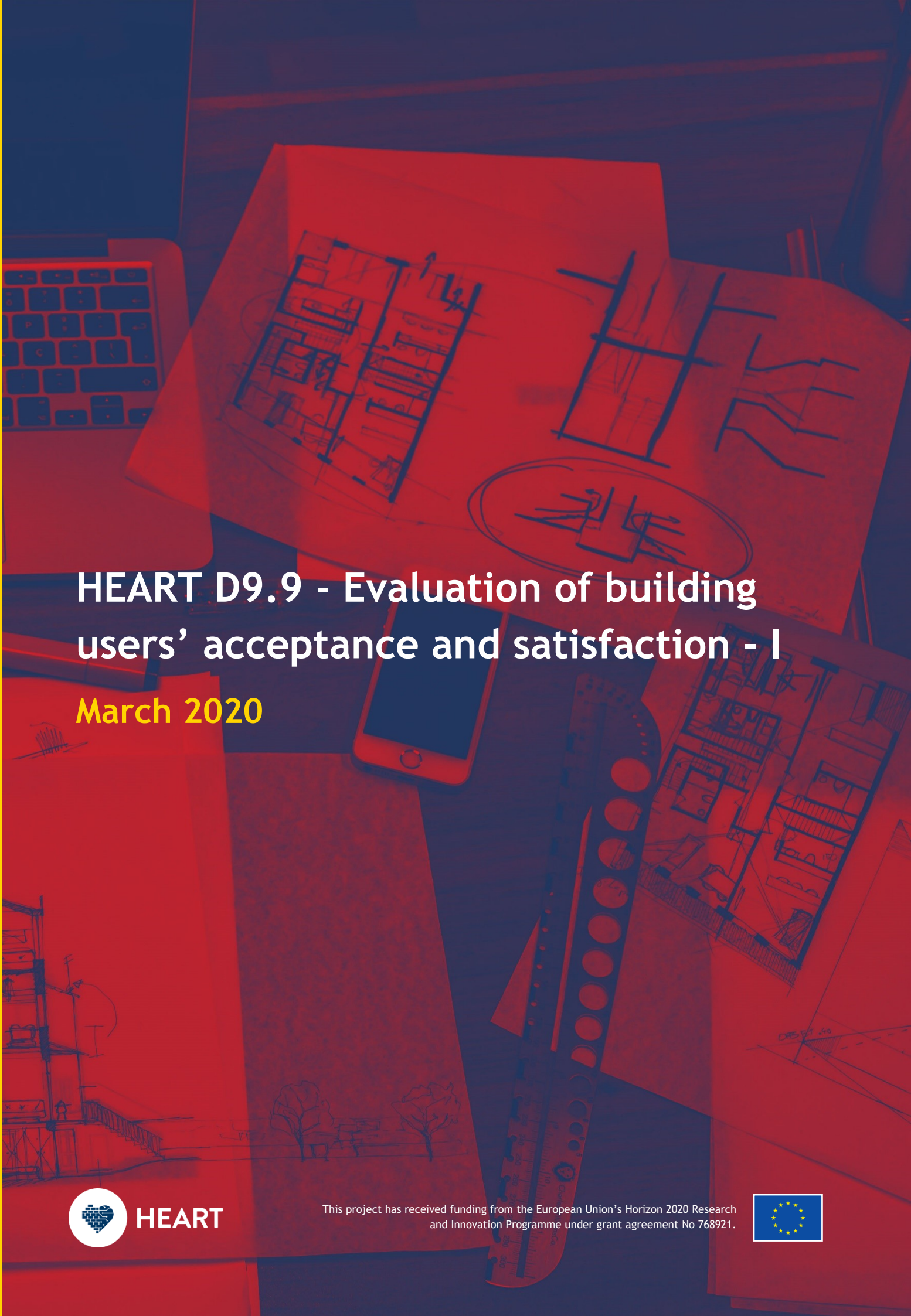

HEART D9.9 - Evaluation of building users' acceptance and satisfaction - I

March 2020

HEART

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EXECUTIVE SUMMARY

Considering the current status of the research, the present report describes the assessment of the ex-ante satisfaction and acceptance of residents regarding their current situation and the retrofit in sight.

More in detail, the target groups of this work are the tenants of the two buildings managed by ACER (Italy) and EMH (France).

This report focuses on the first deliverable on the same topic (D 9.9a) due in month 30 of the project. The second one (D 9.10) will be delivered in M48 at the end of the project in order to take into account of the results of the renovation works performed with the HEART project.

1. INTRODUCTION

1.1. DESCRIPTION OF TASK 9.4

The HEART renovation toolkit is tested in real-life situations. The on-field demonstration of the technologies developed has to ensure the overall quality, performance and cost-effectiveness of the solutions developed in HEART.

Task 9.4 is about the Analysis of building users acceptance and satisfaction. Housing Europe has been working on this task together with the social housing providers ACER (IT) and Est Metropole Habitat (FRA), that are involved as consortium partners in the demonstration of the HEART retrofit toolkit in inhabited buildings.

To ensure the feasibility, quality, acceptance and, finally, the market uptake of the proposed solutions it is key zoom-in on the user's acceptance and satisfaction in these demonstration projects. In this task the involved partners set up specific questionnaires and interviews to zoom-in on the buildings users acceptance and satisfaction, starting from the beginning of the retrofit intervention until the end of the project.

Task 9.4 takes place between Month 23-48 (HE, ACER, EST).

1.2. METHODOLOGY

To assess the satisfaction and acceptance of residents, Housing Europe developed a questionnaire with ACER and EMH to get a better understanding of the residents' opinions.

Assessing the buildings user's acceptance and satisfaction of the demonstration projects helps to inform certain decision within the project and to ensure that techniques and solutions are adapted to the users' needs and demands.

The questionnaires have been developed specifically taking into account the profile of the tenants. The use of technical language was prevented and questions were formulated in a way that reflect the situation and position of tenants (see Annex 1). The survey was translated in French and Italian. The survey was conducted

(in French and Italian) by employees of the two social housing providers during face-to-face meetings with tenants.

The target group of this questionnaire are the tenants of the two buildings managed by ACER and EMH. The survey questions were intended to take into account several dimensions of the building users' experience: the household, the dwelling, the building and the surrounding community.

The surveys were conducted during the first half of 2018 in the case of ACER (IT) and the first half of 2019 in the case of EMH (FR).

Figure 1 – Satisfaction and acceptance dimensions assessed

1.3. SCHEDULE

Questionnaires are used before and after the renovation to compare the development of the satisfaction about the different aspects of the toolkit and the overall perception of tenants, according to the following schedule.

	ACER pilot	EMH pilot
Initiate ex-ante questionnaire and interviews	**06/2018 (M9)**	**12/2018 (M15)**
Receive responses ex-ante questionnaire	**09/2018 (M12)**	**03/2019 (M18)**
Start renovation	*09/2019 (M24)*	*05/2020 (M32)*
Initiate ex-post questionnaire and interviews	*05/2020 (M32)*	*12/2020 (M39)*
Receive responses ex-post questionnaire	*07/2020 (M34)*	*01/2021 (M40)*
Reports on user satisfaction and acceptance (HE)	*09/2020 (M36)*	*04/2021 (M43)*
Final report Case 1 and 2 (HE)	06/2021 (M45)	

1.4. DESCRIPTION OF PILOT PROJECTS

The location of the ACER demonstration project is Bagnolo in Piano, Reggio Emilia, Italy. The building is a large multifamily house realized on 1985 distributed in 2 staircases on 4 floors. It has an overall gross volume of 1,900 m^3 and a net surface of about 636 m^2 subdivided in 12 units.

The demonstration case of EMH (FR) is located near Lyon, France. The building is a large multifamily house realized on 1975, distributed in 3 staircases on 5 floors. It has an overall gross volume of 4160 m^3 and a net surface of about 1300 m^2 subdivided in 18 units.

Figure 2 - Left: demo case in Bagnolo in Piano (IT). Right: demo case Villeurbanne, near Lyon (FR)

2. INSIGHTS & OUTCOMES

2.1. SURVEY RESULTS

2.1.1. Observations from ex-ante survey in the ACER demo

Summary

1. Respondents are **relatively old and are relatively often at home** during the week and during the year. There is preference for communication via post and very low preference to use apps.

2. **Information and consciousness about absolute and relative energy usage is quite low.** At the same time the level of the energy bill does not seem to be a huge concern for most tenants. While most find the temperature during the winter good, there is more concern about the heat during summer.

3. **A large majority wants to improve the efficient use of energy.** Contrary to general assumptions, environmental motivations seem to play a strong part.

We notice a **strong belief in new technology to improve comfort and efficiency levels** in dwellings – although IT communication is not necessarily a favoured channel for many. At the same time, most do strongly agree that **people need to be able to control the energy** themselves, even if this leads to less energy efficiency.

These is a lack of knowledge or information about how to compare one own's usage in terms of energy efficiency.

The willingness to pay (+/-EUR30) for a home display that provide real time info is limited. Half of the respondents also **disagree to receive data on energy consumption on their cell phone.** However, most trust that the new system is able to automatically adjust the levels of comfort and efficiency in homes.

On average, respondents prefer a temperature of 20-21 °C when they are at home and 18-19 °C when they are not.

4. There is almost **complete support for the renovation work and the presented plans.** Almost all respondents wish to be informed about new energy-technical aspect of their building during meetings.

5. According to the respondents the top 3 of most needed improvements in the building are:

1) **Lower the energy bills**
2) **Improve the use of renewable energy**
3) **Improve cooling**

6. Regarding housing affordability, **a share of the tenants does not seem very aware of the share of household income dedicated to rent**. At the same time, one third of them indicate more than 20% of household income goes heating and electricity costs. **Half of them do not know which share this is.** The majority expects savings on housing costs (including energy) to be higher than 10% after the renovation.

7. The attractiveness and security of the surrounding community of the building are rated very poorly. When asked to rate their community, it scores between 6-8 on the scale of 10.

General conclusions

- 10 out of 12 questionnaires/apartments answered (two did not want to participate).
- 6 female and 3 male respondents.
- 70% of respondents older than 60 years. None are below 30 years old.
- 3 out of 10 respondents have children.
- During the week around 50% leaves the home from 9.00 – 12.00.
- During the week around 25% leaves the home from 9.00 – 18.00.
- All 10 respondents are at home at 19.00.
- Approx. 50% leave the home for 1-2 weeks per year.
- Approx. 33% leave the home for 5-6 weeks per year.
- One respondent leaves the dwelling empty for more than 6 weeks for holiday (90 days).
- One respondent (nr 8), answers he never leaves for holiday.

To the question "What would you be willing to do to [to become more energy efficient]?" Only 1 respondent said they would be willing to dress heavier and keep a low temperature. 8 respondents would reduce the temperature using the heating valves. At the same time, 7 out of 9 say they wear extra clothing as the first thing they if they feel very cold.

Preferred ways how to receive information on consumption and advice on how to reduce it:

- 7 out of 10 by post once a month
- 1 out of 10 through an app on smartphone
- None would not like to receive information

Dwelling satisfaction

- 6 out of 9 somewhat or completely dissatisfied by the sound insulation.
- 6 out of 8 have no opinion when asked about their control of ventilation.
- 6 out of 9 have no opinion when asked about the information about energy use.
- 9 out of 9 are somewhat or completely satisfied about the ventilation.
- 3 out of 9 only are somewhat dissatisfied about the level of the energy bill; no one is dissatisfied; 2 have no opinion and 4 are somewhat satisfied.
- Satisfaction of rest of building areas: 4 out of 9 dissatisfied or somewhat dissatisfied.
- Temperature during winter: 6 out of 9 find it good, only 1 out of 9 finds it too low (person commented he is not able to raise it).
- Temperature during summer: for 5 out of 9 it is too high.

Self-assessment of energy behaviour

- "I am conscious about my energy use": only 3 out of 10 agree.
- 4 out of 8 know about the energy labelling of home appliances and buildings.
- 7 out of 8 do Agree or Strongly agree they want to improve efficient use of energy.
- 8 out of 8 do Agree or Strongly agree that new technology helps to improve comfort and efficiency levels in dwellings.
- Motivation to decrease energy usage: 6 out of 10 Agree or Strongly agree it is to save on energy costs and 9 out of 10 Agree or Strongly agree to limit CO2 emissions in the environment is a motivation to decrease energy usage. Contrary to general assumptions, environmental motivations seem somewhat stronger than financial ones in this group.
- 5 out of 8 Agree or Strongly agree that they need to be able to control the energy themselves, even if this is less energy efficient.
- 6 out of 8 regularly change clothes instead of regulating the temperature.
- 3 out of 9 are neutral (or don't know) when asked if they are already energy efficient and 3 out of 8 are neutral (or don't know) when asked if they are conscious about their energy use. This might point to a lack of knowledge or information about how to compare one own's usage. This seems confirmed because most respondents are neutral when asked if they are more energy efficient than most of their neighbours (5 out of 8).
- 3 out of 9 Strongly disagree willing to pay (+/-EUR30) for home display w/ real time info on energy management. 4 out of 9 Agree or Strongly agree.
- 4 out of 8 Disagree or Strongly disagree to receive data on energy consumption on cell phone. Only 3 out of 8 agree.
- 6 out of 8 agree or strongly agree that new systems are able to automatically adjust the levels of comfort and efficiency in homes.
- 6 out of 9 greatly worry about saving energy. One respondent does not worry at all.
- Preferred temperature when adjusting at home? 6 out of 7 chose 20-21 °C.
- Preferred temp when you are NOT at home? 6 out of 7 chose 18-19 °C.
- One person cannot adjust the temperature in his home, it is always too hot. Another person complains about broken blinds and not being able to fix them to prevent water from coming in.

Acceptance of the renovation works

- 9 out of 10 believe building needs a renovation, 10 out of 10 agree with the renovation
- On a scale of 1-10 how satisfied are you about the ideas about the renovation works? 5 out of 7 rate the plan between 7 and 10
- 9 out of 10 respondents wish to be informed about new energy-technical aspect of their building, majority (7) during meetings, the rest (3) via brochure/leaflet.

Tenants satisfaction about involvement

- Most needed improvements in building in their opinion:
    - Lower bills
    - Improve the use of renewable energy
    - Improve cooling
- One person commented: “What if I end up spending more than now?”]

Housing costs

- 4 out of 10 don’t know what % of household income is dedicated to rent, 3 out of 10 spend > 20%
- Economic effort regarding energy costs (heating and electricity)? 3 out of 10 > 20% of household income and 5 out of 10 don’t know
- Estimated savings on housing costs (incl. energy) after renovation? 4 out of 10 don’t know and 4 out of 10 says > 20%

General satisfaction about the community

- Attractive: 5 out of 9 Strongly disagree
- Beautiful: 5 out of 9 Strongly disagree
- Secure: 7 out of 9 Strongly disagree or Disagree
- Accessible (for persons with disabilities): 4 out of 9 Strongly disagree or Disagree
- On a scale of 1-10 how satisfied are you with the quality of life in your community? 8 out of 9 rate it between 6-8

2.1.2. Observations from ex-ante survey results in the EMH demo

Summary

In the EMH demo case the respondents were younger and more mixed in terms of age and background compared to the persons in the ACER demo case.

None of the respondents would like to receive information through a smartphone app. However, they would like to be informed in real time on energy through a table or phone app, the large majority agrees (8 out of 11). However, 10 out of 12 are not willing to pay for this service (only one is willing, and another respondent has no precise opinion).

- 10 out of 11 are dissatisfied with the level of energy bills they pay

- All 13 respondents believe building needs a renovation. The majority of respondents feel they have been informed about the renovation at least to some extent, but 4 feel they have not been sufficiently informed or not at all.

- A large majority (11 out of 13) would like to be informed about new energy/technical aspects of the building. Mainly during meetings

Most needed improvements in building in their opinion:

- Lower bills (11 replies)
- Improve heating (7 replies)
- Improve ventilation (6 replies)

8 out of 12 respondents believe the renovation project may have a positive impact on the community, in terms of:

- Clean: 9 disagree and 4 agree
- Secure: 9 disagree and only 2 agree (2 have no opinion)
- Accessible (for persons with disabilities) 8 disagree, 4 agree and one have no opinion
- Energy efficient: 9 disagree and 4 agree

General

13 out of 26 questionnaires/apartments answered. Households interviewed include 9 male and 7 female adults but 3 respondents did not provide the information. All respondents who did provide information on age (10 households altogether) are between 30 and 60 years old.

In terms of household composition replies are very mixed: 4 are couples with one or more children, 4 are couples without children, 4 are persons living alone and one is a single parent with child

During the week around four households leave the home (times vary between 7.00 to 18.00, with a peak at 12.00) During the weekend one household leaves the home the whole weekend.

Approx. 50% of those who replied the question leave the home for 1-2 weeks per year (4 respondents, who state they usually leave for a week). Other respondents have different habits: one leaves home less than a week per year, one between 3 and 4 weeks, and one for more than 6 weeks. 4 respondents did not provide precise information on this point.

To the question **"What would you be willing to do to [to become more energy efficient]?"** 8 replied they are willing to reduce the temperature when they're not at home and 6 are willing to dress heavier. 3 respondents say they're not willing to do anything and none mentioned reducing the temperature using valves.

6 respondents replied the first thing they do when feeling cold is to wear extra clothing, 5 raise the temperature and 2 drink something hot

Preferred ways how to receive information on consumption and advice on how to reduce it:

6 out of 13 by email; 4 by post (this option was not included as such but those who replied 'other' specified so); 3 would rather not receive information; None of the respondents would like to receive information through a smartphone app;

Dwelling satisfaction

8 out of 13 are dissatisfied with the dwelling size, 4 are satisfied and 1 has no opinion

8 out of 13 are dissatisfied with sound insulation and 5 are satisfied

9 out of 12 (one didn't reply) are dissatisfied with indoor climate

10 out of 11 (two didn't reply) are dissatisfied with the level of energy bills they pay

8 out of 13 are satisfied with the heating, 4 are dissatisfy and one has no opinion on this point

Opinions on ventilation are more mixed, with 7 dissatisfied and 5 satisfied (and one missing answer)

Only three respondents are dissatisfied with condensation issues (such as mould) and the same number claim having respiratory issues

8 respondents out of 11 are satisfied with the possibility to control temperature and only 3 are not satisfied (2 didn't answer).

Opinions on temperature during winter are mixed: 6 respondents believe it's too low while 5 believe it's good. Only one respondent believes winter temperature is too high, and one has no opinion.

Temperature during summer is considered to be too high by 6 respondents and good by 7.

Self-assessment of energy behaviour

7 out of 12 agree their motivation to decrease energy use is to limit CO2 emissions in the environment, while 2 disagree and 3 feel neutral about CO2 emissions

Only 4 out of 11 respondents state they enjoy living as they please even if their behaviour is not energy efficient. However, 8 out of 13 agree that they need to be able to control the energy themselves even if this is less energy efficient.

8 out of 12 respondents agree that they and their neighbours would be more energy efficient if they could control their energy use

6 out of 11 respondents claim they are already energy efficient but 5 disagree with this statement

7 out of 11 respondents regularly change clothes instead of regulating the temperature, while 4 do not

All except one respondent open the window during the day (7 once for a few minutes and 5 several times). They do so mainly to refresh the home in the morning (12 replies) and to eliminate odours (7 replies).

When asked whether they would like to be informed in real time on energy through a table or phone app, the large majority agrees (8 out of 11). However, 10 out of 12 are not willing to pay for this service (only one is willing, and another respondent has no precise opinion).

Acceptance of the renovation works

All 13 respondents believe building needs a renovation. The majority of respondents feel they have been informed about the renovation at least to some extent, but 4 feel they have not been sufficiently informed or not at all.

The large majority (11 out of 13) would like to be informed about new energy/technical aspects of the building. The preferred way of receiving information varies: 5 respondents indicate they would like to be updated during meetings, 3 by post, 2 via a website and 1 through a brochure/guide.

Tenants satisfaction about involvement

In terms of their involvement in the renovation work, 6 respondents state they receive information, 4 have no opinion and 3 claim they have not been involved.

Most needed improvements in building in their opinion:

1) Lower bills (11 replies)

2) Improve heating (7 replies)

3) Improve ventilation (6 replies)

Housing costs: unlike in the pilot in Reggio Emilia, costs were not covered by the questionnaire delivered by EMH in Lyon.

General satisfaction about the community

Respondents were asked whether they agree of not that their building (including common areas) and neighbourhood is:

- Attractive: 7 out of 13 disagree, the remaining 6 either disagree (3) or have no opinion (3)
- Beautiful: 6 out of 13 disagree, 4 agree and 3 are neutral
- Clean: 9 disagree and 4 agree
- Secure: 9 disagree and only 2 agree (2 have no opinion)
- Accessible (for persons with disabilities) 8 disagree, 4 agree and one have no opinion
- Energy efficient: 9 disagree and 4 agree
- Environmentally friendly: 7 disagree, 2 agree and 4 have no opinion

8 out of 12 respondents believe the renovation project may have a positive impact on the community

On a scale of 1-10 how satisfied are you with the quality of life in your community? 5 rate it between 4 and 6, another 5 rate it between 1 and 3, and only one gave a very positive mark (9).

External spaces

Unlike the pilot in Reggio Emilia, some of the questionnaires delivered in Lyon included a question about external spaces, and more precisely on the type of plants respondents would like to have near their building (berries, aromatic plants, flowers, other). 3 respondents out of five would be happy to take care of the plants in front of their entrance.

2.1.3. Initial conclusions from the ex-ante survey results

It is hard to draw general conclusions from the surveys due to the limited group and number of respondents. Also, the people living in the dwellings in the two demo sites show important differences in terms of age,

cultural and geographic background and situations. Some of the most noticeable outcomes that were observed are summarized here:

- **Low awareness about energy costs:** the level of information and awareness about absolute and relative (as % of their income) energy (and housing) costs is low**.** Although many tenants do not seem very aware of the level of their income they dedicate to rent and energy, there is an interest to "become" more energy efficient.

- **Communication towards tenants about renovation works should include direct face-to-face and 'offline' channels.** Both in the EMH and ACER cases the tenants preferred meetings and (clear and brief) brochures/leaflets seem to be preferable to inform them about the new energy/technical aspects of the building and the renovation process.

- **Information about real time use of energy** was welcomed in the EMH case through a tablet or phone app, while in the ACER case half of the respondents did not want to receive data on energy consumption on their cell phone. This might be linked to the presence of older people in the latter.

- **A large majority wants to improve the efficient use of energy:** the satisfaction about the renovation works could not be assessed yet in this ex-ante stage of the project, however there is a high level of acceptance to perform the energy renovations with the HEART toolkit as announced by the EMH and ACER.

- **The belief in new technology to improve comfort and efficiency levels is strong.** However, this did not mean people were open to give up their possibility to control the energy systems themselves and leave control of energy, costs and IEQ to fully automated systems.

- **The top three priority for the results of the renovations** are: 1) By far, lower the energy bills; 2) Improve the use of renewable energy; 3) Improve cooling/ventilation (ACER) and heating (EMH). This indicates that the HEART toolkit should focus mostly on increasing the cost-efficiency of investments by social housing providers in order to lower housing and energy costs, increase renewable sources of energy and increase the level of indoor comfort through improved HVAC solutions.

- **Environmental motivations to have renovations works done** seem to play a strong role. This is contrary to assumptions that financial and comfort benefits are key motivators. The environmental factor – and the associated social acceptance and peer pressure – should therefore be part of communication efforts too.

2.2. DESK RESEARCH

In order to validate the initial conclusions from the survey presented here above, Housing Europe performed a desk research focusing on key factors influencing the satisfaction and acceptance of residents in the scope of renovations, especially deep renovations towards nZEB levels.

The EU has set ambitious CO2 reduction and energy efficiency goals. Specifically, the long-term vision is to reduce greenhouse gas emissions by 80-95% and achieve a climate-neutral economy by 2050 (European Commission 2018). Housing providers in the public, social and cooperative field are working hard with their

partners (local authorities, tenants, service suppliers, local authorities and financiers) to contribute to the acceleration and deepening of energy retrofits of their homes[1].

Besides overcoming technical and financial barriers, another crucial, and often overlooked, part of the work of housing managers is to ensure that their residents (tenants, home-owners or cooperative members) stand behind renovation plans. They are very aware that deep renovation works can cause heavy disturbances and uncertainties. Specific measures and efforts can limit the negative perception and overcome problems endured by tenants (e.g. communication, involvement and support).

Achieving a certain degree of acceptance is also often required by law. However, mere "acceptance" should be regarded as the bare minimum. Building owners/managers need strong approval of the works and should even look for the active involvement of residents starting from the initial design and through to the use phase. Perhaps unsurprisingly, resident involvement has been most active in the preparatory and use phases, though more and more we see residents participating in the design phase.

Initially, the suggestion of renovation can be met with resistance. This is due to fears of, amongst others, disturbance and disruption, hidden increased costs, and breaches of privacy/security. Gaining trust and on-going acceptance is a significant part of the renovation process and certainly of its success (Blomsterberg and Pedersen 2015, Brown, et. al. 2014, Sunikka-Blank 2012).

Behavioural psychology has a role to play here. Certain phenomena such as peoples' myopic tendency to favour short-term results over long-term results (Balast 2018, TripleA-reno 2018), as well as the cognitive bias towards favouring the status quo and resisting change (TripleA-reno 2018), will have an effect on attitudes towards acceptance. Clearly, comprehensive explanation and education of the process and benefits of retrofit/renovation is necessary.

Cultural and demographic contexts must be acknowledged and considered as they can also influence users' habits, routines, perceptions, beliefs and, ultimately, their behaviour (Lutzenhiser 1992, Stephenson et. al. 2010). One study shows how peoples' political ideologies influence their attitudes and choices regarding energy-efficiency (Gromet et al 2013).

One way of gaining trust and securing acceptance is through resident involvement/participation. This involvement/participation can come in different forms and at different levels (see Figure 1). A distinction should be made between "top-down" and "bottom-up" approaches. A "top-down" approach in this context would mean that discussions and decisions are made without residents and can be regarded as paternalistic (e.g. presentations and information sessions). A "bottom-up" approach would consider the views and concerns of residents, encourage their direct participation, including in the decision-making processes (e.g. brain-storming sessions, design charrettes and decision-making tools). A major benefit of resident participation is the sense of ownership of the project that it can instil, thereby increasing levels of acceptance.

Over time, considerable knowledge has been developed regarding the most successful methods, techniques and strategies to help residents overcome doubts and work towards higher degrees of acceptance and, most importantly, satisfaction with the end-result.

[1] Several national umbrella organisations have set ambitious sustainability goals in line with the Paris Agreements, EU's 2030 or 2050 goals. E.g. the Dutch social housing sector, strives for a CO2 neutral stock (2.4 million dwellings) in 2050. Each of its members has to present detailed feasibility and technical plans with milestones in 2018 and following years to line-up with the 2050 goal.

It is key to understand and share successful methods that increase the level of acceptance among residents to ensure that future, increasingly ambitious, renovation projects reach more and more homes. Furthermore, sharing the same commitments has additional benefits as conscious energy behaviour results in substantially higher energy savings and emission reductions.

Once residents have accepted the works and the renovation starts, the question is how to ensure that people show high levels of satisfaction *during* the works. The next and final crucial phase is the operational phase when people start living in their renovated dwellings with often new features.

Finally, the outcomes of each renovation project should be evaluated in order to maximise the outcomes in terms of user acceptance and satisfaction for the next time. This ex-post evaluation should definitely involve residents, but also requires a continuous collaboration between the housing providers and the whole chain of suppliers involved in the renovation process. This is critical to achieving higher energy performances and better quality, more cost-efficient options in the building retrofit market.

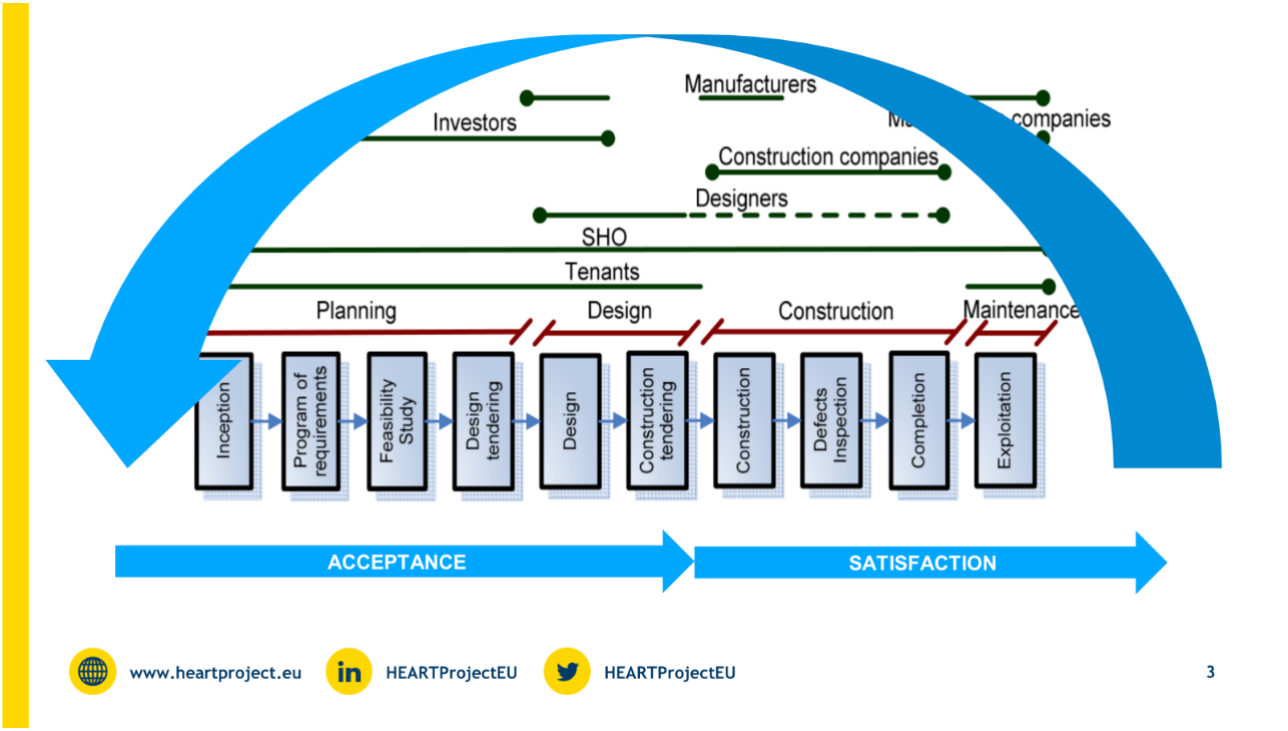

Figure 3 - Key phases and stakeholders during construction/renovation works linked with Acceptance, Satisfaction and feedback loops.

This chapter focuses on these different phases in the renovation process that can improve the acceptance and satisfaction of user. Many of these elements can serve (social) housing providers and other players in the energy retrofit supply chain to help them work with residents involved in deep renovation project.

2.2.1. Residents in the preparation phase

ASSESSMENTS & PLANNING

Before any meeting between housing provider, residents and stakeholders takes place, before any designs are drawn up, before any worker steps on the site – first, the problems and issues existing within the building(s) need to be identified.

The housing provider will most likely have in mind (roughly or exactly) what type renovation/retrofit is necessary and desired. However, assessments including of the energy status of the building(s) will need to be undertaken and this is perhaps an opportunity to consult with residents. At the end of the day, tenants are the ones who know how they live their daily lives in their homes, and this should be considered as a real expertise. They are the best placed to develop ideas and proposals on which kind of energy improvements to adopt to limit consumption and allowing for better use and more eco-friendly behaviours (USH, 2015). Involving tenants at this stage allows not only to ascertain what, in their opinion, types of maintenance or improvements should occur, but also to immediately involve them in the retrofit/renovation project.

An example of this was when a group of neighbours in the Netherlands were asked of the potential benefits of a retrofit which included better insulated window panes and they then shared their concerns related to neighbourhood security, commenting that these improvements could indeed increase feelings of safety (Buurkracht initiative as per TripleA-reno D6.1 2019).

Planning involves identifying what needs to happen, how it should happen, and who should make it happen! So, for when there comes the time to begin sourcing experts including energy expert, professionals, construction companies, contractors and suppliers – residents can be involved in this as they might have certain preferences. For example, it might be an idea to source contractors/companies who offer services such as clean-up during and after each day of the retrofit/renovation works – this will help quell fears of mess or disruption in and outside of the home.

At this stage, the schedule and timeline of works will be discussed and agreed upon. These should be should be clear and detailed, accessible to all, should be broken into smaller parts (TripleA-reno 2018), with flexibility being key (BPIE 2015 report).

Specific steps that can be taken during this phase include:

- collating and analysing energy bills;
- promoting helpful tools, such as the My Energy Compass online tool (https://www.mijnenergiekompas.be/) which was designed to both help assess energy ratings in houses and neighbourhoods, and to encourage residents in their renovation journey (CORDIS 2018). Similar online tools that are free and user-friendly and which help residents in imagining the potential savings, can be developed (Energiaklub 2014);
- assessing the needs of residents, collecting their complaints via one-on-one interviews or group consultations or questionnaires/surveys;
- gatherings: coffee/tea meet-ups, community dinners, festivals;
- making contact with those residents who are most in need of renovation/maintenance, or who would be more open or receptive to the idea (will be easier to get acceptance of all or many residents when some are already on board, especially if it is a “local hero”);
- site visits to houses/apartments where similar works have taken place (Sinfonia 2018c). Most of us have not had the opportunity to experience an “energy efficient”, “nearly zero energy”, “passive” house or similar, indeed, the power of the showroom/this has been shown to be a major influence (Cradden 2016);
- exhibitions;

- organising a committee/working group of housing employees and residents who wish to take a more informed and proactive role throughout the retrofit processes; however, some projects might be more suited for a professional and competent “community manager”/ ”project facilitator”;

- a protocol or group agreement/contract/Resident Charter (GVA & Levitt Bernstein 2016) to be signed by housing provider and residents (Les Pins project from Power House Europe 2014);

Please note: at this stage of the project, it is a good idea to get the “green light” or “go ahead” from the residents, to secure an initial acceptance before further planning more detailed technical and financial arrangements (Energiaklub 2014).

It is key that the housing provider remains the main instigator of getting residents on board, as opposed to a third-party company/organisation – they know their residents best!

INCENTIVES

Gaining acceptance of the retrofit/renovation will involve providing incentives. Depending on the type and scale and time-frame of the project, these incentives can vary. Throughout the project schedule, if and when issues arise, residents can be reminded of the reasons and positive impacts of the retrofit/renovation, which can include:

Finance

Increasing the energy efficiency of buildings aims to lower costs of energy bills. While the cost of the retrofit/renovation is often added to the rent, the hope is that the overall costs for the resident will be lowered, as energy bills will have decreased significantly. Also, the cost of renovation can be paid off over X amount of months/years, “pay-as-you-save”. Some housing providers will give a guarantee to this effect. For example, the EU Horizon 2020 project MORE-CONNECT guaranteed a “return of investment of less than 8 years for the end-user” (MORE-CONNECT 2014). Generally speaking, the maintenance and repair bills for the building can be lowered in the long-term.

It’s very important to have clarity on potential financial impact of the renovation. The Dutch Covenant on energy savings is an interesting example (Convenant Energiebesparing corporatiesector, 2008) that aims at striking a balance for tenants by offsetting increases in rents with savings on energy.

However, financial aspects alone won’t work. Furthermore, it’s important not to overestimate potential savings on energy bills as the actual savings after renovation could be less than expected, at least in the short term, for a number of reasons that are not directly imputable to the quality of the works carried out (e.g. the so-called ‘rebound effect’).

Comfort, health and well-being

Energy efficient renovation aims to better insulate housing/buildings in order to save on energy usage. This means that residents will [hypothetically] have warmer winters and cooler summers in their homes. In the HEART project pilot site where and ex-ante evaluation has been carried out with residents, improving cooling features among the top 3 most needed improvements that tenants hope to achieve through renovation. An SEAI (Sustainable Energy Authority of Ireland) survey found that 60% of those who engaged in an energy renovation of their home did so for comfort reasons (SEAI 2017). There is a positive impact on health and safety by improving indoor climate (DG ENERGY 2017).1 The retrofit/renovation can happen in parallel with e.g. improvements in fire safety and accessibility and/or adaptations for an ageing population.

Aesthetics

Many times, a retrofit or renovation will involve or go hand-in-hand with a general upgrade of the facade and/or interior of the building, i.e. an "aesthetic renewal". Even seemingly small changes such as larger storage/basement/attic spaces, wider window sills, new LED lighting or a new kitchen or bathroom can have a significant impact for residents and their acceptance. This "morphological" aspect is also being assessed by the Triple A Reno EU H2020 project.

Environment

Last but not least, many residents respond keenly and enthusiastically to the fore-casted projections of positive environmental impacts. 9 out of 10 respondents to the HEART questionnaire to tenants Agree or Strongly agree that limiting CO2 emissions in the environment is a motivation to decrease energy usage.

Rewards

A different type of financial incentives can take the form of rewards. For instance, in the case of demand response systems (e.g. Nest's "Rush Hour Rewards", that claims that less than 15% of their users ever change the temperature during a rush hour event.)

COMMUNICATION STRATEGIES

Timing

As a rule, and simply put - the earlier the better, and with clear, non-technical and transparent communication throughout (CORDIS 2018). Using graphics that refer to everyday life situations is also recommended (Sinfonia 2018f).

In the context of a long and complex renovation project, it's important to exchange with residents on a regular basis, to keep up their motivation and ensure maximum transparency (USH, 2015)

Ways to communicate with residents

The options for how to disseminate and exchange information are many. They include:

- Although this should never be an exclusive channel, internet/digital platform can help reach a certain part of the residents in a cost-efficient manner (a dedicated website, a bespoke app, a facebook group, a Whatsapp group, a Slack channel, a Trello account, etc.). It is preferred to leave open the options of two-way communications channels instead of sending only. This allows users to provide feedback.
- leaflets/brochures;
- continuous, updated newsletters;
- guidebook/manual, both online and offline, a collation of relevant information and education materials;
- e-learning material;
- nominated resident "ambassador" to keep residents informed and aware of progress (BUILD UP 2018, Terklensen 2008).

- Regular meetings with residents (collectively but also individually when needed)
- Explore the possibility to enlarge communication to, for instance, local associations and schools based in the neighbourhood
- Notwithstanding the type of communication and dissemination tools, it's important to choose language that is not too technical and as much as possible understandable and accessible for the wider public (USH, 2015).

POINTS OF CONTACT

It might be necessary for both housing professionals and resident alike to receive training, support and guidance from external bodies.

One idea is "renovation coaching", i.e. qualified professional in the area of energy efficiency and residential renovation, who supports residents throughout the process – preparation, design, works and use-phases. This person has both the technical competence and the interpersonal communication skills necessary to convey complicated procedures, and support housing professionals and residents throughout the process (CORDIS 2018).

Similarly, a single "one-stop-shop" or single point of contact is useful for both housing provider and resident. This again involves a qualified professional who remains available to be contacted in case of queries or concerns (CORDIS 2018).

Going further, commentators highlight the attractiveness of "complete deep retrofit/renovation packages" for residents (Cradden 2016). This can counteract the potential confusion that comes with a series of individual measures and their technical details.

LEGAL REQUIREMENTS

Legal requirements related to retrofits/renovations will vary across countries. Some countries might have a legal requirement of X% acceptance by residents for the project to proceed, such as is in the Netherlands where it stands at 70%.

These requirements can be found in national legislation or local policies, or could have been previously agreed upon between the housing provider and residents.

For example, many housing associations do not only provide a home but also services, and any new tenant is made aware of the possibility of future renovations, and what that will involve including with regards to rent increases (Via Caldera project from Power Housing Europe 2014).

In Sweden, laws limit potential increase of rents and are often negotiated with the help of the Association of Tenants and therefore justified increases are easy for people to accept (Krysiński, Nowakowski & Dana, 2017).

In Austria, while tenants do not have the legal right to refuse measures taken on facades, envelopes or entrances/doors, they do have a legal right to refuse entrance into their home (Sinfonia 2018e).

2.2.2. Residents in the design phase

AT WHAT POINT TO INVOLVE

Depending on the type and scale of the project, resident involvement in the design of the retrofit/renovation might come in at varying stages. Unfortunately, it is not uncommon that residents or end-users needs and concerns, the "human factor", are not considered in the design phase (Shove and Walker 2010). Indeed, what tends to occur in retrofit/renovation projects is that residents will have very little input or say and are presented with a mostly finished design and plan (STAM & UCC 2016).

However, many make the claim that involving residents i.e. end-users, at the earliest stages in the design of e.g. systems and interfaces of the technologies, will help in securing trust and acceptance as well as avoiding future technical or practical issues. (E3Soho 2013, STAM & UCC 2016, MORE-CONNECT 2014).

Further, the literature suggests that (rates of) energy usage is linked with users' interactions and experience with systems and technologies (Shove and Walker 2010), from the macro (layout and services) to the micro (buttons and interfaces).

HOW TO INVOLVE

There are many options of how to involve residents in the design phase. Co-design, co-production and co-construction will be discussed here.

One study notes, "The 'co-construction' of user practices and technology is particularly relevant for our interest in reducing energy demand. On the one hand, technologies are adjusted (in smaller and larger steps) to fit better with the user environment. On the other hand, the user environment (user practices, behavioural routines, infrastructures, policies, etc.) is adjusted to accommodate the new technologies. In this way, technologies, environments and user practices co-evolve". (Chilvers 2018).

Integrated Design Process (IDP) is a collaboration between stakeholders i.e. housing provider, residents, architect, engineer, experts and contractors. Main features of IPD is that there is a heavy emphasis on creative problem solving and that the process is circular and iterative[2].

The ID process guidelines are as follow:

STEP 1. DESIGN BASIS

1.1 Select a multi-disciplinary design team, including an ID facilitator, motivated for close cooperation and openness;

1.2 Make analyses of the boundary conditions;

1.3 Refine the brief and specify the project ambitions, preferably as functional goals.

STEP 2. ITERATIVE PROBLEM SOLVING

2.1 Facilitate close cooperation between the architect, engineers, relevant experts [and users] through colocalization/workshops;

2.2 Use both creative and analytical techniques in the design process;

2.3 Discuss and evaluate multiple concepts;

[2] BUILD UP, the European Commission's online hub for building professionals, local authorities and building occupants, recommends IPD.

2.4 Finalise optimised design.

STEP 3. ON TRACK MONITORING

3.1 Use goals/targets as means of measuring success of design proposals;

3.2 Make a Quality Control Plan;

3.3 Evaluate the design and document the achievements at critical points/milestones" (BUILD UP 2014).

Different tools and methods include:

one-to-one or group consultations;

charrettes, which are collaborative working sessions that includes all stakeholders, harnesses expertise and creativity, and generates design solutions. After having identified common goals, teams can come up with solutions in which to work together and realise them;

mock-ups, scenarios, prototypes, design games, storytelling (STAM & UCC 2016);

visualisation tools;

"emotional toolkits allow people make artefacts such as collages or toolkits which express their stories or dreams, and allow access to their unspoken feelings and emotional states,

while cognitive toolkits enable them to make artefacts such as maps, 3-D models, diagrams of relationships and flowcharts of processes (STAM & UCC 2016);

Tools: keypad voting, real-time feedback from participants (Bryson et al., 2013);

CityScope, both tangible and digital open source urban planning and spatial design tools (MIT 2017);

The use of gamification methods and ethnographic research (Triple A Reno)

While it is challenging in practice to actively involve residents, it is important to acknowledge the importance of co-creation processes: "the literature on user innovation [97–99] suggests that users play active roles in the development of new uses of technologies that were not foreseen by producers. (Geels et. al. 2018)."

COMMUNITY-BASED INITIATIVES

It is sometimes necessary and certainly always wise to receive the commitment of the city council, and to involve civil society and community groups and clubs, around the topic of "energy" and "the environment" (Sinfonia 2018).

Involving the wider community on the retrofit/renovation of apartment blocks, estates or neighbourhoods, when and where appropriate, can have a positive impact.

"Community based initiatives could lead to long-term behaviour change because they facilitate the introduction of new, pro-environmental social norms. Examples include groups sharing information to facilitate behaviour change. [For] these types of initiatives to be successful, it is important that they are part of a wider programme that has clear objectives. These could include reducing the environmental footprint or delivering energy savings." (European Environment Agency 2013).

Members of the community can be reached via children (see 3.2.1.), "local heroes", organised "Energy Tours" (Sinfonia 2018), print media, digital and social media, community informatics (STAM & UCC 2016).

Involving schools and children in the community

Children are the future, and we should teach the children well. In a circular and iterative turn, they can teach us.

In the Simmering district of Vienna, children were heavily involved in the urban renewal and adoption of smart city elements of their neighbourhoods. During a series of workshops on topics such as the city of the future, energy, e-mobility, children were trained as "smart city ambassadors". A Research Festival for Kids was held and was open to children of participating schools and the general public (Smarter Together 2018 https://www.smarter-together.eu/).

As part of the Sinfonia EU project, teachers and students of three primary schools in Innsbruck were involved in the renovation of their school buildings. After a good contact was established between project members, headmasters and teachers, kick-off events were held to promote the concept. The Energy and Environment topics had a clear structure and were appropriately embedded into the already existing curriculum (Sinfonia 2018d).

More generally: entire schools can be involved, headmasters and teachers can be trained and on board, curriculum can be modified, overlapping subjects on energy issues encouraged, consciousness raising techniques, pupils can become "energy guides" of their grades/classes (as in Bolzano), workshops, site visits, poster campaigns, exhibitions and events can be organised (as per Sinfonia Smart Cities).

OTHER STAKEHOLDER INVOLVEMENT & ENGAGEMENT

Retrofit projects can utilise "stakeholder theory" in order to: define and identify stakeholders, consider the needs and impacts of various stakeholders, and subsequently try to balance these. The different stakeholders will have different levels of engagement during the project schedule (STAM & UCC 2016).

It is useful to gather all stakeholders at the earliest stage possible, especially during discussions of timing and process of retrofit project schedule. Contact details can be exchanged here, as well as the procedure of notifications on project development.

2.2.3. Residents during the works

DURATION OF WORKS

Some retrofit/renovation projects can be drawn-out and lengthy. Residents can often be subject to disruption or discomfort (noise, dust, parking spaces, etc.) and so great attention and effort should be taken in order to minimise this as much as possible (GVA & Levitt Bernstein 2016).

Besides a limitation on the number of days that renovations are allowed to last, a number of other factors can be important to residents such as a requirement to leave the apartment clean every evening, and an area where people could spend the day while works are taking place (Eurofound (2016)

DISTURBING ELEMENTS IN AND AROUND THE BUILDING

As previously mentioned, when drawing up contracts during the planning phase certain conditions or arrangements or indeed principles can be stipulated and agreed upon, towards the formulation of a "site assembly strategy" (GVA and Levitt Bernstein 2016). These could include, for example, that contractors clean/tidy the area and/or take down scaffolding at the end of each day or week.

In the HEART project pilot sites, to decrease discomfort as much as possible the work to the façade is carried out not with scaffolding but with a movable lift that can be easily removed at the end of each day.

The city of Bolzano employed a "mediator" who would visit the construction site each day in order to listen to residents' potential concerns or worries, to assist residents and contractors in better planning and organising the works, to monitor that the schedule was being respected, and to confirm that previously agreed upon measures were being implemented (Sinfonia 2018a).

During another project in which residents remained in their homes during the works, the housing association involved distributed breakfast bags with fresh bread, newspapers and gifts, as a "thank you for enduring the stress during renovation" (Sinfonia 2018b).

Some projects aim specifically for very rapid retrofit/renovation schedules. For example, the MORE-CONNECT project has an objective of total installation time on site for a maximum of five days, but a final goal of two days (MORE-CONNECT 2014).

The provision of well-designed meanwhile uses is critical and should not just be considered as an "add on" to the wider development and masterplan strategy (GVA and Levitt Bernstein 2016). Further, while the aim of many retrofit/renovation projects is a speedy/quick completion, this is not always possible and so, vital services must remain accessible to residents on site (GVA and Levitt Bernstein 2016).

TEMPORARY RELOCATION

While it has been identified that the possibility of remaining in ones' residence can be a major incentive for users/residents to accept retrofit/renovation (Karlsson 2013), this is not always possible.

Residents' physical and mental health and general well-being can be affected by the experience of undergoing a temporary relocation during a renovation, especially if this is forced and there is a move to housing of lesser quality (Levin et. al. 2018).

A personalised approach to the relocation process, improved housing quality and maintenance and access to support services can result in positive health outcomes (Levin et. al. 2018). In one retrofit/renovation project, residents met with a "professional relocations officer" who made a need assessment and was able to identify appropriate temporary accommodation. Residents were given options of where to temporarily relocate (Crawford and Sainsbury 2017).

2.2.4. Residents in the use phase

ADOPTION OF NEW TECHNOLOGIES

Training is necessary. Potential energy savings can be lost if residents are not made aware of how to correctly or efficiently operate the new technologies and systems in their home. The "rebound effect" describes the behavioural phenomenon of an increase in (energy) usage as a response to installation of new technology, consequently offsetting potential energy savings (Gillingham, Rapson and Wagner 2015).

Some of the training requires cognitive work (learning about the systems and developing new knowledge), symbolic work (articulation categories, symbols, and beliefs that guide 'sense-making' of new technologies) and practical work (adjustment of user routines to match the new technology) (Geels et. al. 2018).

AFTER CARE / SALES SUPPORT

One effective strategy for the post-works and use-phase is to have an "after sales"/"after care" support, a point of contact (phone line, email account, social media platform) where residents can reach someone for user support. This is not necessarily the housing provider as they might not have the knowledge or expertise (Bouwgroep Dijkstra Draisma 2018).

ENERGY PERFORMANCE GUARANTEES

The Energiesprong concept addresses this issue by linking the energy refurbishment to a guaranteed performance level over a long period (e.g. 30 years). This energy performance guarantee needs to be provided by industry and can only be achieved through a whole-house solution. To then address the split incentive issue tenants are charged a fixed monthly/annual energy service plan charge which entitles them to a defined annual energy allowance (akin to a mobile phone bundle), resulting in an additional, secured cash-flow to the social housing provider (Transition Zero project).

The FRESH project analysed the option to introduce an Energy Performance Contract (EPC) under which "an energy service company (ESCO)designs and implements an energy retrofit with a guaranteed level of energy performance. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on meeting the other agreed performance criteria. In an EPC, the achievement of actual improvement of the energy performance is one of the conditions for the ESCO to be paid."3[...] "EPCs quantify and guarantee long-term energy savings. EPCs can serve as a basis for a business model where intangible energy savings are transposed into a secured cash-flow (guaranteed energy performance), so that they can be presented as counterpart to investment in energy performance and secure debt repayment."

"Currently, EPCs are generally limited to the simplest operations and most mature technologies, well known by operators, with relatively short payback period (< 10 years). In particular, the majority of the EPCs signed to date focus on the refurbishment of energy production/distribution systems (e.g.: replacement of boilers, insulation of the distribution systems...), without any impact on the useful energy demand (e.g.: insulation of the frontages, replacement of the door frames...)." [...] "In a nutshell, if implemented in accordance with current market practices, EPC may focus only on the "low hanging fruits" and once those have been picked, building owners may never be able to finance the required interventions on the building envelope, which represent very high costs with long payback periods."[3]

This is why EnergieSprong takes this idea even further by radically reconfiguring the contracting arrangement and asking for a whole-house solution so that an industry solution provider takes on the responsibility for the long-term energy performance of their refurbishment design and installation, including maintenance. This is achieved through outcome-based procurement with a long-term energy performance warranty backed by an insurance.

INTERACTION WITH THE DIFFERENT ELEMENTS IN THE NEW DWELLING

Active Control

Active Control is counter-posed to Automated Control. Automated Control refers to new systems and technologies (energy saving, HVAC, lighting, water saving, other smart home features) being automated i.e.

[3] FRESH final project report

set and controlled not by the user/resident, but by the housing provider, energy provider or some other external force.

Eco-feedback.

Much of the discussion here is predicated on the assumption that accurate and continuous feedback on consumption will positively influence user behaviour, i.e. reduce energy usage, and indeed gas or water usage, etc. (EEA 2013, Buchanan 2014). Feedback makes the invisible visible (Buchanan 2014), and while not conclusive, many studies do show that when given the opportunity, residents will observe, monitor and modify their energy usage in accordance with the feedback (Westskog 2015, Gram-Hanssen 2009).

Social scientists consider behaviour-based approaches, while engineers and developers consider more technological, design and systems-based approaches (Eichler et. al. 2017, Sanguinetti et. al. 2018). A marriage between the two seems most appropriate.

One of the more effective ways of providing this "eco-feedback" (feedback on individual or group usage with the explicit goal of reducing the environmental impact) is through "computerised consumption feedback [via] optimally designed user interfaces" (Taylor and Jain 2012, quoting others).

This visualisation of consumption data can enable residents in monitoring their usage and potentially limiting their usage of certain high-energy, non-essential appliances or modifying certain behaviours. However, projects have shown that this can be difficult and so feedback technology and systems should be tailored to the end-user or resident. One project showed how proper advice and training encouraged residents to expand their understanding of and engagement with IHDs (SMART UP, DG Energy 2017).

IHDs

The user-interfaces, monitors, home energy displays or In-Home Displays (IHDs), can vary in appearance, but most often come in the form of a small, sometimes portable, electronic device with a touch screen. It come in the form of a tablet, be incorporated into or replace a fixed thermostat on the wall, or exist as an app for a smartphone.

Design dimensions of eco-feedback on IHDs can be broken down into the following:

- **Information** - "What information is presented?" e.g. Usage kW, costs, CO2 production, etc.
- **Display** - "How is the information presented?" e.g. numerals, graphs, traffic lights, emoticons, cartoons, etc.
- **Timing** - "When is the information presented?" e.g. real-time by the second or minute, updates twice a day, etc. (Sanguinetti et. al. 2018).

The level of detail or granularity (from fine to coarse) of the information can vary. On the fine end of the spectrum, a heavy disaggregation of information can allow users/residents to identify and analyse down to e.g. a single appliance,[4] whereas on the coarse end e.g. a thumbs up/smiley face symbol can signify if the user is maintaining a set limit or goal.

[4] While studies affirm the need to link specific actions or appliances with consumption as well as survey responses showing the desire for this on the part of the user/resident (Fischer 2008, Fitzpatrick 2009), it is in practice difficult to achieve. Individual appliances would have to be set up with sensors, or be "smart appliances" connected to other devices in the "smart home" as part of an Internet of Things style connection.

One study showed that historical comparison is one of the more effective ways to present information and encourage behaviour modification, or personal goal comparisons (Jain et. al. 2012). Going further, some literature suggests rewards and penalisation as useful strategies (Jacucci et. al. 2009).

However, as with many things in life, simplicity is key. For example, one project looking at ICT and energy efficiency, noted that, “a simple interface and easy to understand indicators (such as traffic light indicators) [is] optimal. They need to be intuitive, easy to use and graphical” (E3Soho 2013).

Many [home energy systems] give the option for residents to access more detailed information and analytics through an online account.

Below are a number of examples of interfaces:

Figure 4 - Examples of user interfaces

Smart meters

Not to be confused with IHDs (as does happen), smart meters are electricity meters that are connected to the smart grid, which are energy networks that automatically monitor energy flows and accordingly adjust to changes in supply and demand. User/residents can then monitor their usage through above-mentioned user interfaces.

The EU aim to replace 80% of electricity meters with smart meters by 2020. The Energy Efficiency Directive, outlines that customers for electricity, natural gas, district heating, district cooling and hot water should normally have an individual meter that accurately reflects their individual energy consumption and provides information on the time of their energy use (with exceptions on technical and financial grounds, or for example if smart meter roll-out does not take place in a Member State).

Uptake varies among Member States. In some countries, smart meter roll-out has been met with scepticism or controversy, related to concerns over perceived increased costs, inefficiency, inaccuracy, health effects,

privacy and security.[5] The European Commission recommends that attention be paid to user protection against remote disconnection, benefits such as cost savings should be clearly assessed and communicated and that the effects of smart metering for those in vulnerable situations should be monitored carefully (EC 2014).

Users in vulnerable situations may not be able to change their consumption patterns to benefit from the best value tariffs and may continue to use electricity at peak times e.g. those who do not have a choice as to when they either heat their boilers or who use high energy-consuming household appliances. Similarly, those who do not opt for time-of-use tariffs[6] may continue to be at a disadvantage if standard tariffs remain among the highest priced tariffs on the market.

Nevertheless, the introduction of smart meters should make switching energy providers easier, and in general bills will no longer be based on consumption estimates (EC 2014).

2.2.5. Quality assessment and feedback

Label and framework for participation of residents and other stakeholders

In France, a company called Environment BDM based in Lyon pilots a label (in Region PQ, Occitaine, Montpellier) to provide a framework for participation in the planning and implementation of renovation projects. It is a non-profit label on sustainable buildings which focuses on supporting the establishment of a platform to facilitate open dialogue between residents, landlords and other stakeholders, (finance and construction sector?) to enable discussion and negotiation on technical, financial and social aspects of the renovation process.

As we know in many countries there are obstacles to the renovation process (legal, financial, organisational, social,) which prevent any renovation EVENT in some cases where funds (e.g. EU ERDF structural funds) are available. Residents, landlords together with other stakeholders (finance and construction sector) should be involved discussion and negotiation on technical, financial and social aspects of the renovation process. Such labels could help to structure in a clear way the process by which obstacles can be identified, discussed and overcome.

This is also one of the aims of the Triple A Reno project mentioned before. It also recognizes that in the preparation of deep energy renovation, the decisions of the residents and their acceptance can be a major challenge. TripleA-Reno intends to make deep and net zero energy (zero on the meter) renovations more attractive to consumers and end-users by providing them with clear, unambiguous and meaningful information and communication on real, proven energy performance, indoor environment quality and personal health. TripleA-reno will strengthen consumer-focused business models for major renovations, such as one-stop-shop concepts and building passports. This is done through the development of an end-user focused gamified platform for validation and community building.

More work would be needed to further explore the need and occurrence of quality process and frameworks to ensure the involvement of residential end-user and other key stakeholders' in (deep) renovation process. This could improve the level of satisfaction and the overall quality of products and services in this field. It

[5] Smart meter installation is now voluntary in England. Energy providers can suggest to their customers whether they would like a smart meter installed. Customers can request they be uninstalled in the future, if desired.
[6] Tariffs which charge cheaper rates during off-peak times (night or day) i.e. lower rates when demand is low, higher rates when demand is high.

could also generate data and information that can feedback in future project and ensure a constant improvement.

3. MID-TERM CONCLUSIONS

The ex-ante survey and the desk research provide however valuable information about the opinions of current residents in social housing and insights about the different elements and approaches that can influence the level of satisfaction and acceptance. It is clear that there is a **large acceptance** among the group of households renting from ACER and EMH for the renovation works using the HEART toolkit. At this stage (M30) it is not yet possible to draw conclusions about their level of satisfaction. The work done does however help to draw attention to the following points:

- **Communicating about renovation plans** is best done face-to-face and meetings in an open and collaborative attitude and supported with clear material that informs about the benefits in terms of costs, comfort, environmental impact and aesthetics (inside and outside the dwellings).
- **User interfaces can/should empower residents** with meaningful data to help them take informed decision about their energy behaviour and related aspects, such as costs, environmental footprint, price incentives.
- **The value of (semi-) automated systems and new technologies is recognized** by tenants. At the same time they want to keep a certain level of control. This has probably to do with the fact that energy efficiency/costs is only one preference variable for them apart from comfort, habits, cultural preferences, differing physical needs, etc.
- **Top three priority for tenants as a result of the renovations** are: 1) By far, lower energy bills; 2) Improve the use of renewable energy; 3) Improve cooling/ventilation (ACER) and heating (EMH). This indicates that the HEART toolkit should focus mostly on increasing the cost-efficiency of investments by social housing providers in order to lower housing and energy costs, increase renewable sources of energy and increase the level of indoor comfort through improved HVAC solutions.
- **Less obvious aspects of energy renovations play an important part:** the interaction and use of the user interfaces; the aesthetical value of a renovation (inside the dwelling, on the outside of the building and on the whole community) and the peer pressure at community or national level on a certain behaviour related to the use of scarce resources such as energy.
- **After-care support to educate the hosuing providers and residents in the use of the HEART toolkit** will be important during a certain period (and for new tenants). So are nearby contact points to further the deployment of the HEART toolkit in the neighbourhood and other areas.
- **Offer offline and online channels to actively gather feedback** from tenants and other stakeholders during the use phase is an excellent opportunity to improve renovation solutions such as the HEART toolkit.

After the installation of the first HEART renovation toolkits (M30), an ex-post survey will be conducted to assess the real satisfaction of tenants. This will be compared with the ex-ante results and will be presented in an updated version of this report.

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5. ANNEX 1 – SURVEY

Questionnaires and methodology

Introduction

The main objective of Work Package 9 of the Heart project is the on-filed demonstration of the technologies developed to ensure the overall quality, performance and cost-effectiveness of HEART.

Under Task 9.4 Housing Europe (HE), ACER and Est Metropole (EMH) will zoom-in on the buildings **user's acceptance and satisfaction** of the demonstration projects, from the beginning of the retrofit intervention until the end of the project. For that purpose, Housing Europe, developed a questionnaire with ACER and EMH to get the tenants' opinions.

Main aim

Assess the buildings **user's acceptance and satisfaction** of the demonstration projects. This helps to inform certain decision within the project and to ensure that techniques and solutions are adapted to the users' needs and demands.

The target group of this questionnaire are the tenants of the two buildings managed by ACER and EMH.

Schedule

The questionnaire will be used before and after the renovation to compare the development of the satisfaction about the different aspects of the toolkit and the overall perception of tenants.

	ACER	EMH
Initiate ex-ante questionnaire and interviews	**06/2018 (M9)**	**12/2018 (M15)**
Receive responses ex-ante questionnaire	**09/2018 (M12)**	**03/2019 (M18)**
Start renovation	*09/2019 (M24)*	*05/2020 (M32)*
Initiate ex-post questionnaire and interviews	*05/2020 (M32)*	*12/2020 (M39)*
Receive responses ex-post questionnaire	*07/2020 (M34)*	*01/2021 (M40)*
Reports on user satisfaction and acceptance (HE)	*09/2020 (M36)*	*04/2021 (M43)*
Final report Case 1 and 2 (HE)	06/2021 (M45)	

Indications to use the questionnaire

To learn about the user experience, it is important to get a clear and honest picture from residents. Therefore, we suggest some guidelines to use the questionnaire and hold the interviews

Clearly explain the purpose of the interview and what will be done with the responses.

Respondents should remain anonymous. Please, use a unique questionnaire number for each form. It is important to keep the same unique reference number per household/dwelling when filling in the form before and after the intervention.

Holding personal interviews based on the questionnaire might be preferable, but other ways can be less intrusive and time-consuming. Send reminders after a week.
Make sure the person feels at ease and during the interview.
We tried to limit the number of questions. Please, do not add more questions.
To improve the number of responses, an incentive, like a prize draw, may help.
Please take into account any data privacy protection legislation in your country (including the new EU General Data Protection Regulation).
The questionnaire should take +/- 30 – 40 min to answer.

Representativeness

The bigger the sample, the more reliable. However, a variation in the type of population (age, sex, household type, etc.) is also important. Some type of households might require more effort to involve but those are as important to persuade to participate.

Structure of the questionnaire

Resident questionnaire ex-ante

Before the start of the renovation works

Unique questionnaire number: …….. [to be filled in by EMH or ACER, important to keep the same reference for the questionnaire before and after the intervention. See indications.]

1. General household information

Gender

☐ Male
☐ Female

Age

☐ less than 30 year old
☐ from 30 to 60 year old
☐ more than 60 year old

Household composition in the dwelling

☐ Single person
☐ Single person with children,
please specify how many ……
☐ Couple without children
☐ Couple with children,
please specify how many ……

Educational level

☐ Elementary school
☐ Junior high school
☐ High school
☐ Academic degree
☐ Other: _____

For how many hours, on average, is the dwelling occupied per day?

☐ Less than 8 hours
☐ 8-12 hours
☐ 12-18 hours
☐ More than 18 hours

2. Satisfaction about the dwelling

What is your opinion regarding your dwelling?

	Very satisfied	Somewhat satisfied	Somewhat Dissatisfied	Dissatisfied	No opinion
Size of apartment					
Number of rooms					
Maintenance level					
Accessibility to/in dwelling					
Sound insulation					
Indoor climate					
The level of your energy bill					
Cooling					
Heating					
Ventilation					
Respiratory issues (e.g. asthma)					
Control of temperature					
Control of ventilation					
Information about energy use					
Condensations issues (e.g. mouldy)					
General level of comfort					
Satisfaction about the rest of the building areas					
Quality of life in your community					

The temperature during the winter

☐ Is too high
☐ Is too low
☐ Is good
☐ No opinion

The temperature during the summer

☐ Is too high
☐ Is too low
☐ Is good
☐ No opinion

Any additional comments on the satisfaction about the dwelling:

……
……
……

3. Self-assessment of energy behaviour

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware of my energy use.					
I know about the energy labelling of home appliances and buildings.					
I want to improve my efficient use of energy.					
New technology helps to improve comfort and efficiency levels in dwellings.					
The main motivation to decrease my energy usage is to save on energy costs.					
I do not care about energy savings.					
My motivation to decrease energy usage is to limit CO2 emissions in the environment.					
I enjoy living as I please, even if my behaviour is not energy efficient.					
I need to be able to control the energy use myself, even if this is less energy efficient.					
I am already energy efficient.					
I am more energy efficient than most of my neighbours.					
I regularly change clothes instead of regulating the temperature.					
My neighbours and I are more energy efficient if we can regulate our energy use.					
I am willing to pay a small extra (+/- EUR 30) to get a home display with real time information on my energy management.					
I want to be informed in real time on the energy consumption and savings through a tablet and/or mobile app.					
Real time information on a tablet/mobile app will influence my energy behaviour.					

Any additional comments on your energy behaviour:

……

……

……

……

4. Acceptance of the renovation works

Do you believe your building needs a renovation?

☐ Yes ☐ No ☐ No opinion

Do you know the reasons for the renovation?

☐ Yes ☐ No ☐ No opinion

Do you agree with the renovation?

☐ Yes ☐ No ☐ No opinion

Have you been informed about the renovation works?

☐ Yes, sufficiently
☐ Yes, somewhat
☐ No, not sufficiently
☐ No, not at all
☐ No opinion

Would you like to be informed about the new energy-technical aspects of your building?

☐ Yes ☐ No ☐ No opinion

If YES, how would you like to be informed?

☐ During meetings
☐ Brochure, guidebooks
☐ Via a website
☐ Other: _____

On a scale of 1-10 how satisfied are you about the ideas about the renovation works?

☐ 1 ☐ 6
☐ 2 ☐ 7
☐ 3 ☐ 8
☐ 4 ☐ 9
☐ 5 ☐ 10

Any additional comments on the renovation works:

……
……
……

5. Tenants satisfaction about involvement

How are you involved as tenant in the renovation works?

☐ We receive information
☐ We can make comments
☐ We collaborate actively in (parts of) the works
☐ Other, please specify: .....
☐ No opinion

How satisfied are you about your involvement in the renovation project until now?

☐ Very satisfied
☐ Somewhat satisfied
☐ Somewhat dissatisfied
☐ Unsatisfied
☐ No opinion

If (somewhat) dissatisfied, please comment why

……
……
……

In your opinion, which three improvements are most needed in your building?

☐ Improve the heating
☐ Improve the cooling
☐ Improve the ventilation
☐ Improve the air quality
☐ Improve the possibility to adapt the temperature
☐ Improve the energy efficiency
☐ Improve the use of renewable energy
☐ Lower the energy bills
☐ Other, please specify: .....
☐ No opinion

Any additional comments:

……
……
……
……

6. Housing costs

What is your economic effort regarding housing costs (excluding energy bills)?

- ☐ less than 10% of household income is dedicated to rent
- ☐ between 10%-20% of household income is dedicated to rent
- ☐ between 20%-30% of household income is dedicated to rent
- ☐ between 30%-40% of household income is dedicated to rent
- ☐ more than 40% of household income is dedicated to rent
- ☐ Do not know
- ☐ No opinion

What is your economic effort regarding energy costs (heating and electricity)?

- ☐ less than 5% of household income is dedicated to energy bills
- ☐ between 5%-10% of household income is dedicated to energy bills
- ☐ between 10%-20% of household income is dedicated to energy bills
- ☐ more than 20% of household income is dedicated to energy bills
- ☐ Do not know
- ☐ No opinion

Please, estimate the savings on housing costs (incl. energy) after the renovation?

- ☐ less than 5%
- ☐ between 5%-10%
- ☐ between 10%-20%
- ☐ more than 20%
- ☐ Do not know
- ☐ No opinion

Any additional comments:

……

……

……

……

7. General satisfaction about the community

Today, your building (including common areas) and the neighbourhood is…

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Attractive					
Beautiful					
Cleaner					
Secure					
Accessible (for persons with disabilities)					
Energy efficient					
Environmentally friendly					

On a scale of 1-10 how satisfied are you with the quality of life in your community?

☐ 1 ☐ 6
☐ 2 ☐ 7
☐ 3 ☐ 8
☐ 4 ☐ 9
☐ 5 ☐ 10

Any additional comments:

……
……
……
……

We thank you very much for your help and cooperation, we will get back to you with the results of our survey,

To be filled in by EMH or ACER:

Indicate the position of the apartment

☐ *Ground floor*
☐ *First floor*
☐ *Second floor*
☐ *Third floor*

Indicate how many sides (walls + roof) of the apartment are on the outside of the building

☐ *None*
☐ *One*
☐ *Two*
☐ *Three*
☐ *Four*
☐ *Five*

Resident questionnaire ex-post

After the completion of the renovation works

Unique questionnaire number: …….. [to be filled in by EMH or ACER, important to keep the same reference for the questionnaire before and after the intervention. See indications.]

1. General household information

Gender

☐ Male
☐ Female

Age

☐ less than 30-year-old
☐ from 30 to 60-year-old
☐ more than 60-year-old

Household composition in the dwelling

☐ Single person
☐ Single person with children,
please specify how many ……
☐ Couple without children
☐ Couple with children,
please specify how many ……

Educational level

☐ Elementary school
☐ Junior high school
☐ High school
☐ Academic degree
☐ Other: _____

For how many hours, on average, is the dwelling occupied per day?

☐ Less than 8 hours
☐ 8-12 hours
☐ 12-18 hours
☐ More than 18 hours

2. Satisfaction about the dwelling

What is your opinion regarding your dwelling?

	Very satisfied	Somewhat satisfied	Somewhat Dissatisfied	Dissatisfied	No opinion
Size of apartment					
Number of rooms					
Maintenance quality					
Accessibility to/in dwelling					
Sound insulation					
Indoor climate					
The level of your energy bill					
Cooling					
Heating					

Ventilation					
Respiratory issues (e.g. asthma)					
Control of temperature					
Control of ventilation					
Information about energy use					
Condensations issues (e.g. mouldy)					
General level of comfort					
Satisfaction about the rest of the building areas					
Quality of life in your community					

The temperature during the winter

☐ Is too high
☐ Is too low
☐ Is good
☐ No opinion

The temperature during the summer

☐ Is too high
☐ Is too low
☐ Is good
☐ No opinion

Any additional comments on the satisfaction about the dwelling:

……
……
……
……

3. Self-assessment of energy behaviour

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I am aware of my energy use.					
I know about the energy labelling of home appliances and buildings.					
I want to improve my efficient use of energy.					
New technology helps to improve comfort and efficiency levels in dwellings.					
The main motivation to decrease my energy usage is to save on energy costs.					

I do not care about energy savings.					
My motivation to decrease energy usage is to limit CO2 emissions in the environment.					
I enjoy living as I please, even if my behaviour is not energy efficient.					
I need to be able to control the energy use myself, even if this is less energy efficient.					
I am already energy efficient.					
I am more energy efficient than most of my neighbours.					
I regularly change clothes instead of regulating the temperature.					
My neighbours and I are more energy efficient if we can regulate our energy use.					
I am willing to pay a small extra (+/- EUR 30) to get a home display with real time information on my energy management.					
I am well-informed in real time on my energy consumption and savings through a tablet and/or mobile app.					
The real time information on a tablet/mobile app influences my energy behaviour.					

Any additional comments on your energy behaviour:

……

……

……

4. Acceptance of the renovation works

Did you agree with the renovation?

☐ Yes ☐ No ☐ No opinion

Have you been informed about the renovation works?

☐ Yes, sufficiently
☐ Yes, somewhat
☐ No, not sufficiently
☐ No, not at all
☐ No opinion

On a scale of 1-10 how satisfied are you with the renovation?

☐ 1 ☐ 6

☐ 2 ☐ 7
☐ 3 ☐ 8
☐ 4 ☐ 9
☐ 5 ☐ 10

Any additional comments on the renovation works:

……
……
……
……

5. Satisfaction about the interventions and works

Regarding **the works and interventions** in your dwelling, please give your opinion on:

	Very satisfied	Somewhat satisfied	Somewhat Dissatisfied	Dissatisfied	No opinion
The duration of the works					
Timeliness of the dates					
Punctuality of companies					
The dates and times proposed for the interventions					
Contact with the persons involved in the works and interventions					
The cleanliness of the interventions					
The aesthetic look of your dwelling from the exterior.					
The common areas in the building.					
The noise or smell					
The circulation of the personnel or engines in or outside the building					
Any stress and fatigue caused in your dwelling by the interventions					
Official communication with you before, during and after the interventions					

When you encountered problems or nuisance about works, who did you address?

☐ The landlord
☐ The guardian or community manager
☐ My neighbours or fellow residents

☐ Other, please specify: .....
☐ No opinion

Any additional comments:
.....
.....
.....
.....

6. Tenants satisfaction about involvement

How were you involved as tenant in the renovation works?
☐ We received information
☐ We could make comments
☐ We collaborated actively in (parts of) the works
☐ Other, please specify: .....
☐ No opinion

How satisfied are you about your involvement in the renovation project?
☐ Very satisfied
☐ Somewhat satisfied
☐ Somewhat dissatisfied
☐ Unsatisfied
☐ No opinion

If somewhat dissatisfied or unsatisfied, please comment why
.....
.....
.....

In your opinion, which three improvements are still needed in your building?
☐ Improve the heating
☐ Improve the cooling
☐ Improve the ventilation
☐ Improve the air quality
☐ Improve the possibility to adapt the temperature
☐ Improve the energy efficiency
☐ Improve the use of renewable energy
☐ Lower the energy bills
☐ Other, please specify: .....
☐ No opinion

Any additional comments:

……

……

……

……

7. Satisfaction about the energy systems in the dwelling

Regarding the **new interface (at home and mobile)** in your dwelling, please give your opinion on ...

	Very satisfied	Somewhat satisfied	Somewhat Dissatisfied	Dissatisfied	No opinion
User friendliness					
The visibility and readability					
The information on CO2 levels					
Interesting and new insights					
The information on electricity usage					
The information on temperature					
The possibility to send feedback					
The possibilities to interact					
The mobile/ web interface					
The reliability of the information (s)					
The information on how to use the systems and interface(s)					
The aesthetic of the interface in your dwelling					

Any additional comments:

……

……

……

……

8. Housing costs

What is your economic effort regarding rent costs (excluding energy bills)?

- ☐ less than 10% of household income is dedicated to rent
- ☐ between 10%-20% of household income is dedicated to rent
- ☐ between 20%-30% of household income is dedicated to rent
- ☐ between 30%-40% of household income is dedicated to rent
- ☐ more than 40% of household income is dedicated to rent
- ☐ Do not know

☐ No opinion

What is your economic effort regarding energy costs (heating and electricity)?

- ☐ less than 5% of household income is dedicated to energy bills
- ☐ between 5%-10% of household income is dedicated to energy bills
- ☐ between 10%-20% of household income is dedicated to energy bills
- ☐ more than 20% of household income is dedicated to energy bills
- ☐ Do not know
- ☐ No opinion

Please, estimate the savings on housing costs (incl. energy) after the renovation?

- ☐ less than 5%
- ☐ between 5%-10%
- ☐ between 10%-20%
- ☐ more than 20%
- ☐ Do not know
- ☐ No opinion

Any additional comments:

……
……
……
……

9. General satisfaction about the community

Today, your building (including common areas) and the neighbourhood is…

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Attractive					
Beautiful					
Cleaner					
Secure					
Accessible (for persons with disabilities)					
Energy efficient					
Environmentally friendly					

On a scale of 1-10 how satisfied are you with the quality of life in your community?

☐ 1 ☐ 6
☐ 2 ☐ 7
☐ 3 ☐ 8
☐ 4 ☐ 9
☐ 5 ☐ 10

Any additional comments:

……

……

……

We thank you very much for your help and cooperation, we will get back to you with the results of our survey.

To be filled in by EMH or ACER :

Indicate the position of the apartment

☐ *Ground floor*
☐ *First floor*
☐ *Second floor*
☐ *Third floor*

Indicate how many sides (walls + roof) of the apartment are on the outside of the building.

☐ *None*
☐ *One*
☐ *Two*
☐ *Three*
☐ *Four*
☐ *Five*

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