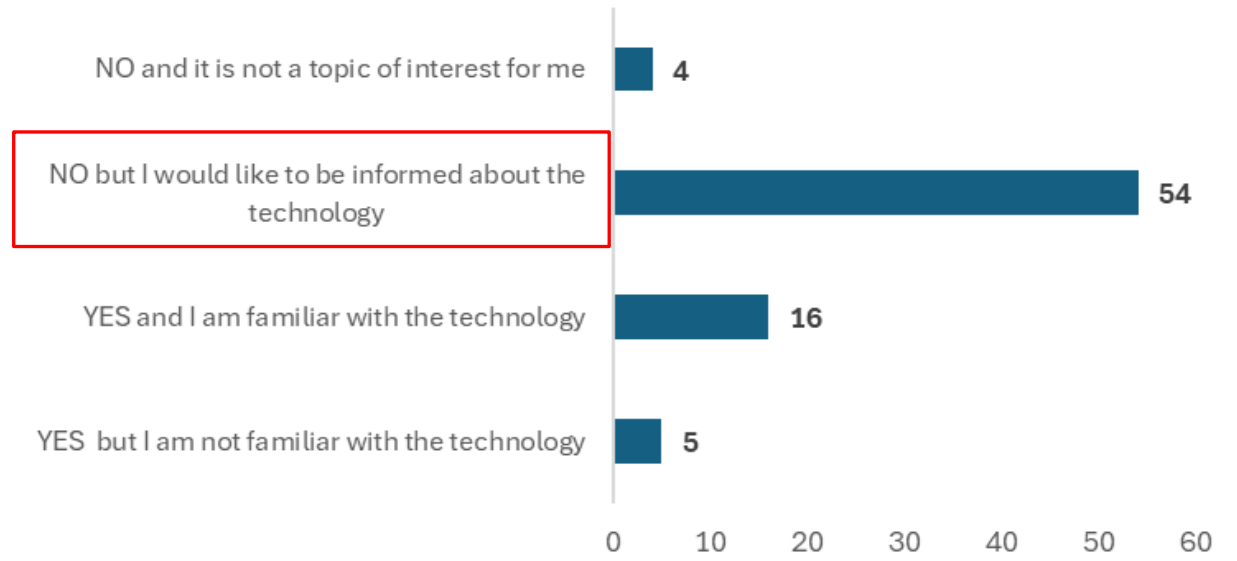


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Have you ever heard about phase change materials for energy storage applications?



Have you ever heard about thermochemical materials for energy storage applications?



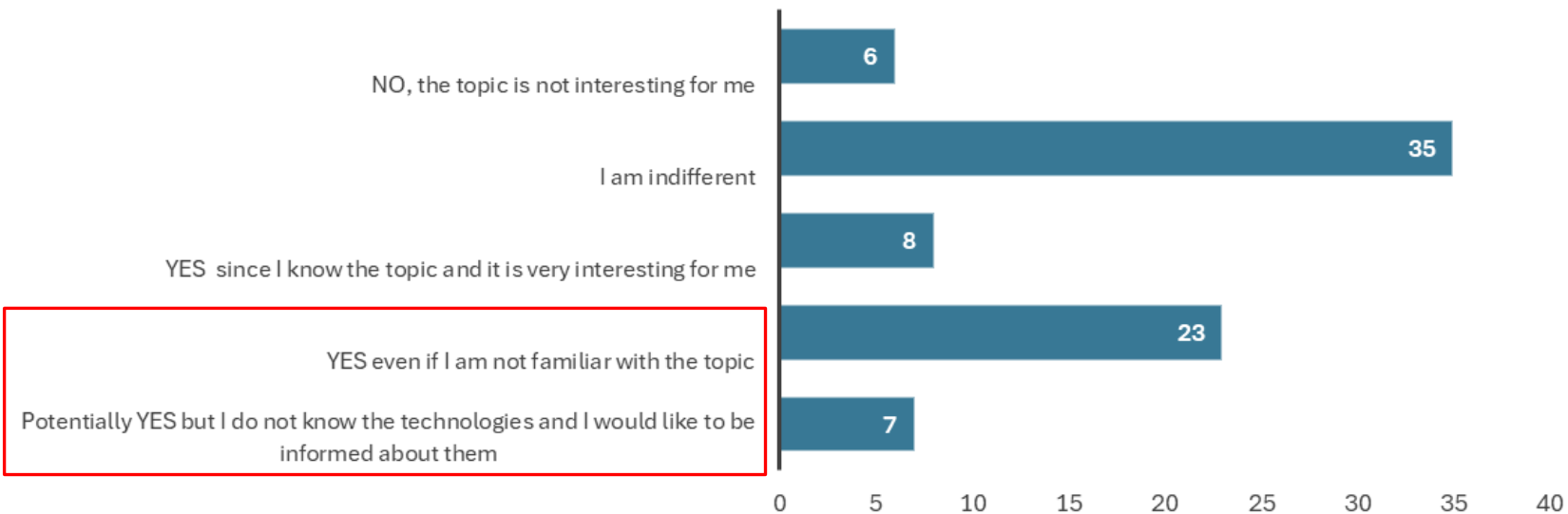
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1st Stakeholder engagement activity: interest in the topic and classification of potential barriers suggested

Are you potentially interested in applying a thermal energy system in your house?



Which are in your opinion the limiting factors that obstacle TES diffusion (1: most important; 5: least important)?

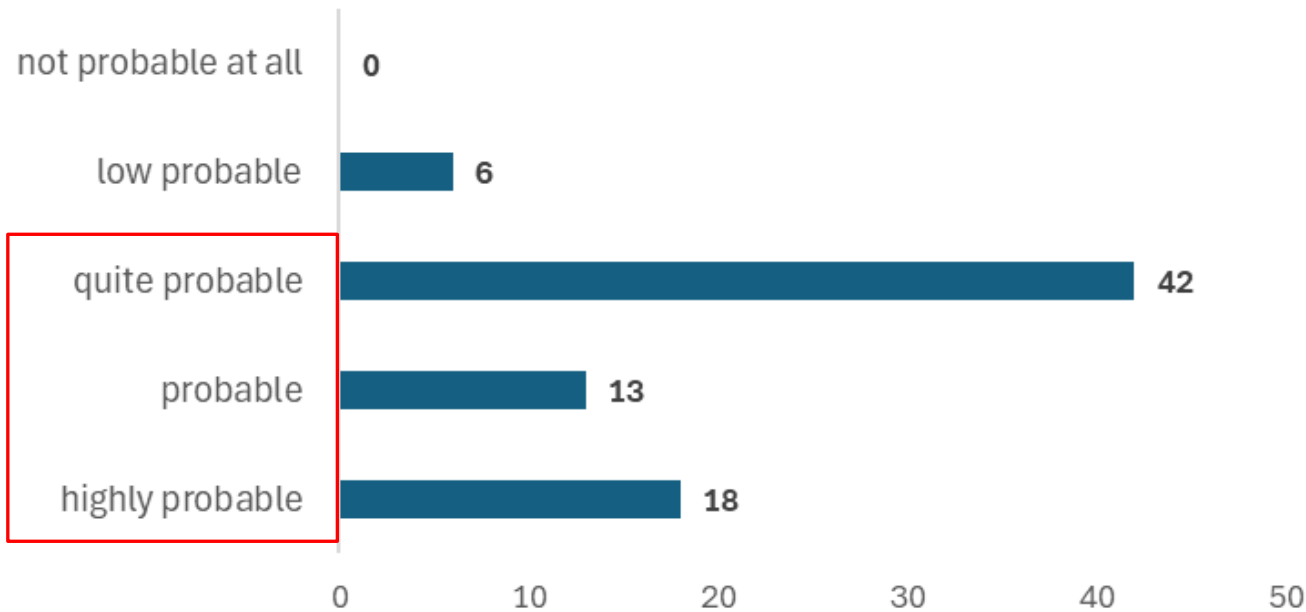


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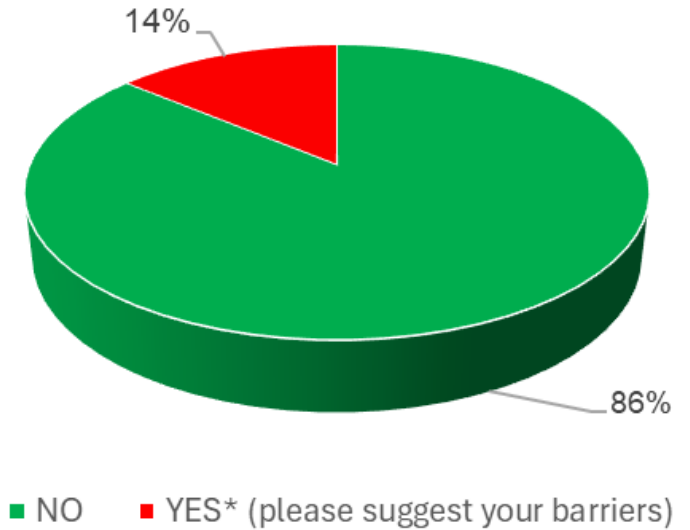
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In your opinion how much is TES large scale diffusion in the next decades credible?



Do you foresee additional socio-economic barriers not considered in the present survey?



- ↓
- Future conveniency of nuclear energy
 - Effective gain in efficiency
 - Topic not considered relevant among general population
 - Inadequacy of public administration toward the topic
 - Lack of knowledge about the energy market
 - Local availability of district heating
 - Long term benefits unknown
 - Lack of knowledge about the specific technologies



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Thanks for your attention



Maria Chiesa

EU project expert

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"Citizens and community's role are central when innovative technologies are introduced on the market to enhance the energy system flexibility and resilience."



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Social Perspectives and TES: Insights from THUMBS UP

Rafael Nunes, ESRI



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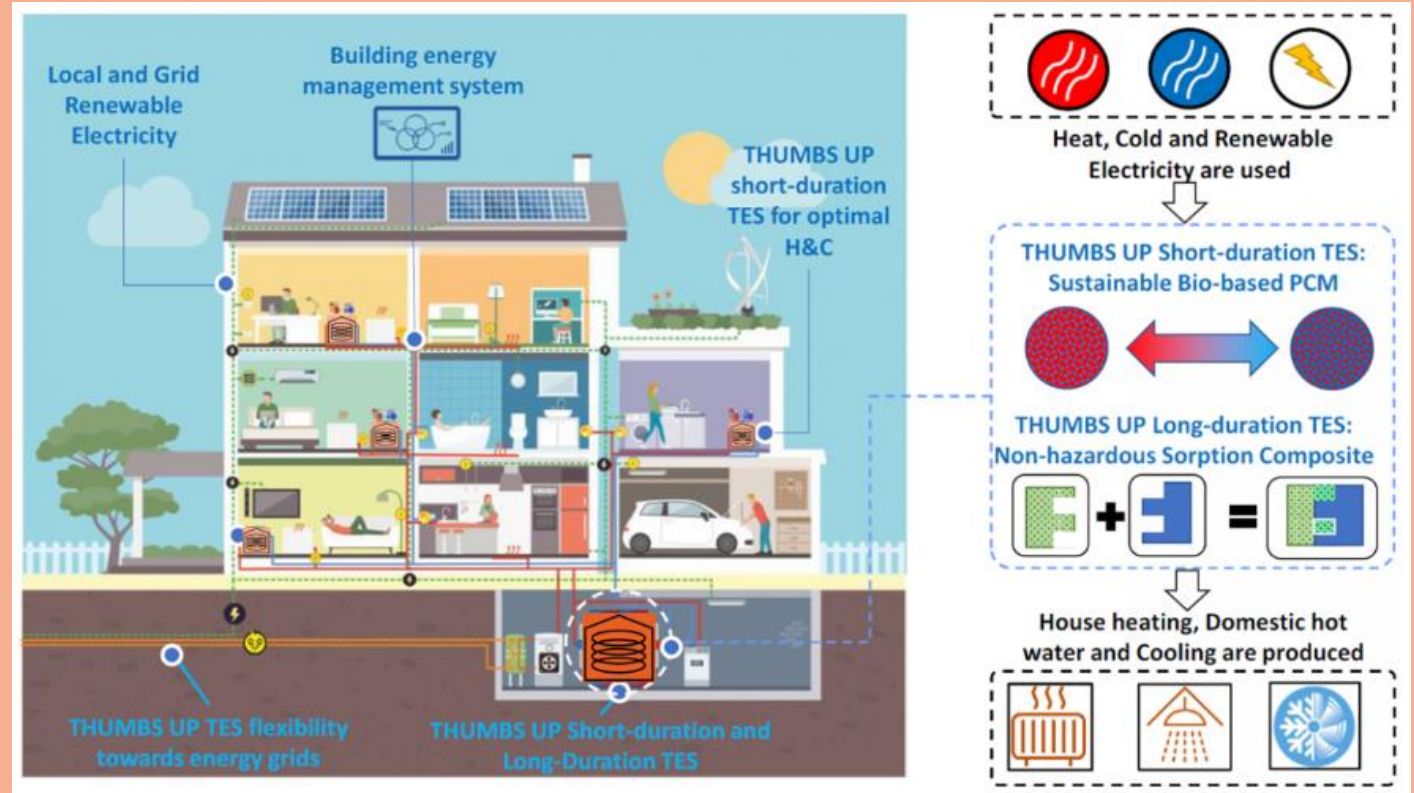


What is THUMBS UP?

- Thermal Energy Storage (TES)
- Integrated energy management system
- Short- and long-duration
- Grid flexibility and renewable integration
- Applies to different building types

Some key features:

- Relatively new technology
- Designed for single-family and multi-family buildings
- Promoting environmental impact (sustainability)
- Potential to save money (initial cost vs. future gain)



Users' opinion

Test Site – Survey

Quick Overview



User Feedback – Valladolid Test Site (N=42)

✓ Positive Impressions

-Satisfaction with the product: ★ 3.95 / 5

-Perceived positive environmental impact: 🌍 2.95 / 3

-High reliability: ⚙️ 2.46 / 3

⚠️ Mixed Feelings on Responsiveness

-Responsiveness: ⌚ 2.08 / 3

Key Takeaway:

Most participants were **satisfied** with the product's performance.

A **significant majority** reported being happy with its environmental impact.



Caption: Distribution and mean responses - Satisfaction, Impact, Reliability, and Responsiveness.

User Feedback – Valladolid Test Site

Textual Analysis:

Participants expressed curiosity and optimism about the potential of new technologies to reduce energy consumption and costs.

Quotes:

"I think it could be interesting to try new technologies to save consumption and costs."

"I love the idea of the project."

"I would love to see this technology used to warm the pool."



Caption: Distribution and mean responses - Satisfaction, Impact, Reliability, and Responsiveness.



User Feedback – Valladolid Test Site

✗ Lack of awareness

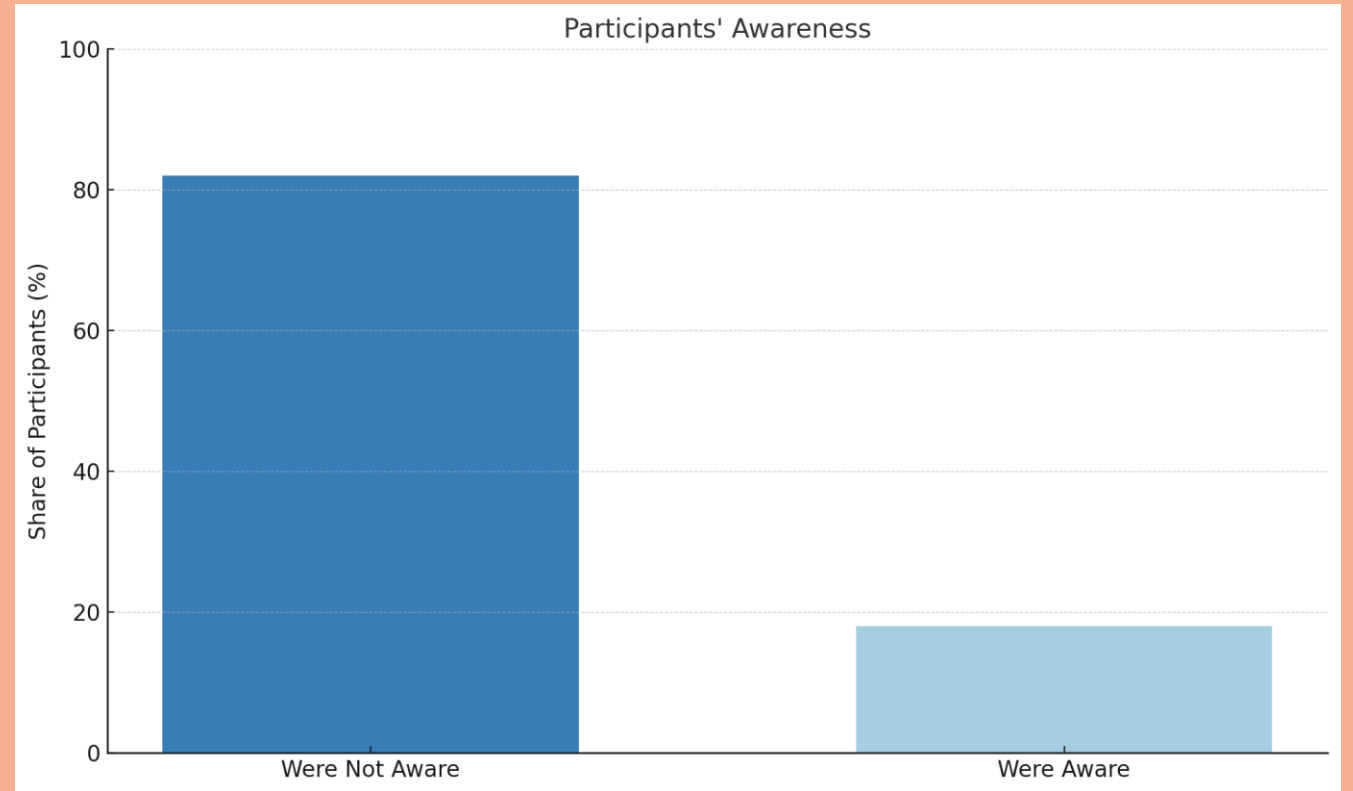
-82% reported that they were not aware what is a TES before the test

Textual Analysis:

Some participants expressed confusion over about the technology.

Quotes:

"I feel uncertain about facing something unknown and experimental."



Caption: Share of participants who reported not being aware of what a TES is before the test.



User Feedback – Valladolid Test Site

✘ Negative Impressions

-67% of participants expressed concerns about the technology's efficiency and effectiveness.

Textual Analysis:

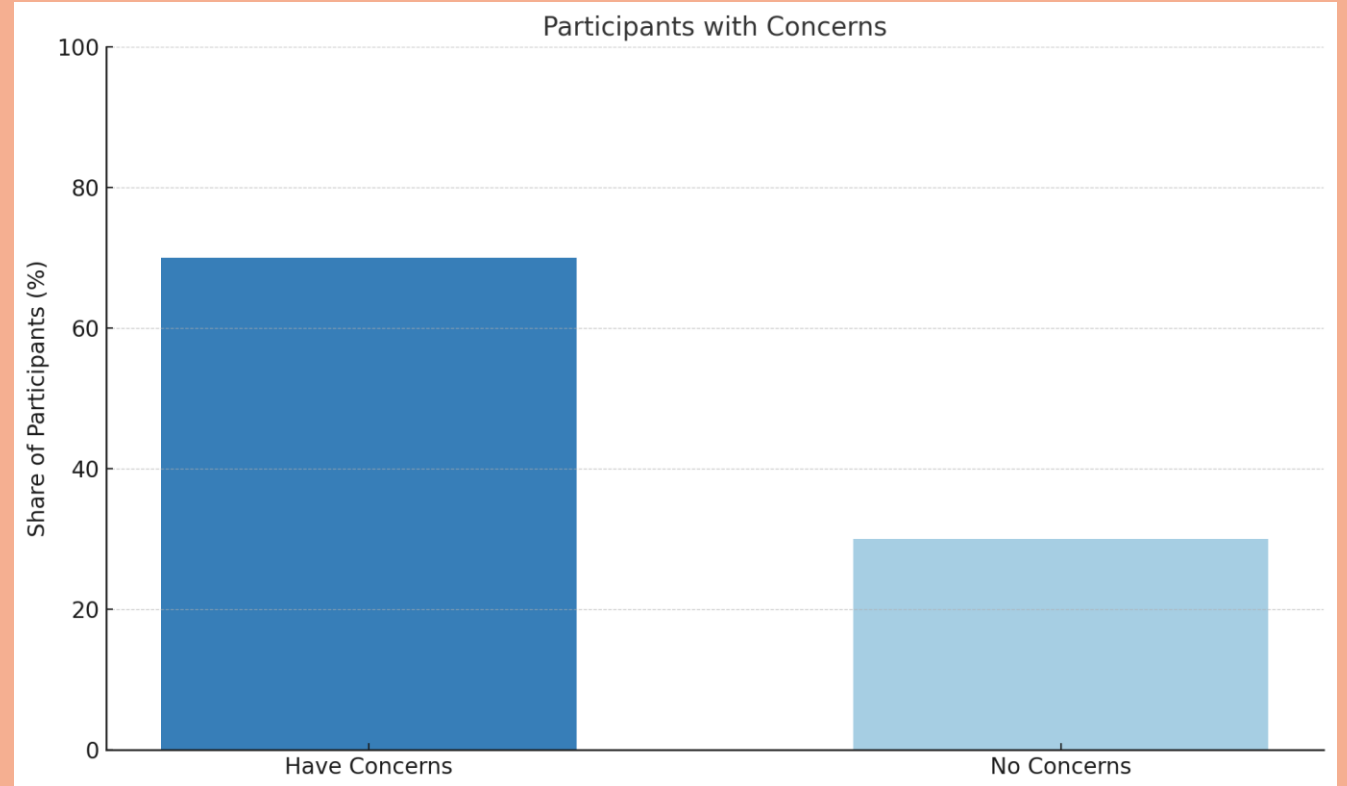
Concerns were raised about whether the technology would be efficient and effective in achieving its goals.

Quotes:

- "I hope it is efficient, quiet, and easy to maintain."

- "It is not clear if the installation will impact energy savings."

- "It seems beneficial, but I am concerned about the future and battery durability."



Caption: Share of participants who reported having concerns with the TES

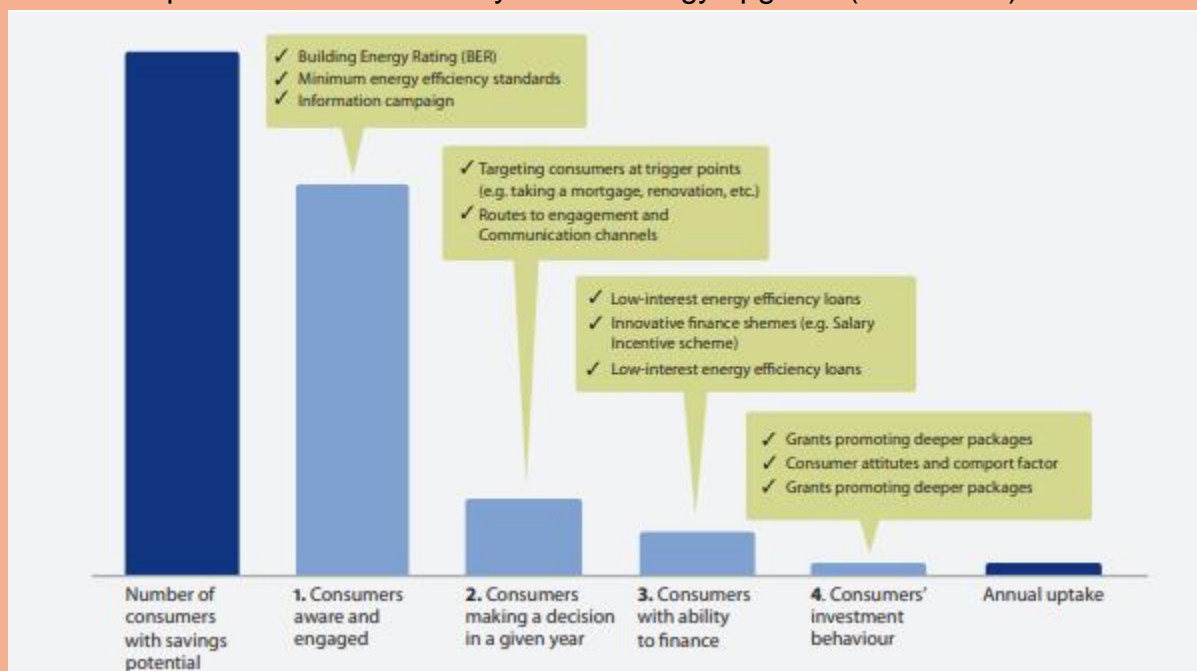
Other Insights

Financial Barriers: Retrofitting Case

-70% of people are aware that they can make their homes more energy efficient...

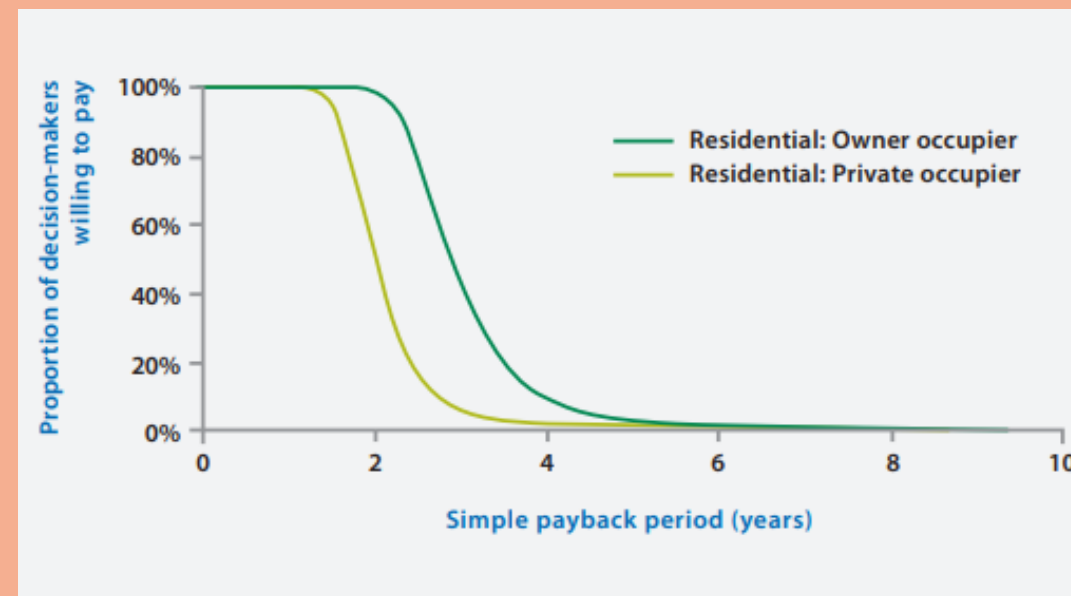
-62% say they cannot do any change due to financial constraints

-25% report PLANNING to carry out an energy upgrade (12 months)



The fraction of private landlords willing to pay for a measure drops: from nearly 100% with a 1-year payback time to almost 0% when it exceeds 4 years.

Self-reported





Framing effects: Potential impacts

The way information about TES technologies is presented—financial savings, environmental benefits, or social norms—can shape how users evaluate and adopt it.

Frame Type	Example Message	Effect
Gain Framing	"Save up to €150/year with TES"	Highlights direct benefit
Loss Framing	"You're losing €150/year without TES"	Leverages loss aversion
Environmental Frame	"Store off-peak energy and cut your carbon footprint"	Appeals to climate-conscious users
Financial Frame	"Reduce your energy bills by 20% using TES"	Boosts economic motivation
Social Norms	"30% of households in your area are adopting TES"	Builds trust and legitimacy

In general, normative and loss-framed messages tend to outperform purely informational ones in increasing user engagement and investment willingness.

Effective framing might reduce perceived risk and complexity, encouraging adoption of emerging technologies like TES.



Next Steps



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TES Social, Environmental and Financial Impact

We collected data on the financial and environmental impacts at the test sites.

We are going to run a survey targeting the European population.

The survey aims to assess public perception of the observed TES impacts, conditional on those impacts.

Furthermore, the survey will:

- Explore how people position themselves regarding the benefits of TES
- Identify which framings and features are most relevant and appealing to highlight
- Test small changes in the information provided to participants to evaluate which aspects are most impactful



Thank you!

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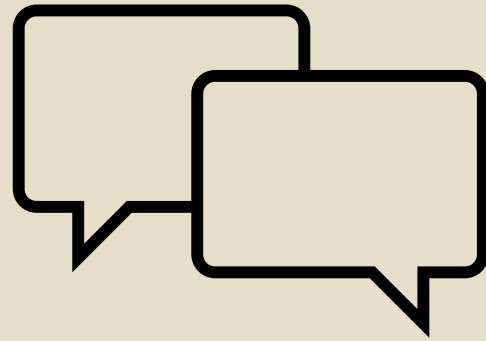


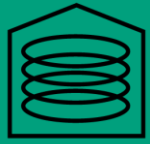
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Let's talk about it!





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What did you think?





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Thank you!

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Thermal energy storage solutions to optimally manage buildings and unlock their grid balancing and flexibility potential.