D6.4 E-Handbook with guidelines for integration of the solutions in public and private, tertiary and residential buildings

WP6, T6.3

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Technical references

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[1] PU = Public

CO = Confidential

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Versions

No.	Name SURNAME	Partner	Contribution	Date
0.1	Michele VALERY	RINA-C	First complete version	2024/08/06
0.2	Irantzu URKOLA	TECNALIA	Review	2024/08/30
0.3	Michele VALERY	RINA-C	Incorporation of comments	2024/09/24
0.4	Irantzu URKOLA	TECNALIA	Final version ready for submission	2024/09/29

Abbreviations and acronyms

Acronym	Description
CAPEX	Capital Expenditure
DSO	Distribution System Operator
ESCO	Energy service companies
GHG	Green House Gases
H2020	Horizon 2020
HP	Heat Pump
OPEX	Operating Expenditure
PE	Primary Energy
PV	Photovoltaic
US	United States

Abstract of the HAPPENING project

Currently, **buildings are responsible for 40 % of the energy demand and 36% of the CO_2 emissions in Europe**. Decarbonisation of existing buildings plays a key role in order to reach the overall climate protection targets. However, current renovation rates lie in the order of 1%.

Heat pumps are a key technology in bringing renewable shares into heat supply of buildings; especially their combination with onsite renewable electricity production e.g. by PV allows to bring high renewable shares. Their current installation in existing multi-apartment buildings is however still marginal.

The proposed technological solution is based on decentralized heat pumps, in such a way that it results an easy-to-install solution for installers, low-intrusive for the occupants and easily adaptable to a large number of different building situations. This is flanked by developing near-zero planning, implementation and operation processes, in order to facilitate the work during the planning phase, ensure a high-quality installation and effective operation, and reduce the efforts and costs within the whole retrofitting project. The challenge of cost-competitiveness is addressed by developing new financial and business models. Bringing new players (such as financial experts) and financing models to the renovation market is expected to bring the needed paradigm change and boost investments in the residential retrofitting sector. Dissemination of measured performance and system characteristics from HAPPENING will be one of the key results of the project.

Through **3 demo sites (Spain, Italy and Austria)**, the project will demonstrate a highly versatile, scalable and replicable solution package for buildings energy system retrofitting allowing 70-75% of renewable energy fraction, 30-50% of PE and GHG savings, reduction of planning time by 50% and installation/operation time by 30% and payback time for ESCOs and investors of less than 8 years, compared to best available solution existing today.

1. Introduction

1.1 Objectives of the deliverable D6.4

The goal of the deliverable "**D6.4 E-Handbook with guidelines for integration of the solutions in public and private, tertiary and residential buildings**" (related to the task T6.3) is to translate demonstration results into comprehensive guidelines for replication.

Specifically, the deliverable aims at offering valuable insights and direction to stakeholders in social housing, energy service companies (ESCOs), construction companies, and municipalities in the topic of the implementation of the HAPPENING solution for the refurbishment and "making more renewable" of the heating, cooling and DHW generation in existing multifamily buildings.

In parallel with this deliverable, a scientific paper titled "*Potential Social Replication of Decentralized Heat Pumps for Building Retrofitting*" has been submitted to the scientific journal Next Research, addressing the potential replicability of the HAPPENING solution from a social perspective.

1.2 Deliverable description

In this deliverable D6.4, a method is proposed for identifying the guidelines for replication addressing potential stakeholders of the HAPPENING system. The deliverable D6.4 is structured in the following chapters:

- Description of the HAPPENING concept and its social implications
- Methodology to assess replicability
- Guidelines for integration of the HAPPENING Solution
- Conclusions
- Annexes

1.3 Contribution of partners

RINA-C contributes to the core parts of the deliverable, i.e., RINA-C conducted the literature review and prepared the survey to collect the information and inputs from the partners in regard to the HAPPENING experience (lessons learnt, specific knowledge of partners, etc.), and after agreeing with the Consortium members the question of surveys, they shared ang analysed the gathered answers.

The survey has been disseminated to relevant stakeholder by ALOKABIDE, TECNOZENITH and AEE INTEC. Relevant social data has been gathered by the same partners.

RINA-C then organized all the information collected and developed the content of this deliverable. TECNALIA and ANESE are in charge of reviewing the deliverable.

1.4 Relation with other activities in the project

This deliverable is strictly connected to task “T5.3 HAPPENING system design guideline development” and “T5.4 Technical manuals and instructions for installers and end-users”, in which more specific and technical guidelines are provided for more advanced stages, such as design, implementation and operation phases.

2. Description of the HAPPENING concept and its social implications

2.1 HAPPENING concept in short

The energy supply system demonstrated in the HAPPENING project allows the energy transformation of existing buildings from fossil fuels to green electricity, allowing high quotas of renewable energy. It is a solution for the building renovation sector.

The HAPPENING system has heat pumps (BCs) as main elements for heating, DHW and cooling (optional), supported by locally generated electricity (such as, photovoltaic panels - PV) and thermal and electrical storage as needed.

HAPPENING proposes the combination of a decentralized HP system in each dwelling that covers its specific heat demand connected to a central HP through a low-medium temperature distribution system. Thanks to this cascading configuration of the HPs, the heat distribution within the building is carried out at low-medium temperatures, minimizing thermal losses. In addition, at dwelling level, the heat emitters can be chosen by the occupants from a variety of options from the most conventional solutions, such as radiators, to the most innovative, including or not the cooling service in addition to heating and DHW.

Schematically, the HAPPENING concept based on cascading heat pumps is described as follows:

1. First thermal gap (**ΔT_1**) > **Central** aerothermal heat pump(s) generating “neutral temperature” water (20-30ºC)
2. **Thermal inertia**, which contributes to the decoupling of generation and consumption
3. **Distribution** at low temperature (20-30ºC) to dwellings (minimization of distribution losses)
4. Second thermal gap (**ΔT_2**) individually at **consumption** level (optimized demand response), from the ring temperature (20-30ºC) to the consumption temperature, with different configurations, such as:
    - W/W microHP for DWH + W/A microHPs for heating & cooling in each room
    - W/W booster heat pump, for both DHW and heating, combined with low temperature emitters
5. Locally generated and consumed **renewable energy**
6. **Smart** management and **control system** for optimization

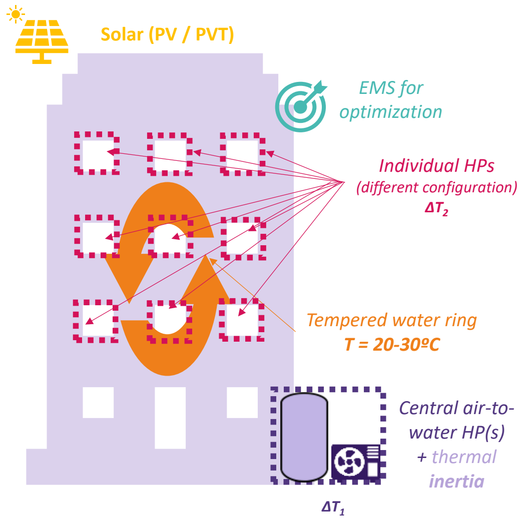

Figure 2.1: HAPPENING concept

2.2 Social implications of the HAPPENING concept

Considering the above, the HAPPENING solution has several social implications that could impact both individuals and communities. Main implications regard:

1. **Increased Energy Efficiency and Cost Savings:** By integrating heat pumps and renewable energy sources such as photovoltaic panels, the HAPPENING system could help reduce energy costs for households. The use of locally generated electricity and optimized energy management systems lowers the dependency on external energy supplies, making heating, cooling, and domestic hot water more affordable. This is especially beneficial for low-income families, contributing to energy equity.

2. **Improved Environmental Awareness:** As the system directly promotes the use of renewable energy sources and reduces carbon footprints, it could foster greater environmental consciousness among occupants. Residents may become more engaged in energy-efficient behaviors, contributing to broader societal shifts toward sustainable living.
3. **Customization and Control Over Comfort:** The system allows occupants to choose from a variety of heating and cooling options, providing a personalized approach to thermal comfort. This flexibility increases user satisfaction and encourages wider adoption of energy-efficient technologies, while also improving the quality of life through enhanced indoor comfort.
4. **Job Creation in the Green Economy:** The widespread implementation of the HAPPENING system in the building renovation sector could stimulate job creation in the renewable energy and construction industries. New roles may emerge in installation, maintenance, energy management, and smart system control, helping to transition workers from fossil-fuel-related jobs to green energy sectors.
5. **Reduction of Energy Poverty:** The project's focus on renovating existing buildings to use renewable energy can help mitigate energy poverty by providing affordable, sustainable energy solutions for heating and cooling. Communities with aging infrastructure or inadequate heating systems, particularly in colder climates, stand to benefit greatly from such innovations.
6. **Decentralized Energy Systems and Community Empowerment:** The system's decentralized nature empowers local communities to generate and manage their own energy. This increases energy security and resilience, reducing reliance on large, centralized grids that may be prone to disruptions.
7. **Health and Well-being Benefits:** By reducing reliance on fossil fuels and encouraging cleaner air through renewable energy usage, the HAPPENING system contributes to improved public health. Reducing indoor pollution from inefficient heating systems can lower the incidence of respiratory illnesses and enhance overall well-being.

3. Methodology to assess replicability

In order to assess the replicability of the HAPPENING solution, this study relied on four different sources of information:

(i) Literature review: analysis of the existing literature on social acceptance and implications of energy efficiencies innovation in buildings.

(ii) Social data: deep study of the social data gathered from the three pilot projects in Spain, Italy, and Austria.

(iii) Stakeholders survey: assessment of the outcomes of the stakeholders' surveys that has been submitted to all the dwellings part of the pilot projects.

(iv) Data from HAPPENING implementers: analysis of the information gathered from the various implementers of the HAPPENING solution regarding the problems, the lessons learned, and the suggestions on what to change, encountered during the Project implementation.

3.1 Literature review

There is already a widespread literature on energy efficiency investments in the building sector. For the present document we used the literature review developed in D6.1, mainly focusing on the literature that investigates (i) the potential social impacts of energy efficiency investments on society and (ii) which the current status of the social acceptance of this kind of energy efficient solutions is within European population. The outcomes of this review highlighted that energy-efficient renovations have the potential to generate widespread socioeconomic benefits, such as job creation, increased property values, and poverty alleviation, particularly for low-income households. However, the success of these projects depends on overcoming several social barriers. These include mistrust toward energy efficiency investments due to a lack of knowledge, concerns about economic returns, and fears of disruption during renovation work. Engaging stakeholders early in the process, providing clear information on benefits and impacts, and offering financial support options are essential for fostering social acceptance. Additionally, addressing the impact on displaced workers and high initial investment costs will be key to ensuring broad support for these initiatives.

For more information see **Annex II: Literature Review from D6.1.**

3.2 Social Data

Social data from the three Demo Cases (Pasaia, Verzuolo and Liezen) have been gathered prior to the HAPPENING implementation during the development of D6.1. Information collected regards (i) age, nationality, occupation and gender of residents, (ii) if they were tenants or owner of the dwelling, and (iii) how they have been engaged along with the outcomes of such engagement.

Across the three demo sites—Pasaia, Verzuolo, and Liezen—the HAPPENING solutions reveals diverse social dynamics that shape its implementation. In Pasaia, tenants with low to medium incomes require financial support to ensure the project's success. While most residents are Spanish, foreign tenants face bureaucratic challenges and need additional support. Verzuolo has a younger and diverse population, with a significant number of non-Italian tenants, leading to potential communication issues due to language and cultural differences, especially given their limited role in decision-making. Clear communication and active involvement of all tenants build trust. In Liezen, despite not owning the building, tenants maintain a strong role in decision-making and actively participate in the project. While most are Austrian, cultural differences with foreign tenants require careful management. Early engagement, tailored communication, and financial assistance played key roles in overcoming social barriers and ensuring the success of Project interventions across all sites.

For more information see **Annex III: Social Data of the Demo sites from D6.1.**

3.3 Stakeholders Survey

The Survey has been developed to capture the impressions of the various users of the HAPPENING solution at the end of the Project Cycle. A total of 17 tenants responded to the survey: 6 from Verzuolo, 4 from Liezen, and 7 from Pasaia. The survey was developed on the Microsoft form application, where the questions were provided in English, Italian, Spanish, and German languages. It has been submitted to all the dwellers of the housing units affected by the implementation of the HAPPENING Solution.

The Survey was anonymous and was composed of the following 13 questions:

1) What location do you reside in?
2) How many people live in your housing unit?
3) How long has the HAPPENING solution been in operation?

4) How satisfied are you with the heating capabilities of the HAPPENING solution?
5) What issues have you encountered, or what suggestions and observations do you have regarding the heating capabilities of the HAPPENING solution?
6) How satisfied are you with the cooling capabilities of the HAPPENING solution? (Do not respond if not applicable)
7) What issues have you encountered, or what suggestions and observations do you have regarding the cooling capabilities of the HAPPENING solution? (Do not respond if not applicable)
8) Who bore the implementation costs of the HAPPENING Solution?
9) How much the HAPPENING Solution have reduced the energy consumption
10) Taking into account the answer to the previous question, this has had an impact on energy expenses that I would describe as:
11) Do you have any further comments regarding the HAPPENING solution and its features (such as noise, space occupancy)?
12) Overall, how satisfied are you with the HAPPENING solution?
13) Would you recommend the HAPPENING solution?

Briefly summarizing, surveys results indicate a generally positive reception of the HAPPENING solution, with an overall satisfaction rating of 7.35 out of 10. Respondents from Verzuolo were notably satisfied with both the heating and cooling capabilities, while some issues such as noise, slow heating, and occasional system failures were reported across all sites. Energy consumption results varied, with some respondents noting significant reductions, while others experienced no change or even increases in costs. Despite these mixed results, the majority (12 out of 17) expressed willingness to recommend the HAPPENING solution, highlighting its potential for broader acceptance.

For more information see **Annex IV: Stakeholders Survey**

3.4 Data from HAPPENING implementers

Implementers from the three Demo Cases have been consulted asking them to provide their opinions, experience and lessons learnt on the implementation process of the HAPPENING solution. More specifically, during a dedicated workshop they have been asked to provide and discuss (i) challenges encountered, (ii) what worked / points of strength, (iii) lessons learned, and (iv) suggestions / area of improvement. The outcomes of this discussion have been gathered and included in the present document, along with information gathered during face-to-face interviews with the same implementers. Briefly summarizing such outcomes, the major challenges encountered included complex procedures and permissions, misalignment among stakeholders, space limitations, and public perception issues. High capital expenditure and noise concerns also presented obstacles. However, strengths emerged, such as tenant appreciation of cooling systems, operational savings, system versatility, and environmental benefits from reduced fossil fuel use. Lessons learned stressed the need for better communication with tenants, administrative preparation, and adjusting the system for seasonal needs. Areas for improvement included managing customer expectations, enhancing installer and community engagement, and simplifying bureaucratic processes. These findings provide valuable guidance for future project implementations and improvements.

For more information see **Annex V: Data from HAPPENING implementers**

4. Guidelines for integration of the HAPPENING Solution

The development of the guidelines for integrating the HAPPENING solution is aimed at helping in replicating and expanding the solution beyond the Demo Cases. As energy-efficient renovations become increasingly crucial in addressing climate change and improving living conditions, the insights gained from the HAPPENING project offer valuable lessons for future implementations. The identified guidelines are based on the outcomes of the various type of data (Literature Review, Social Data, Stakeholders Survey and data from HAPPENING implementers) gathered during the HAPPENING implementation.

The primary aim of these guidelines is to provide a structured pathway for others to replicate the HAPPENING solution. Outlining key considerations and strategies helps ensure that future projects can achieve similar levels of success and efficiency. Recognizing that each community has unique social, economic, and technical conditions, the guidelines offer adaptable strategies tailored to different settings. This flexibility is necessary for overcoming localized challenges and ensuring the solutions meet specific community needs.

The following guidelines have been divided into key topics that address the essential aspects of a successful HAPPENING implementation. These topics include, among others, stakeholder engagement, financial considerations, technical implementation, social dynamics, and feedback mechanisms. Each area plays an important role in ensuring that energy-efficient renovations like HAPPENING are both effective and widely accepted.

4.1 Stakeholder Engagement

Early and Inclusive Engagement

The success of implementing a solution significantly depends on involving all relevant stakeholders from the very beginning. The HAPPENING project highlights that early engagement is a key factor in ensuring the project's smooth progression and acceptance. This approach involves the following aspects:

- **Building Trust:** By engaging stakeholders such as residents, local authorities, social housing organizations, and community leaders early in the process, project developers can foster trust. Transparency in communication and decision-making helps stakeholders feel more confident about the project's intentions and processes.

- **Understanding Community Needs:** Early involvement allows project teams to gather insights into the specific needs, preferences, and concerns of the community. This understanding ensures that the project design and implementation align with local expectations and requirements, which can lead to better outcomes.
- **Proactive Issue Resolution:** Engaging stakeholders from the start enables project teams to identify potential concerns or objections early on. Addressing these issues proactively, before they escalate, can prevent delays and opposition later in the project lifecycle.
- **Inclusivity and Collaboration:** Involving a diverse group of stakeholders encourages inclusivity and promotes a sense of ownership among affected members. This collaborative approach can lead to more innovative solutions and a stronger sense of community support.

Communication Strategies

Effective communication ensures that all stakeholders have a clear understanding of the project's benefits, costs, and any potential disruptions. Key elements of a robust communication strategy include:

- **Clarity and Transparency:** Information about the project's objectives, timeline, and expected outcomes should be communicated clearly and openly. This transparency helps manage expectations and reduces uncertainty among stakeholders.
- **Tailored Messaging:** Developing communication strategies that are customized to the demographic and cultural characteristics of the community can significantly enhance acceptance. This may involve using different languages, media, or messaging styles to reach various segments of the population effectively.
- **Highlighting Benefits:** Emphasizing the positive impacts of the HAPPENING project, such as energy efficiency, cost savings, and environmental benefits, can increase stakeholder buy-in. Demonstrating how the project aligns with broader community goals can further enhance support.
- **Addressing Concerns:** Acknowledging and addressing potential disruptions or drawbacks of the project upfront can build credibility and trust. Providing clear plans for mitigating negative impacts can alleviate stakeholders' concerns.
- **Engagement Platforms:** Utilizing multiple platforms for communication, such as community meetings, social media, newsletters, or local events, can ensure that information reaches a wide audience. Interactive platforms also allow stakeholders to provide feedback and engage with project leaders directly.
- **To create an information point?** A phone number or an email stakeholder can contact when they have any concern or problem…

By prioritizing early and inclusive engagement alongside effective communication strategies, the implementation of a heat pump system can be more efficient, community-focused, and successful in achieving its intended outcomes.

4.2 Understanding Demographics and Social Characteristics

Demographic Analysis

This analysis involves collecting and examining data on various demographic factors, such as age distribution, income levels, nationalities, and household compositions. Understanding this information allows developers to anticipate the needs of different groups. For instance, younger residents may prioritize cost savings, while older adults might focus on comfort and ease of use. Income levels provide insights into the community's ability to afford upfront costs or ongoing expenses, guiding the development of financial assistance programs, like subsidies or low-interest loans.

Analysing nationalities and cultural backgrounds can reveal specific preferences or concerns that might affect the adoption of a new system like HAPPENING. For example, cultural attitudes towards technology or environmental sustainability can impact acceptance levels. Understanding household compositions — whether they are single-person households, families, or shared accommodations — helps in tailoring communication and education efforts to ensure that all residents understand the benefits and usage of the new heat pump system. Overall, demographic analysis allows the project to be customized to the community's specific needs, increasing the likelihood of successful implementation and widespread adoption.

Social Dynamics

Social dynamics include the relationships and interactions between various groups, such as tenants and building owners, or the influence of community organizations and leaders. For instance, a positive relationship between tenants and building owners can facilitate smoother negotiations for installing new systems, especially when it involves structural changes or shared financial commitments. Conversely, strained relationships might require additional mediation or incentives to achieve consensus.

Understanding social dynamics also involves recognizing the informal networks and communication channels within the community. These networks can be leveraged to disseminate information effectively, gather feedback, and address concerns swiftly. By acknowledging and integrating these social dynamics into the project planning and implementation phases, the HAPPENING solution can achieve higher levels of engagement, acceptance, and overall success.

4.3 Financial Considerations

Economic Incentives and Support

For what regards economic barriers, the high initial costs associated with installing a new heat pump system can be a significant obstacle for many residents. To overcome this barrier, it is essential to provide a range of financial support mechanisms, such as financial incentives, subsidies, or low-interest loans. These measures help to offset the upfront investment required for energy-efficient renovations, making them more accessible and appealing to residents.

Understanding the economic status of the community is vital in designing these financial support mechanisms. For example, low-income households may benefit more from direct subsidies or grants, while middle-income residents might prefer low-interest loans that spread the cost over time. Tailoring these incentives to match the specific financial circumstances of the target population ensures that the support is effective and reaches those who need it most. Additionally, providing information on available financial aid and how to access it can further encourage participation and adoption of the new system.

Cost-Benefit Communication

Another important financial aspect concerns to the effective communication about the long-term economic benefits of the HAPPENING solution. Many residents may be hesitant to invest in it without understanding how it will save them money in the long run. Therefore, it is important to clearly articulate the potential reductions in energy bills, increased property values, and other financial advantages that come with energy-efficient renovations.

Highlighting successful case studies from similar projects can serve as powerful evidence of the benefits. Providing transparent cost-benefit analyses, which detail the expected savings over time compared to the initial investment, can help residents make informed decisions. Demonstrating how these savings contribute to a return on investment can further persuade sceptical stakeholders. Clear and compelling communication strategies can build confidence and encourage residents to embrace the new technology, as mentioned already many times.

Monopoly-related Issues

A significant challenge in the implementation of the HAPPENING solution is the monopoly held by one of the suppliers of the system. This monopoly creates uncertainty about production continuity and poses a potentially insurmountable limitation for the replication of the solution. Dependence on a single supplier can lead to supply chain vulnerabilities, pricing issues, and potential disruptions in project timelines if the supplier chooses not to proceed with production.

To avoid or overcome these challenges, it is important to explore alternative suppliers or encourage competition within the market. This could involve supporting the entry of new manufacturers or working with existing suppliers to expand their production capabilities. Diversifying the supply chain reduces the risk of dependency to one single supplier and ensures a more stable and reliable provision of the necessary components for the heat pump system.

Additionally, engaging in dialogue with the current supplier to address their concerns and uncertainties can help mitigate potential disruptions. Exploring partnership opportunities or collaborative approaches may incentivize the supplier to continue production. Addressing monopoly-related issues is crucial to ensuring the widespread replication and success of the HAPPENING solution.

4.4 Technical Implementation

System Flexibility and Adaptability

The success of implementing the HAPPENING solution heavily depends on the technical systems' flexibility and adaptability to diverse building types and climates. Energy-efficient systems must be designed to accommodate varying architectural styles, structural conditions, and environmental factors to ensure broad applicability. For example, a heat pump system needs to perform efficiently in different types of buildings, from modern high-rises to older, more traditional structures.

Adaptability to seasonal variations is also a key consideration. Feedback from the HAPPENING project has highlighted that systems must be capable of adjusting to changes in temperature and weather conditions throughout the year. This means the system should efficiently manage both heating and cooling needs as seasons change, providing consistent comfort to users regardless of external conditions. A flexible system not only improves energy efficiency but also enhances user satisfaction by maintaining a stable and comfortable indoor environment year-round.

Ensuring that the system can be customized or scaled to fit various building sizes and types, as well as different local climates, increases its viability and attractiveness to a wider range of users. This adaptability helps in addressing the specific needs of different communities and building types, making the technology more versatile and broadly applicable.

User-Friendly Design

Systems need to be intuitive and easy to operate to ensure that residents can use them effectively without frustration. A complex or confusing interface can lead to difficulties in controlling the system, which may negatively impact user satisfaction.

Providing adequate training and support is needed to ensure that residents understand how to use the system properly. This training should cover the basic functions of the heat pump, how to adjust settings for optimal performance, and troubleshooting common issues. Proper training helps users feel confident and capable in managing their new system, which can lead to greater acceptance and satisfaction.

Technical issues, such as difficulties in controlling thermostats or experiencing frequent system failures, can significantly affect the overall user experience. Therefore, designing the system with user-friendly controls and interfaces, and ensuring that there are clear instructions and support available, can help mitigate these issues. Effective user education and straightforward design not only enhance the functionality of the system but also improve its overall acceptance among residents.

4.5 Public Health and Quality of Life

Health Benefits Communication

Improved energy efficiency not only offers economic and environmental advantages but also significantly impacts residents' health and well-being.

One key health benefit is enhanced thermal comfort. An efficiently functioning heat pump system maintains a consistent indoor temperature, which can prevent the discomfort associated with extreme temperatures. This consistent thermal environment helps to reduce health risks related to temperature fluctuations, such as hypothermia in cold weather or heat exhaustion during hot periods.

Another important aspect is the reduction of respiratory issues. Traditional heating systems often involve combustion processes that can release pollutants and allergens into the indoor air. In contrast, modern heat pump systems, which are typically powered by electricity, reduce or eliminate these harmful emissions. This can lead to improved air quality and a decrease in respiratory problems, such as asthma or allergies, especially for vulnerable populations like children and the elderly.

Providing clear, evidence-based information about these health benefits can be a powerful motivator for residents. Highlighting studies or data showing the positive impact of improved air quality and thermal comfort can help build trust and encourage residents to support and invest in the new system.

Improving Living Conditions

Demonstrating how energy-efficient renovations, such as those involving the HAPPENING solution, can improve overall living conditions is another effective strategy for encouraging adoption. Beyond the immediate health benefits, these renovations contribute to a higher quality of life in several ways.

One notable improvement is reduced noise levels. Many traditional heating and cooling systems can be noisy, which can be disruptive and affect the comfort of living spaces. Modern heat pump systems are often designed with quieter operation in mind, leading to a more peaceful and serene indoor environment. Reduced noise pollution enhances residents' overall comfort and contributes to a more pleasant living experience. In, some this regard, it should be noted that some HAPPENING users complained about the noisiness of the HAPPENING solution. Thus, this potential benefit depends on the design of the specific solution.

By highlighting these improvements in living conditions, such as noise reduction and enhanced air quality, the benefits of adopting the new heat pump system become more tangible. Residents are more likely to be motivated to participate in the project if they understand how these changes will positively impact their daily lives.

4.6 Overcoming Social Barriers

Addressing Displacement Concerns

Displacement concerns can arise when residents fear being temporarily relocated or experiencing significant disruptions to their daily lives while renovations are underway. These concerns can lead to resistance to the project and hinder its progress.

To mitigate these fears, it is indispensable to develop and communicate detailed plans that outline how the renovation process will be managed. This includes providing a clear timeline for the project, detailing the phases of construction, and specifying the measures that will be taken to minimize disruption. For example, scheduling renovations in phases or during off-peak hours can help reduce the impact on residents' daily routines.

Additionally, offering assurances about temporary accommodations or support services can address concerns about displacement. If temporary relocation is necessary, ensuring that residents are provided with suitable alternative housing and are informed well in advance can help alleviate inconveniences, such as anxiety or other problems. Clear communication and engagement with the community throughout the process are key to building trust and ensuring residents feel supported and informed.

Historic Preservation

Historic preservation involves maintaining the architectural and cultural significance of buildings, which can be a significant concern when introducing modern technologies or renovations.

To address these concerns, it is essential to collaborate with conservation experts who specialize in historic preservation. These experts can provide guidance on how to integrate the new heat pump system without compromising the building's historical integrity. This might involve developing renovation plans that respect the original architecture, using materials and methods that blend seamlessly with the historic elements, and ensuring that any modifications are reversible or minimally invasive.

Incorporating preservation strategies into the renovation plans not only helps protect the historical value of the buildings but also demonstrates a commitment to maintaining the community's cultural heritage. Communicating these efforts clearly to residents and stakeholders can enhance their acceptance of the new technology. Highlighting how the project balances modern energy efficiency with historical preservation can build confidence in the renovation process and address any potential objections related to the impact on historic structures.

4.7 Feedback and Continuous Improvement

Regular Feedback Mechanisms

Establishing regular feedback mechanisms is essential for the continuous improvement of the HAPPENING Solution and ensuring that the project meets the needs and expectations of residents. Feedback mechanisms provide a structured way for residents to voice their concerns, share their experiences, and offer suggestions for improvement throughout the project's lifecycle.

Surveys are a practical tool for gathering quantitative and qualitative feedback from residents. By designing and distributing surveys at various stages of the project — such as before implementation, during, and after the installation — project managers can collect valuable data on residents' satisfaction, identify any issues, and assess the effectiveness of communication and support strategies. Surveys can also be tailored to address specific aspects of the heat pump system, such as performance, ease of use, or comfort levels.

Community meetings serve as a platform for more interactive and in-depth discussions. These meetings allow residents to provide feedback in a group setting, ask questions, and engage directly with project representatives. They also provide an opportunity to address concerns in real-time and foster a sense of community involvement. Regularly scheduled meetings help to build trust and to keep residents informed about project progress and any upcoming changes.

Suggestion boxes offer a more informal way for residents to submit feedback anonymously. This can be particularly useful for gathering candid opinions from those who may be hesitant to speak up publicly. Suggestion boxes can be placed in common areas or accessed digitally, making it easy for residents to share their thoughts at their convenience.

By implementing these feedback mechanisms or others, project managers can create a responsive and adaptive approach to addressing issues and making improvements. Regular feedback not only helps in fine-tuning the implementation process but also demonstrates a commitment to resident satisfaction and engagement.

Learning from Experience

Learning from the experience of implementing the HAPPENING solution is crucial for refining the project and aiding the replication of similar initiatives in other communities. Documenting both the challenges encountered, and the successes achieved provides valuable insights that can inform future projects and enhance their effectiveness.

Documenting challenges involves capturing specific issues that arose during the project, such as technical difficulties, logistical hurdles, or communication breakdowns. Understanding these challenges allows project managers to develop strategies for overcoming similar issues in the future. Detailed records of how these challenges were addressed can also serve as a reference for other communities facing similar situations.

Recording successes is equally important. Success stories, such as effective solutions to problems, high levels of resident satisfaction, or notable improvements in energy efficiency, provide positive examples of what worked well. These successes can be highlighted in case studies and reports to showcase the benefits and effectiveness of the HAPPENING solution.

Sharing these learnings with other communities involves creating detailed case studies and guidelines based on the HAPPENING project's experience. Case studies should include an overview of the project, the challenges faced, the solutions implemented, and the outcomes achieved. Guidelines can offer practical advice on best practices, strategies for overcoming common obstacles, and tips for engaging with residents effectively.

4.8 Research Methodology

Finally, in order to effectively maximize the replication of the HAPPENING solution several, comprehensive methods should be employed to ensure that the system is adapted to various contexts and that it is successful in diverse settings. Each method provides valuable insights that contribute to the overall understanding and implementation of the solution.

Case Studies Analysis

This analysis entails a thorough examination of each demo site to collect data on various factors, including the demographic composition of the area, the economic conditions of the residents, and the technical challenges encountered during implementation. A detailed demographic analysis aids in understanding the needs and characteristics of the population served. Stakeholder interviews offer insights into the perspectives and experiences of those involved, while surveys quantify feedback on the system's performance and impact. Compiling and analysing this data allows project planners to identify best practices, potential pitfalls, and factors that contributed to the success or challenges of the initial implementations.

Comparative Studies

Comparative studies involve evaluating the findings from the HAPPENING project against other similar projects conducted globally. This comparison helps to identify common factors that influence the success of energy-efficient technologies and to pinpoint unique challenges encountered in different regions. By analysing similar initiatives, researchers can uncover patterns and trends that offer valuable lessons for replication. This method also highlights how different factors — such as local regulations, climate conditions, and cultural attitudes — affect the implementation of heat pump systems. Understanding these similarities and differences enables the adaptation of the HAPPENING solution to align with various global contexts, ensuring broader applicability and success.

Surveys and Interviews

Surveys can provide both quantitative and qualitative data on stakeholder attitudes, perceived benefits, and potential barriers, while interviews offer more qualitative insights into individual experiences and specific concerns. Engaging with stakeholders — including residents, local authorities, and community organizations — helps to tailor the solution to meet local needs and address any reservations or obstacles that may arise. This engagement ensures that the solution is both relevant and acceptable to the target audience.

Focus Groups

Focus groups facilitate in-depth discussions on various aspects of the system, including its adaptability to local conditions, potential modifications required, and any issues that need to be addressed. These discussions provide a platform for collaborative problem-solving and can generate innovative ideas for improving the solution. Engaging a diverse group of participants ensures that multiple perspectives are considered, leading to a more comprehensive and effective implementation strategy.

Demo Cases

Demo cases serve as pilot projects, facilitating the practical application of the system in various environments and conditions. Observing the system's performance and collecting user feedback during these trials allows project planners to identify necessary adjustments before wider rollout. Demo cases yield valuable data on system performance, user satisfaction, and potential improvements, aiding in refining the solution for broader application.

Policy Analysis

Policy analysis involves reviewing local, regional, and national regulations that may impact the implementation of the HAPPENING solution. This includes understanding incentives, subsidies, zoning laws, and building codes that could influence the adoption of new technologies. Identifying regulatory obstacles and opportunities enables project planners to navigate the regulatory landscape effectively and to advocate for supportive policies that facilitate successful replication.

5. Conclusions

In this document, several key strategies for future implementation of the HAPPENING solution are outlined.

According to these, success of this solution relies on early and inclusive stakeholder engagement. Engaging residents, local authorities, and community leaders early in the process helps build trust and fosters acceptance. Transparent communication and regular updates ensure stakeholders understand the project's goals, timeline, and benefits, thus reducing resistance. Tailored messaging, which accounts for the demographic and cultural characteristics of each community, is key. Younger residents may prioritize cost savings, while older ones might be more concerned with system usability and comfort. Addressing concerns early, particularly regarding disruptions or system complexities, is crucial for securing broad support.

Financial challenges, particularly the high upfront costs of energy-efficient systems, present a significant barrier to adoption. The guidelines recommend various financial mechanisms, including subsidies, low-interest loans, and other incentives, to make the HAPPENING solution more accessible to a wider population, especially in low-income communities. Additionally, communicating the long-term financial benefits—such as reduced energy bills and increased property values—helps convince residents that the initial investment is worthwhile. Transparent cost-benefit analyses and examples from similar projects can further build confidence and encourage adoption.

The technical success of the HAPPENING solution depends on its flexibility and adaptability. The system must accommodate various building types, from modern high-rises to older structures, and adapt to different climate conditions. Flexibility in both heating and cooling capacities ensures year-round efficiency and user comfort. Additionally, a user-friendly design is essential to the system's success. Complicated systems may lead to dissatisfaction or improper use. To prevent this, adequate training and support must be provided, ensuring that residents understand how to operate the system effectively.

Public health and quality of life improvements are additional benefits of the solution. The system can significantly improve indoor air quality by eliminating harmful emissions often associated with traditional heating systems. This is particularly important for vulnerable populations, such as children and the elderly, who are more susceptible to respiratory issues. Additionally, the solution offers enhanced thermal comfort, maintaining consistent indoor temperatures that prevent health risks associated with extreme weather conditions.

In addition, social dynamics are very important for the project success. Positive relationships between tenants and building owners, for example, can ease negotiations for system installation, especially when it requires shared financial contributions. Conversely, strained relationships may necessitate additional mediation or incentives. Recognizing and leveraging informal social networks within the community can help disseminate information more effectively and address concerns promptly.

To ensure the project's long-term success, regular feedback mechanisms should be implemented. These can include surveys, community meetings, and suggestion boxes, which allow residents to express concerns and provide input throughout the project lifecycle. Feedback helps project teams adjust strategies in real-time, ensuring continuous improvement and greater satisfaction among residents.

In conclusion by focusing on stakeholder engagement, financial incentives, technical flexibility, and continuous feedback, these guidelines addressed potential challenges along with the project's potential for success. The identified strategies will be essential for ensuring widespread adoption and long-term sustainability. Hopefully, sharing these learnings will facilitate the adoption of the HAPPENING solution (and similar ones) in the future.

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Annex II: Literature review from D6.1

According to recent studies[2], energy efficient renovation could potentially affect various socioeconomic variables:

- economic activity and employment
- fiscal impact
- environmental impact due to reduction of CO_2 emissions
- quality of life
- energy security

And among these potential impacts, the existing literature mainly focuses on the following aspects:

- labour markets, with a focus on occupations and skills
- household income
- public health

Regarding the first aspect, i.e., **labour markets, with a focus on occupations and skills**, according to the existing literature[3], investment in energy efficiency will likely:

(i) lead to net employment generation, being energy efficiency activities more labour intensive (and less capital intensive) than the production of energy saved.

(ii) lead to employment benefits as a result of the export potential of energy efficiency activities and / or from the substitution of imported energy.

(iii) increase building values and rentals as a consequence of improved energy efficiency. US data suggest that values of buildings with certified energy performance are 10-16% higher than similar non-certified buildings.

Concerning **household income**, the same studies claim that energy efficiency measures can lead to economic redistribution and poverty alleviation. Indeed, the excessive cost of energy primarily affects the poorest sectors of society, who often cannot afford energy costs to maintain a healthy environment at their homes, nor to have modern and energy-efficient homes. In this sense, this is probably the main social positive impact related to this Project and the one to focus on.

Strictly connected with the abovementioned aspect, there is the topic of the **public health**. Different medical studies[4] have identified several health conditions associated with cold housing, such as circulatory diseases, respiratory problems, and mental ill-health. A meta-analysis[5] of the impact of energy efficiency measures on health, synthesising research from 36

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[2] Davor Mikulić, Ivana Rašić Bakarić & Sunčana Slijepčević (2016) The socioeconomic impact of energy saving renovation measures in urban buildings, Economic Research-Ekonomska Istraživanja, 29:1, 1109-1125, DOI: 10.1080/1331677X.2016.1211952

[3] Assessing the Employment and Social Impact of Energy Efficiency, Cambridge Econometrics, 2015

[4] Xavier Bonnefoy, Inadequate housing and health: an overview, 2007

[5] Maidment et al (2014).

primary research studies, found a small but significant and positive effect of household energy efficiency measures on health, with significant health benefits, especially for children.

Regarding the social acceptance of energy efficiency activities, relying on a study[6] based on a comprehensive and holistic Social Sciences and Humanities (SSH) analysis, which is focused on European population, different levels of social acceptance are identified in different countries. In general, however, the study shows that there is a certain mistrust towards energy efficiency investments, mainly due to two factors:

(i) lack of knowledge on the subject

(ii) fear that economic return is not assured in this kind of investments

Other social barriers identified are the worry that these interventions will damage historic buildings, and the concern that tenants will not be able to continue to live in their homes during the renovation work. The study states that it is, therefore, necessary to start involving stakeholders from the earliest stages of the Project, so that they acquire awareness and can express their doubts and needs.

According to the abovementioned studies, the latter is undoubtedly the most common social barrier. If stakeholders are not adequately informed from the very beginning of the implementation of the project, they will tend to resist it especially if they are subjected to the inevitable impacts that every innovation brings with it. It is therefore appropriate to conduct information disclosure activities, so that all stakeholders are informed of both the benefits and the impacts of project implementation. This is especially crucial when a collective agreement is needed.

Another social barrier relates to those jobs whose usefulness may be reduced or eliminated as a result of the implementation of innovative solutions. For each innovation, it is appropriate to consider which technology will be replaced and how the associated supply chain will be affected. Usually, the best solution to mitigate this is to provide sector workers refresher courses on the new implemented technologies. However, when this is not possible, it is advisable to engage the affected workers and find a way out that satisfies all parties involved.

Finally, the last social barrier concerns those innovations that involve private investment. This barrier includes two sub-barriers, namely:

[6] Dawid Krysiński *, Paweł Nowakowski and Przemysław Dana, Social Acceptance for Energy Efficient Solutions in Renovation Processes, 2017

- High investment costs, long payback times, and lack of motivation connected to consumer priorities, attitude, and behaviour.
- Lack of awareness of financing opportunities.

In regard to the first, consumers' perceptions of prohibitive investment costs and long payback times along with lack of motivation in investing are a common problem for projects involving stakeholders as investors. In order to address these, the direct co-benefits of the intervention should be emphasised, the installation of innovative technologies should be done at the same time as other envisaged traditional works in order to reduce the time a building is unusable due to construction activities; emphasis should be put on those characteristics or attributes that the homeowner is more likely to value.

Concerning the second, it is typical that stakeholders are not properly aware of the financing opportunities which they can access to.

Annex III: Social Data of the demo sites from D6.1

Social data of Pasaia demo site

The Spanish Demo Case Building for the HAPPENING project is located in the Municipality of Pasaia, in the province of Gipuzkoa, in the autonomous community of Basque Country, northern Spain. The chosen building is a multi-family building with 8 dwellings.

In the demo building the proposed system consist of a neutral temperature water loop, the temperature of which will be maintained by means of central air-source heat pumps, and terminal micro water-source heat pumps for space heating and domestic hot water production. Domestic hot water will be then stored in an individual tank for each dwelling.

ALOKABIDE, a public social-housing entity is the owner of the building, and the residents are tenants of the dwellings. The residents have been engaged since the beginning of the Project, providing relevant information and also asking them for key information about their energy demands and uses to design the HAPPENING system.

Demographic characteristics of the Pasaia demo building are listed in Table A3.1.

Number of Tenants for each dwelling	• four (4) dwellings with 1 tenant • four (4) dwelling with 2 tenants
Age of tenants	• two (2) aged between 30 and 39 years old • three (3) aged between 40 and 49 years old • one (1) aged between 50 and 59 years old • three (3) aged between 60 and 69 years old • one (1) aged between 70 and 79 years old • two (2) tenants whose age data could not be collected
Occupation of tenants	• five (5) employees • four (4) unemployed • two (2) retired • one (1) disability pension recipient

Nationality of tenants	• eight (8) Spanish • two (2) Moroccan • one (1) Romanian • one (1) Colombian
Gender of Tenants	• six (6) males • six (6) females

Table A3.1: Demographic data of Pasaia building's residents

From this, it is possible to extract general demographic characteristics, namely:

- the residents of the dwellings are single individuals and couples
- they are of various nationality even though mostly Spanish (8 out of 12)
- regardless of age or type of resident family, all residents have presumably from very low to medium income

From which the following considerations can be deduced: (i) Spanish nationality (and especially being a native speaker) facilitates the engagement process also due to a stronger familiarity with national laws and bureaucracy, on the contrary residents of others nationality may need specific support to address bureaucracy-related issues and (ii) the level of income presumably does not allow for excessive expenditure (especially for unemployed and disabled residents) for the HAPPENING implementation, thus the financial support by external investors (and related stakeholder instruction on the use of the financing mechanisms) could be crucial.

Social data of Verzuolo demo site

The Italian Demo Case Building for the HAPPENING project is located in the Municipality of Verzuolo, in the Province of Cuneo in the region Piedmont, north-west of Italy. The chosen building is a multi-family building with 10 dwellings.

In this Demo building, the proposed system consists of a primary neutral temperature water loop and several micro heat pumps as terminal units.

In the Italian Demo Case, all the dwellings have the same owner namely the Delgrosso family. Thus, residents are tenants, and the flats are now rented out under a lease agreement.

Although not being owners and having a limited voice in the decision-making process, the tenants were involved in the stakeholder engagement process. According to the information provided, each tenant has been met individually by the owner and TECNOZENITH technicians.

Demographic characteristics of the Verzuolo demo building are listed in Table A3.2.

Number of Tenants for each dwelling	• seven (7) dwellings with 1 tenant • two (2) dwellings with 2 tenants • one (1) dwelling with 3 tenants
Age of tenants	• one (1) under 10 years of age • two (2) aged between 21 and 30 years old • eight (8) aged between 31 and 40 years old • one (1) aged between 51 and 60 years old • two (2) aged between 61 and 70 years old
Occupation of tenants	• one (1) driver • three (3) office workers • three (3) agricultural workers • four (4) construction workers • two (2) hawkers
Nationality of tenants	• three (3) Italians • five (5) Romanians • four (4) Albanians • one (1) Palestinian • one (1) Malian
Gender of Tenants	• nine (9) males • five (5) females

Table A3.2: Demographic data of Verzuolo building's residents

From this, is possible to extract general demographic characteristics, namely:

- The majority concentration of residents in the 30-40 age group

- The variety of nationalities among the residents of the dwellings

The fact that most of the residents are between 30 and 40 years old is a positive factor, as their relative youth indicates a tendency to be more open to changes (such as the HAPPENING solution) and the inevitable problems associated with them.

Conversely the variety of nationalities may indicate a difficulty on the part of foreign residents in properly receiving information and expressing their opinions. For this reason, throughout the stakeholder engagement phase, it should be ensured that the level of mutual understanding is adequate and if not, an interpreter should be used.

Social data of Liezen demo site

The Austrian Demo Case Building for the HAPPENING project is located in the Municipality of Liezen, which is the district capital of the Bezirk Liezen, located in the federal state of Styria, in the centre of Austria. The chosen building is a multi-family building with 20 dwellings.

The building is owned by the non-profit social housing company GWS. Being it a social housing, even if the residents are not owners, they have a strong say in the decision-making process, differently from the Italian housing demo.

According to the information provided, tenants were engaged through a resident survey, tenants were informed first by email and followed by bilateral meetings to explain the system and installation procedure.

Demographic characteristics of the Liezen demo building are listed in Table A3.3.

Age of tenants	• four (4) aged between 21 and 30 years old • five (5) aged between 31 and 40 years old • four (4) aged between 41 and 50 years old • three (3) aged between 51 and 60 years old • three (3) aged between 61 and 70 years old • one (1) aged between 81 and 90 years old
Nationality of tenants	• seventeen (17) Austrians • one (1) Syrian • one (1) Afghan • one (1) Italian

Gender of residents	• eleven (11) males • seventeen (17) females • six (6) children

Table A3.3: Demographic data of Liezen building's residents

Annex IV: Stakeholders Survey

17 different residents replied to the survey. The following are the results of each question submitted.

1) What location do you reside in?

   Of the 17 respondents, 7 resides in the Pasaia Demo Case, 6 in Verzuolo and 4 in Liezen:

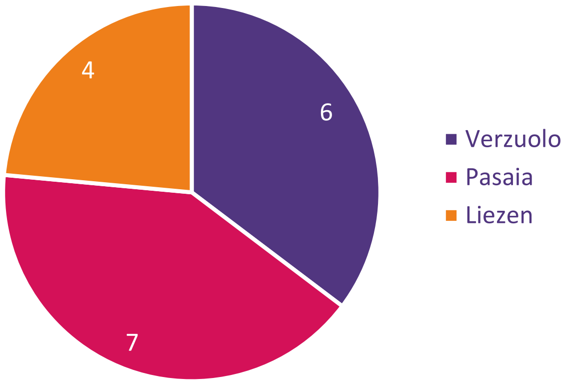

Figure A4.1: Respondents' residence

2) How many people live in your housing unit?

   Of the 17 respondents, 6 households are composed of one person, 6 of two persons, 3 of three persons and 1 of six persons:

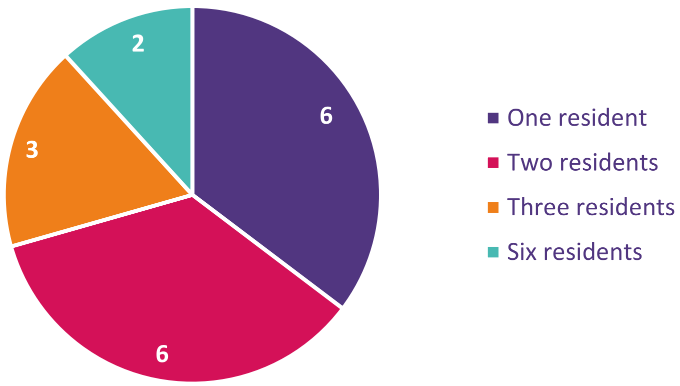

Figure A4.2: Residents in housing unit

3) How long has the HAPPENING solution been in operation?

   Of the 17 respondents, 6 (all from Verzuolo) have seen the HAPPENING solution in operation for more than a full summer-winter cycle, while 11 (all from Pasaia and Liezen) for less than a full cycle using the solution only to heat the house during winter:

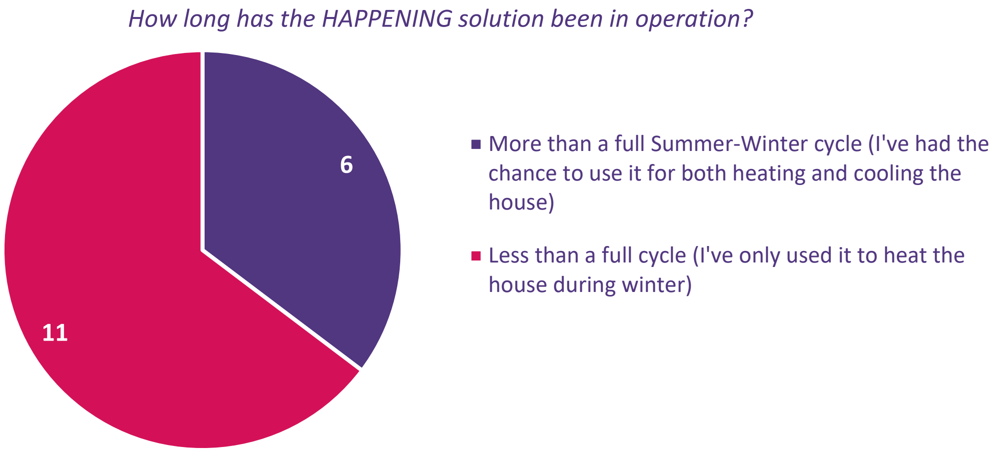

Figure A4.3: Duration of operation phase of the HAPPENING Solution

4) How satisfied are you with the heating capabilities of the HAPPENING solution?

   16 of 17 respondents replied to this question. From them, it emerges that the average rating in terms of the satisfaction of the heating capabilities of the HAPPENING solution is 7.44:

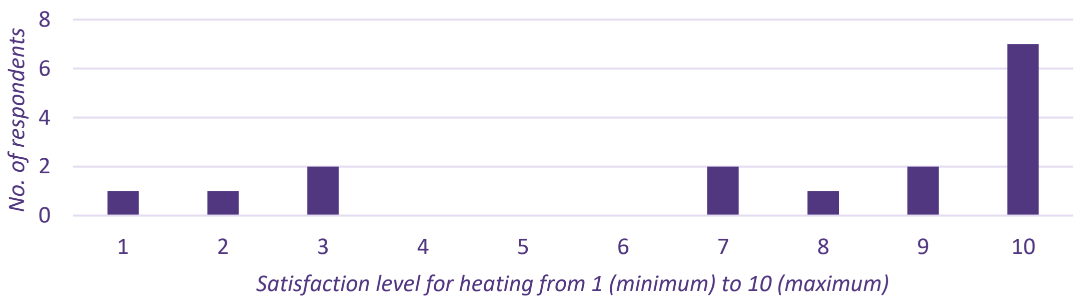

Figure A4.4: Level of satisfaction for the heating capabilities (1 minimum and 10 maximum)

5) What issues have you encountered, or what suggestions and observations do you have regarding the heating capabilities of the HAPPENING solution?

   16 of the 17 respondents replied to this question, the following are their responses:

#	Feedback about heating service
1	*Nothing, zero problems*
2	*Zero problems, the HAPPENING solution is better*
3	*The inability to control the thermostat as desired*
4	*HAPPENING is better*
5	*Repeatedly no hot water! Especially on weekends when no one can help!*
6	*The hot water and heating fail very, very often, which never happened with gas! Furthermore, the costs have increased by 100 €, which is far too high for supposed cost savings!!!*
7	*It didn't heat up. I called several times because it was cold, and they came many times to check the white appliances and then gave me a heater*
8	*Noisy and ineffective, it was cold*
9	*None*
10	*None*
11	*The heating takes time to warm up*
12	*It takes longer to warm up*
13	*Heats up quickly*
14	*None*
15	*None*
16	*Everything worked satisfactorily. Since I only used the HAPPENING solution for hot water (heating was rarely needed, my small cozy wood stove was sufficient), I couldn't answer question 5.*

Table A4.1: Comments on the heating capabilities

6) How satisfied are you with the cooling capabilities of the HAPPENING solution? (Do not respond if not applicable)

6 of 17 respondents replied to this question, all from Verzuolo demo case, as in Pasaia ansd Liezen there is no cooling service. From them, emerges that the average rating in terms of the satisfaction of the cooling capabilities of the HAPPENING solution is 7.83:

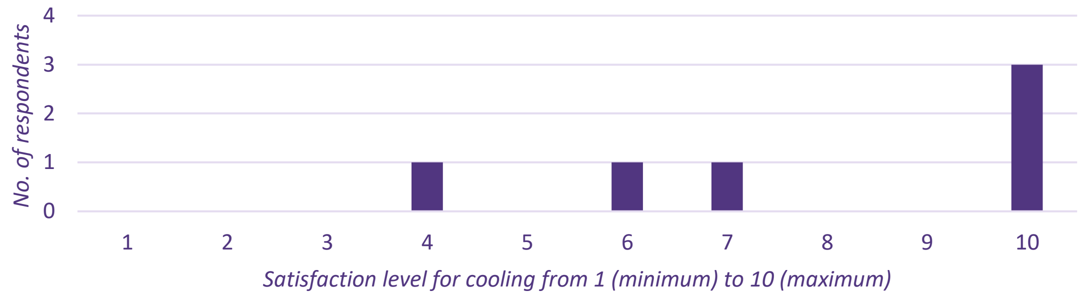

Figure A4.5 Level of satisfaction for the cooling capabilities (1 minimum and 10 maximum)

7) What issues have you encountered, or what suggestions and observations do you have regarding the cooling capabilities of the HAPPENING solution? (Do not respond if not applicable)

6 of the 17 respondents replied to this question, the following are their responses:

#	Feedback about cooling service
1	*Nothing, zero problems*
2	*Zero problems, the HAPPENING solution is better*
3	*The inability to control the thermostat*
4	*ZERO PROBLEMI*
6	*It didn't cool much, especially the living room. The machine turned on and made noise but cooled little*
7	*The cooling worked quite well*

Table A4.2: Comments on the cooling capabilities

8) Who borne the implementation costs of the HAPPENING Solution?

Of the 17 respondents, 6 replied that the costs were borne by the property owner, while 1 replied that they were borne by himself. Nevertheless, the latest probably misinterpreted the question, being that, according to the information provided, in all the three demo cases the implementation costs were assumed by the property owner.

9) How much the HAPPENING Solution have reduced the energy consumption

Of the 17 respondents, 5 replied that they have greatly reduced the energy consumption, 2 that they have lowered it (not slightly nor greatly), 3 that they have slight lowered it, 1 that energy consumption remained the same, 1 that energy consumption greatly increased and 5 that they don't know:

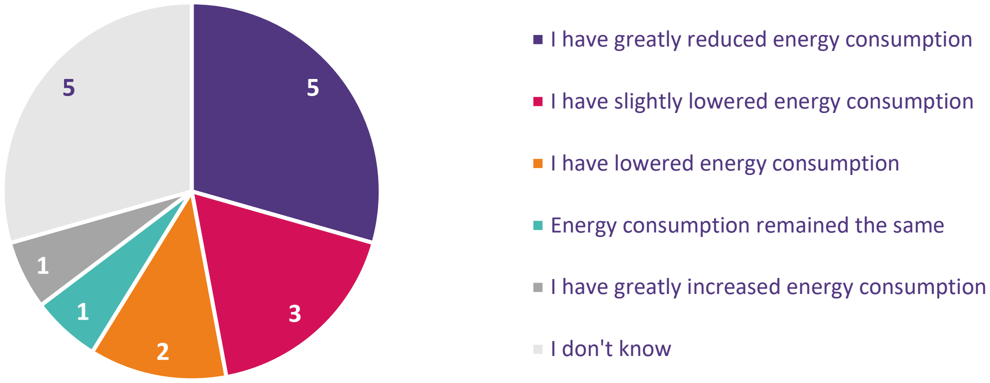

Figure A4.6: Energy Consumption

10) Taking into account the answer to the previous question, this has had an impact on energy expenses that I would describe as:

Of the 17 respondents, 8 replied that they assess the impact as significant, 2 as medium, 2 as negligible, 1 that there has been no saving, 1 that expenses have increased and 3 that they don't know:

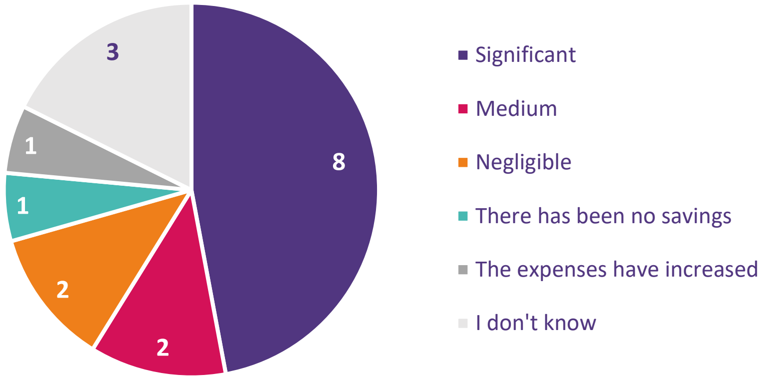

Figure A4.7: Impact on energy expenses

11) Do you have any further comments regarding the HAPPENING solution and its features (such as noise, space occupancy)?

    Of the 17 respondents, 12 replied to this question. The following are their responses:

#	General feedback
1	*No*
2	*HAPPENING is better*
3	*Nothing, HAPPENING solution is the best*
4	*Machines sometimes noisy and do not work*
5	*No*
6	*None*
7	*None*
8	*None*
9	*None*
10	*It makes noise when it starts, but it is acceptable. This solution is important since we are damaging the planet*
11	*None*
12	*Noise: indeed, the box is somewhat loud. Space requirement: in the garden? The radiators in the apartment are not that small. There was nothing there before, so the living space has become somewhat smaller.*

Table A4.3: General comments on HAPPENING Solution

12) Overall, how satisfied are you with the HAPPENING solution?

    All the 17 respondents replied to this question. From them, emerges that the average rating in terms of the satisfaction of the HAPPENING solution is 7.35:

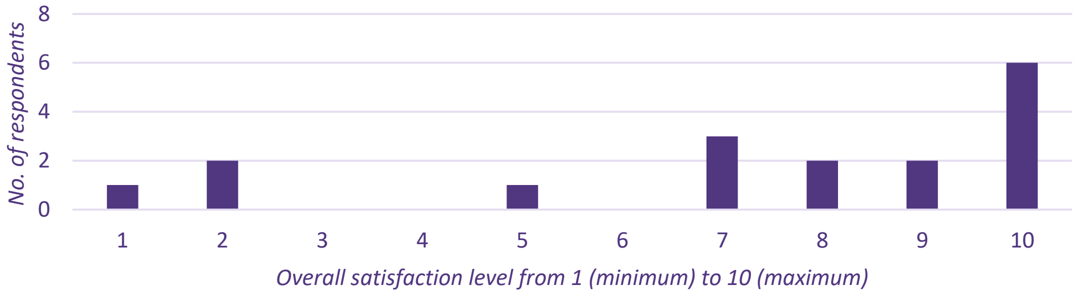

Figure A4.8 Level of satisfaction for the HAPPENING Solution(1 minimum and 10 maximum)

13) Would you recommend the HAPPENING solution?

All the 17 respondents replied to this question. Of them, 12 replied “Yes”, 4 replied “No” and 1 “I Don’t Know”:

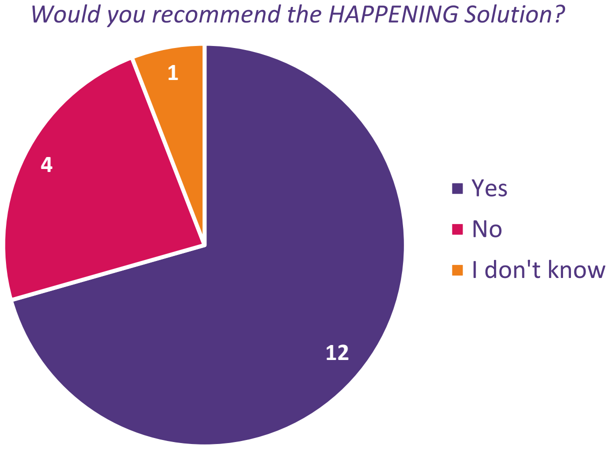

Figure A4.9: Recommending HAPPENING Solution

Annex V: Data from HAPPENING implementers

During the workshop, conducted at the end of the Project implementation, all the involved HAPPENING implementers have been asked to provide their opinions on the implementation process, more specifically on (i) challenges encountered, (ii) what worked / points of strength, (iii) lessons learned, and (iv) suggestions / area of improvement.

The following are the main outcomes for each point:

1) Challenges Encountered:

- Procedures and Permissions:
  - Complex procedures, regulations, and permits required.
  - Need for permissions to perform installations in or through private spaces.
  - Permissions from city councils and DSOs for installations, such as external HP units on facades and PV connections to the grid.
- Stakeholders:
  - Misalignment within stakeholders, particularly tenants.
  - Difficulty in achieving 100% agreement in condominiums.
  - Communication challenges with tenants and building owners.
  - Older individuals may not perceive the benefits.
- Physical Constraints:
  - Space limitations for installing new heat pumps (HPs) in dwellings or central technical rooms.
- Coordination and Installation:
  - Need for coordinated installation works.
- Public Perception and Maintenance:
  - Difficulties in explaining the benefits to the general public.
  - Potential noise issues bothering users.

  - More complex systems require more maintenance.
- Financial Considerations:
  - High capital expenditure (CAPEX) costs.
  - The producer of the HAPPENING system holds a monopoly, affecting competition.

2) What worked / Points of strength:

- Tenant Appreciation:
  - Cooling system is appreciated by tenants.
- Operational Savings and Efficiency:
  - Lower operational expenditure (OPEX) due to high efficiency.
- Versatility and Adaptability:
  - Versatile solution adaptable to different needs, including various configurations for winter and the possibility of cooling.
- System Explanation:
  - The complex system has been effectively explained to users.
- Environmental and Safety Benefits:
  - Improved air quality in cities due to the absence of fossil fuels.
  - Enhanced safety with no gas usage.
  - Increased energy independence through no gas reliance and locally generated electricity with photovoltaic (PV) systems.
- Cost-Effective Energy Storage:
  - Cost-effective energy storage via hot water tanks, cheaper than electric batteries, providing internal system flexibility and operational optimization.

3) Lessons learned:

- Challenges with Multi-Property Buildings:

   - Greater difficulty in getting multi-property buildings on board.
- Customer Communication and Education:
   - Need for detailed explanations of the central heating system's cost structure to avoid customer dissatisfaction.
   - Importance of clear and fluent communication with tenants.
   - Planning work schedules with tenants for dwelling-level installations.
- System Flexibility and Seasonal Adjustments:
   - Adjusting season limits is challenging, though the system provides technical flexibility to address this.
- Maintenance and Commissioning:
   - Complex systems require additional maintenance and have more difficult commissioning processes.
- Deployment and Design Considerations:
   - Keep prototypes close to the main operation site.
   - Standard design/installation procedures may not always apply; attention to specific details is necessary.
- Administrative Preparation:
   - Advance paperwork, permissions, and bureaucratic processes as much as possible.
- Functionality and Benefits of the HAPPENING Solution:
   - Recognizing the HAPPENING solution's functionality and benefits.

4) Areas of improvement:

- Customer Expectations:
   - Better manage customer expectations.
- Project Outcomes:
   - Clearly outline project outcomes, including guides and other documentation.
- Installer and Community Engagement:
   - Convince installers of the benefits of HAPPENING heat pumps (HPs).

  - Involve key community members to increase acceptance.
  - Increase social awareness about the project.
- Support and Guidelines:
  - Assist administration in installing HPs by preparing guidelines.
- Demonstrations and Commitment:
  - Ensure a functioning demonstration of the system.
  - Secure real commitment from institutions to simplify and speed up permissions and bureaucratic procedures.