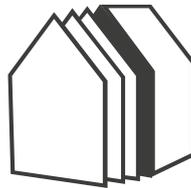


MORE-CONNECT

Development and advanced prefabrication of innovative, multifunctional building envelope elements for MOdular RETrofitting and CONNECTIONS (No. 633477)

D5.8 Monitoring report of inhabitants involvement and experience



Status: public

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1 Executive summary

The objective of this project was to study tenants' overall satisfaction with how the retrofitting of their dwellings was carried out and more specifically their experiences and satisfaction with their dwellings after the retrofits. For different practical reasons – the buildings had been emptied before renovation or the timing didn't allow it – the tenants involvement in the retrofitting process of the pilots have been scarce if not existing. However, in Presikhaaf, the Netherlands, a sound board group of residents was involved in the plans for the homes in advance and during implementation. They were also explained by the housing company what was going to happen during the renovation in the hope that they would catch up with other residents about this.

Therefore, the focus of this work has been mainly on the quality of the indoor environment after the renovation. A questionnaire was developed by the Estonian participants to assess the perceived indoor climate parameters. This was used by the Danish, Estonian and Latvian participants. The Dutch evaluation had been carried out earlier using a similar approach by the housing company 'Volkshuisvesting Arnhem'; as the housing company insisted to follow their own occupant investigation and their own questionnaire, the format is different from the other demonstration projects. However, the results give a good and detailed view of the experiences of the occupants.

In Portugal the pilot could not be implemented in the end and for the RLLL settings there were no tenants to involve, although for the RLLL occupants were involved. However, as they were not the original inhabitants, it did not make sense to ask about the experience with renovation and the quality of the house before and after renovation. Yet, in the RLLL house in Heerlen extended monitoring campaigns took place on thermal comfort and well-being. This is reported in D5.5. So, in general, no monitoring and evaluation of the inhabitants' satisfaction could be carried out for the pilot in Portugal and the RLLL pilots.

The feedback from the tenants living in the pilots in Denmark, Estonia, Latvia and the Netherlands were generally satisfied with the retrofitting of their apartments. The perceived indoor climate was improved by the retrofitting. Similarly, the perceived air quality was improved after retrofitting.

2 Introduction

2.1 The framework

The objective of work package 5 is the testing, pilot implementations and demonstration in real settings, as well as in industrial settings (demonstration of production), as in practice (demonstration and testing of the developed modular renovation elements both in real settings as in real life learning lab (RLLL) settings. The testing and demonstration in practice will be organised on six locations:

- Czech Republic (RLLL setting for in deep testing)
- Denmark (full real setting)
- Estonia (full real setting)
- Latvia (full real setting)
- The Netherlands (full real setting and RLLL setting for in deep testing)
- Portugal (partial real setting)

The work package comprises 6 tasks of which this deliverable presents the inhabitants involvement and experience of Task 5.6 Total evaluation of the renovation process. In this task the total renovation process as described in the tasks 5.1 to 5.5 will be evaluated and analysed and the results presented in three deliverables 5.7 – Monitoring, 5.8 - The inhabitants' involvement and experience and 5.9 - Analyses of the total renovation processes in the pilots. So, this report constitutes deliverable 5.8.

At the outset of the work in the MORE-CONNECT project it was anticipated that the inhabitants would be involved in the decisions concerning the renovation process of the pilots. And the first part of this report was intended to report on how this involvement went. As it went carrying out the pilots in the participating countries this involvement of the users was either not possible – as for example in the Estonian project where the building was empty before the renovation started. In the other countries the timing of the implementation didn't allow for this involvement. In Portugal, unfortunately, due to insuperable administrative reasons, it was not possible to complete the implementation within the stipulated deadline for the project and therefore no data could be collected regarding inhabitants involvement. For the RLLL settings there were no tenants to involve.

On this background it has been decided that this report focus on the experience of the tenants/inhabitants after the implementation of the energy renovation. For Denmark, Estonia and Latvia this has to do with the quality of the indoor environment: temperature, air, light and sound quality including a comparison of the before and after situation. This has been done through a questionnaire investigation with questions on these issues. For the Netherlands a somewhat broader investigation was carried out in the pilot Presikhaaf.

Task leader: Cenergia

Other participants knowledge: Zuyd, RTU, TUT

Other participants industry: BJW, LWCC

2.2 The questionnaire

To compile the experiences of the inhabitants of the renovated pilot projects a questionnaire was conceived by the Estonian partners. The questionnaire is presented in table 2.1. It covers seven questions concerning the thermal, air, lighting, and acoustic quality within the apartments as well as the working of the new ventilations system. The final question ask the inhabitants to judge whether the indoor climate has improved or not by the renovation.

Table 2.1 Questions in the questionnaire

How do you rate your thermal sensation?	Are you satisfied with the room temperature?	How do you perceive the indoor air quality?	How do you perceive the illumination level?	How do you perceive acoustic quality?	How do you perceive odor intensity? Is the	How has the indoor climate changed after the
Hot	Very good	Very good	Very good	Very good	Very strong odor	A lot better
Warm	Good	Good	Good	Good	Strong odor	A little bit better
Slightly warm	Ok	Ok	Ok	Ok	Moderate odor	The same
Neutral	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Weak odor	A little bit worse
Slightly cool					No odor	

The questionnaire has been used to compile the view of the tenants/inhabitants of the Danish, Estonian and Latvian pilot projects. The results are reported in the following chapters.

3 Denmark

In Denmark the pilot project renovation was carried out on an apartment block, which is located in an area classified by the authorities to be a ghetto area. This means that communication with the tenants has been very difficult. Only by a dedicated effort by the local representative of the building association has made it possible to collect answers from five inhabitants in five different apartments. Their answers have been plotted and can be seen on the figures 3.1-3.4.

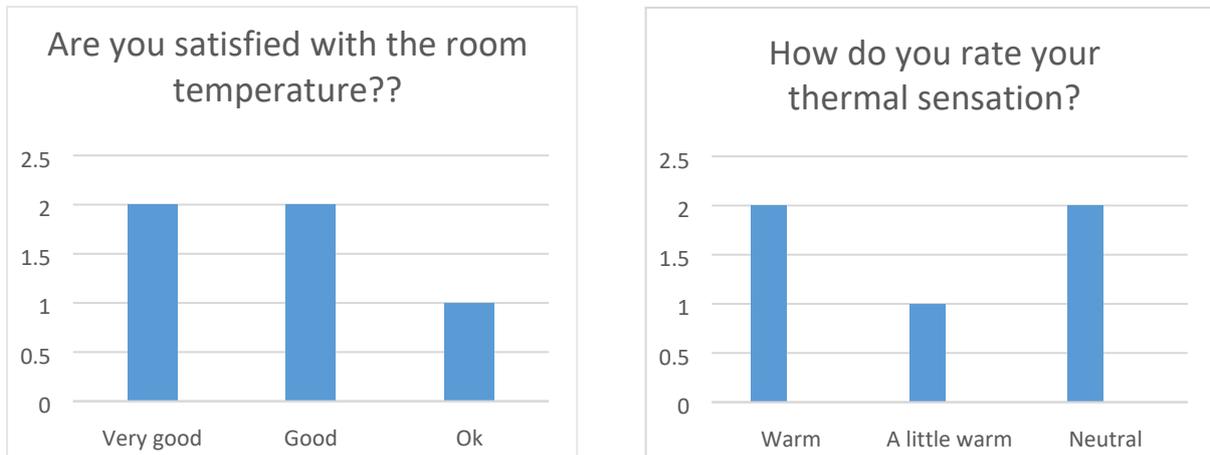


Fig. 3.1 Distribution of answers about the thermal indoor climate

The tenants find their apartments warm enough and are satisfied with the temperatures.

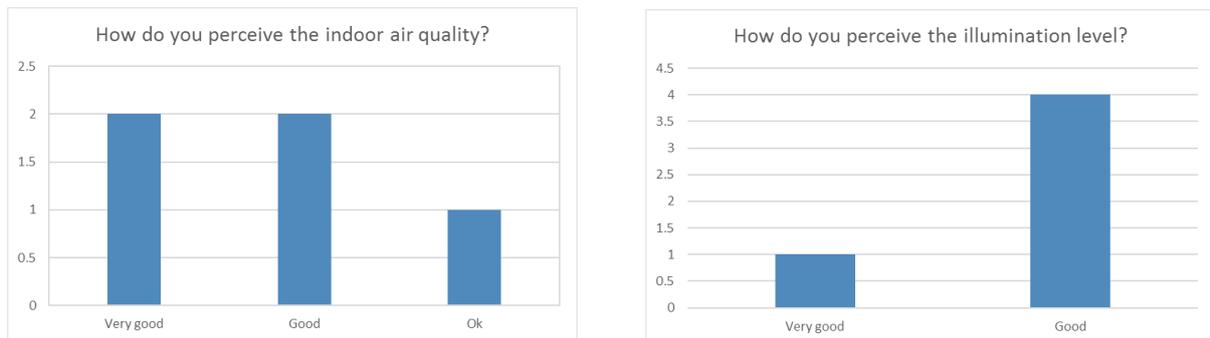


Fig. 3.2 Distribution of answers concerning air quality and illumination level

Also the indoor air quality and the illumination level are perceived positively.

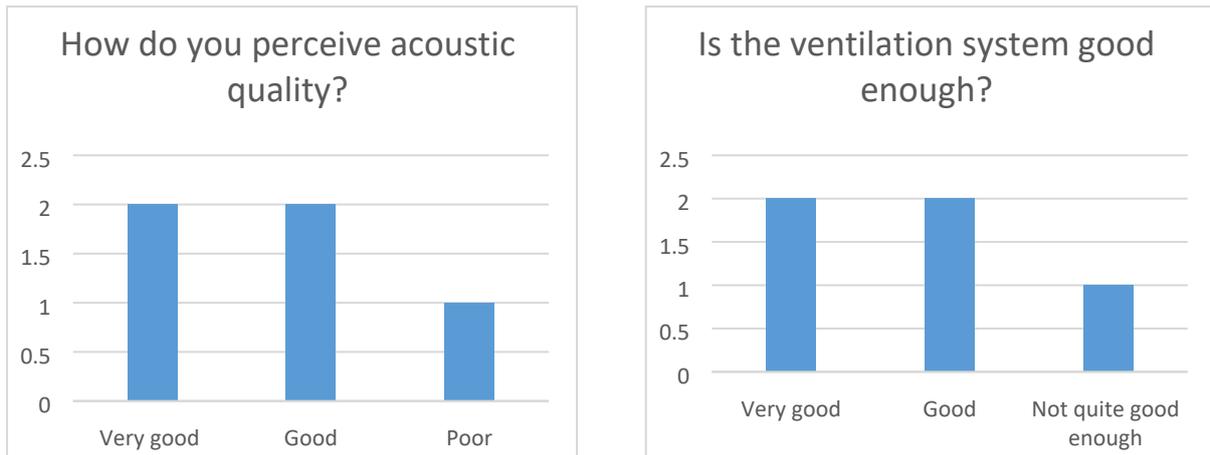


Fig. 3.3 Distribution of answers concerning the acoustic quality and ventilation system ability

The acoustic quality is judged good or very good by four out of five, but one tenant claim about the noise from the neighbouring apartments. Likewise four tenants are happy with the ventilation system and one not – the air becomes too dry – often a problem in well ventilated dwellings.

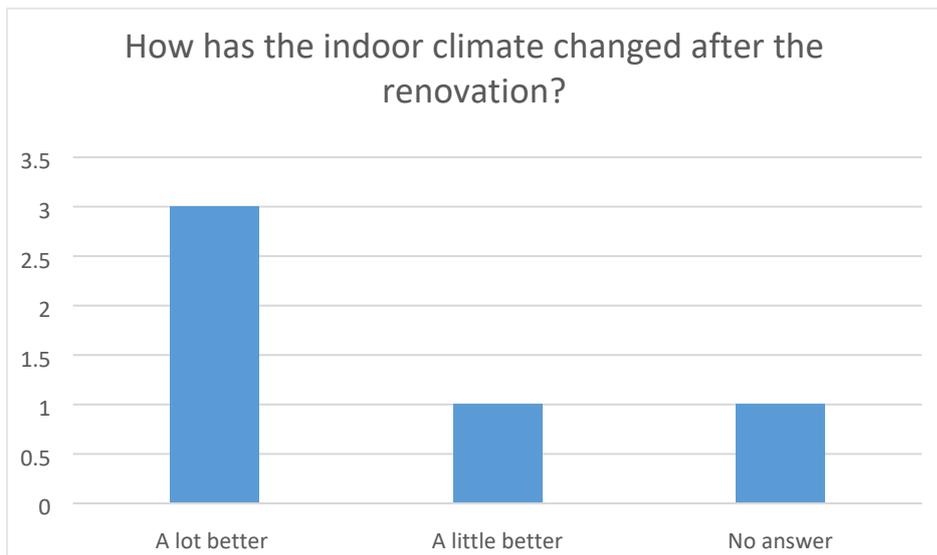


Fig. 3.4 Distribution of answers concerning the improvement of indoor climate by the renovation

The overall impressions by the tenants who has answered the questionnaire is the indoor climate has improved due to the renovation. One of the tenants had not lived in the apartment before the renovation.

One of the tenants has added the following comment: “I find that it all works very well and have only positive things to say. The apartment has been warm enough throughout the winter and I have not been too cold one single time”.

4 Estonia

The objective of the questionnaire was to get occupant's opinion on the indoor climate: thermal comfort, indoor air quality, illumination and acoustic comfort. The questioning was conducted through the internet.

From occupants who lived in the dormitory before the renovation we asked also to compare the indoor climate before and after the renovation.

The indoor temperature measurements were conducted with the help of building automation system.

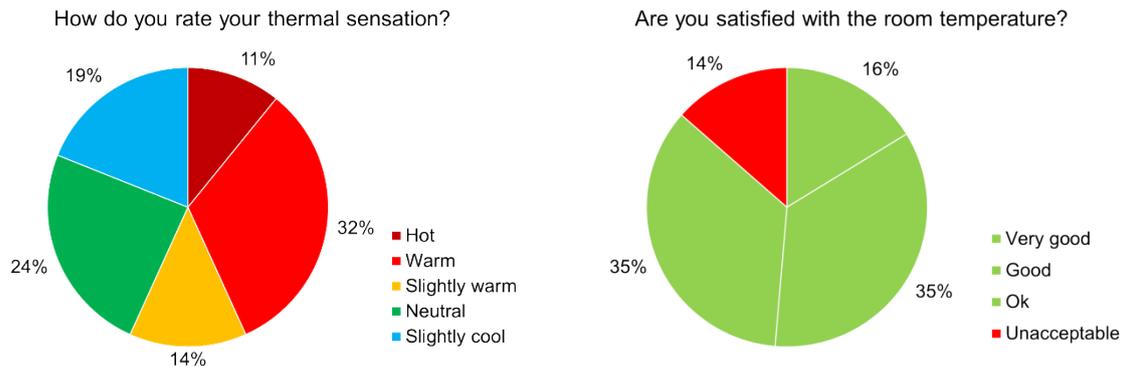


Figure 4.1 Occupants comments on the indoor thermal environment (37 answers).

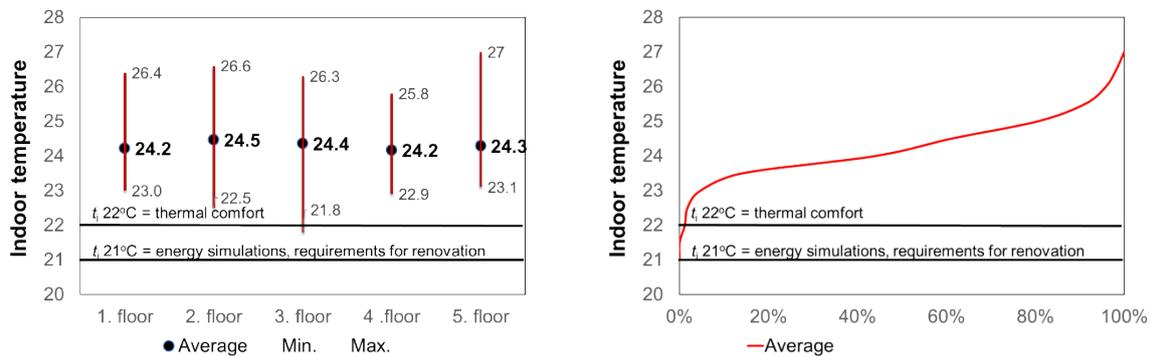


Figure 4.2 Indoor temperature measurements during winter (170 rooms).

Survey results on Fig. 4.1 about thermal comfort – room temperature and thermal sensation – are reflecting the real situation right after the renovation. The palette of the answers to thermal sensation (Fig.4.1, left) is reflecting the wide range composition of inhabitants (like it is probably almost in all apartment houses). Usually older people and females feel more cool than younger and male persons. Fig.4.1 (right) is showing that the situation is more than satisfactory - because over 80% of the answers are positive (i.e. acceptable level). On Fig.4.2 we can see that user profiles all over the building are not corresponding to standard use – room temperatures are 2...3 degrees higher than the standard setup for thermal comfort and designed min. requirements for renovation. This is common problem for deep renovated buildings and with up-to-date ventilation systems. It will reflect in the whole energy consumption of the renovated building, which will be higher than expected in the design phase.

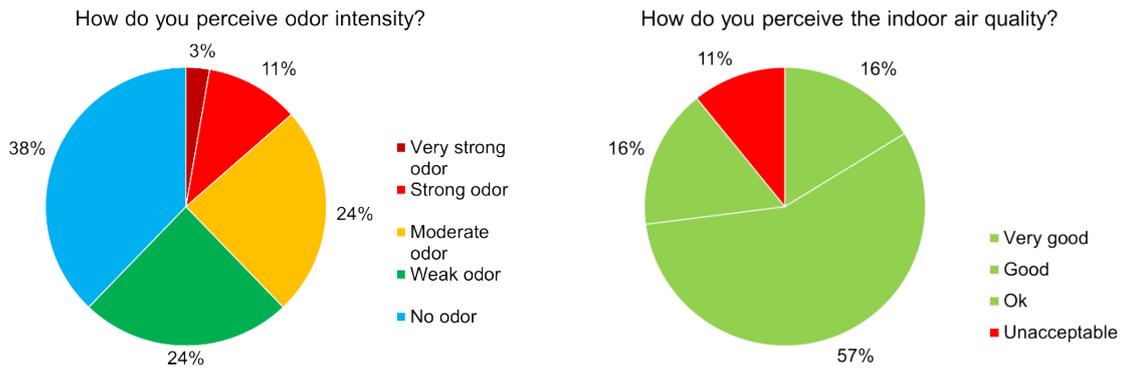


Figure 4.3 Occupants comments on the indoor air quality (37 answers).

On Fig. 4.3 (left) represent odour intensity answers are describing the cognition of inhabitants, moved in right after the renovation period. Painted walls and ceilings, new furniture and parquet are unfortunately sources for volatile adhesives for some time after their installation. Fig.4.3 (right) is somehow in conflict with Fig.4.3 (left) – it is difficult to see how almost 90% of answers are positive, if there is to some extent odour in the apartments at the same time.

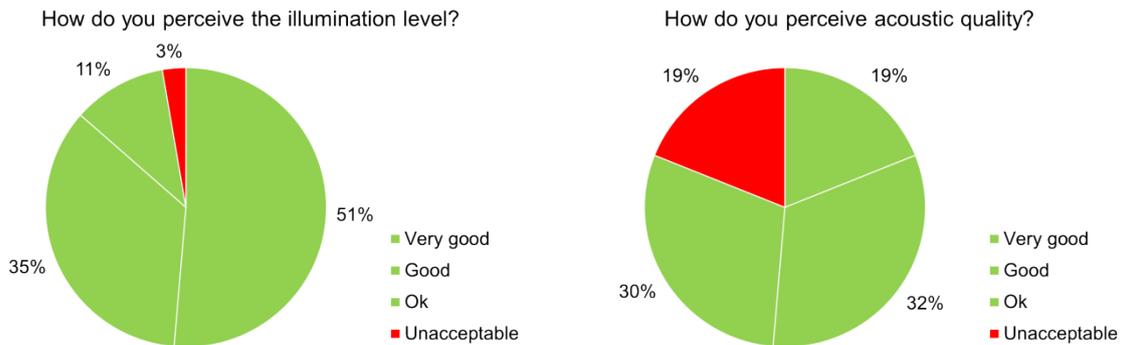


Figure 4.4 Occupants comments on the illumination (left) and acoustic (right) quality (37 answers).

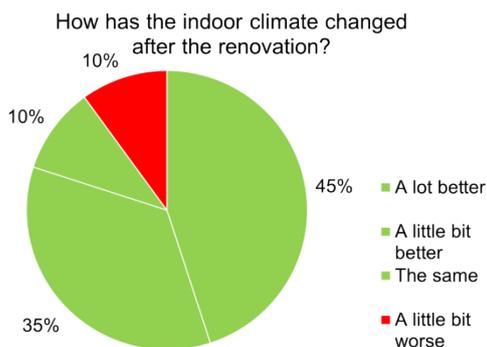


Figure 4.5 Occupants opinion about the indoor climate before the renovation (20 answers, only from occupants that lived there also before the renovation).

Fig. 4.4 and Fig.4.5 are in correspondence with hereinbefore shown results about room temperature and indoor air quality, where more than ¾ of answers are giving grade “good” or “very good”. Fig.4.4 answers are confirming that the designed bigger windows and acoustic measures (especially impact noise protection under the flooring, suspended ceilings, closed shafts etc.) are satisfying the expectations of most of the inhabitants. Fig. 4.5 compared to Fig.4.1 (right) allows us to presume that most of the inhabitants who were living in the building before, have moved back after the nZEB renovation.

5 Latvia

The Latvian pilot building is a relatively small building, which is occupied by seniors. Considering the small number of inhabitants, the survey was done by phone and during the placement of sensors. The overall impression of the retrofitting impact was very positive. During the survey, it was found out that the inhabitants now are able to maintain higher indoor air temperatures. While it has a negative impact on the energy consumption, it allows to insure better thermal comfort for the elderly people.

Table 5.1 Occupants answers concerning the thermal and other sensation

How do you rate your thermal sensation?	Are you satisfied with the room temperature?	How do you perceive the indoor air	How do you perceive the illumination	How do you perceive acoustic quality?	How do you perceive odor intensity? Is the	How has the indoor climate changed after
Warm	Good	Ok	Ok	Very good	Weak odor	A little bit better
Neutral	Good	Ok	Ok	Very good	No odor	The same
Warm	Good	Good	Ok	Very good	No odor	A lot better
Warm	Good	Good	Ok	Very good	No odor	A lot better

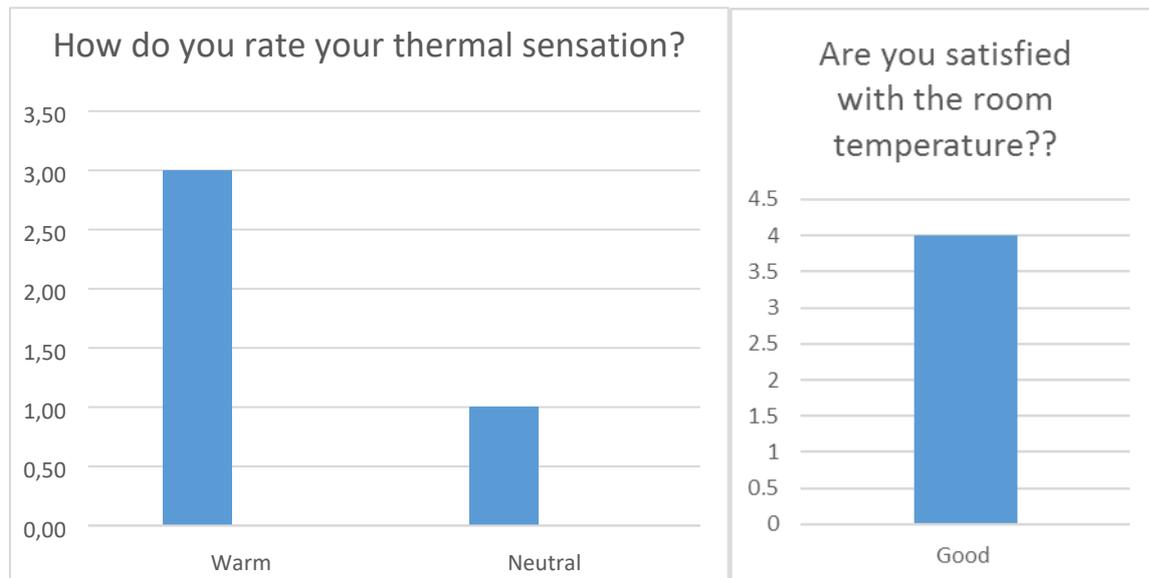


Figure 5.1 Occupants comments on the thermal sensation (left) and temperature (right)

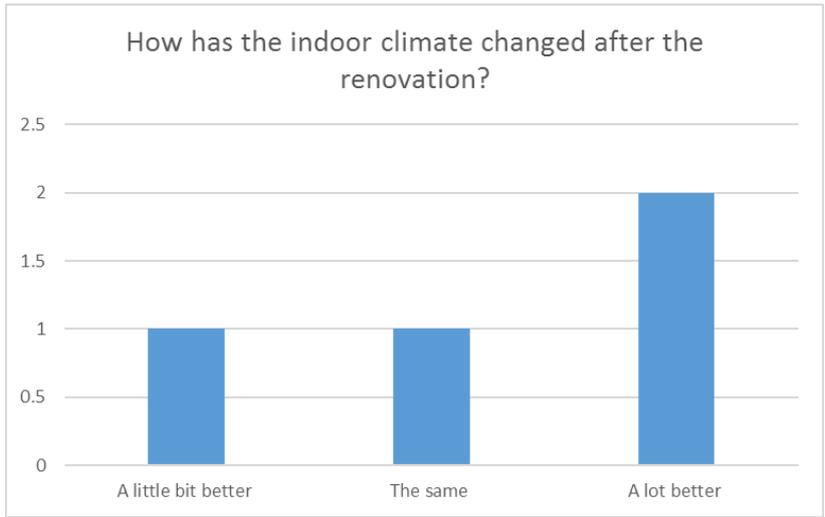


Figure 5.2 Occupants comments on the indoor climate change

6 The Netherlands

Project Presikhaaf project (WEBO and BJW)

Survey conducted by Yvonne Bierings, Volkshuisvesting Arnhem

Number of dwellings: 48 apartments

Date of execution of works: August 2015 to January 2016

Old situation:

Installations / facilities before renovation: Gas stoves in the living room and in a number of apartments also in kitchen / bedrooms

- 'Geysers' in kitchen (small open combustion appliances) for domestic hot water
- Some apartments with central heating or hot water boilers
- Single glazing and wooden frames, facades and roofs not insulated

New situation:

Installations / facilities after completion of the project: New mechanical ventilation with heat recovery system with 2 positions - 0/1 (Renovent Excellent)

- Condensing boilers (Intergas) for domestic hot water and space heating by air heating via mechanical ventilation system; small extra radiators in living room and bathroom. Heating is only used on very cold days. Control by thermostat
- Triple glazing, wooden frames, high-quality insulation of the facades, roofs and floors between dwellings first floor and storage rooms
- Night hatch for night ventilation in summer
- Inlet and exhaust valves in all rooms in the house. Extraction of air in kitchen, bathroom and toilet. Fresh air supply in living room, bedrooms and hallway.

Information / instructions for residents prior to implementation

- Information evening for residents before the start of the project
- Information booklet and letters to all residents
- Information evenings in test houses just before the execution

Information / instructions for residents during implementation

- Explanation of new installations in the home by project supervisor
- Plasticized instruction for the installation cabinet (2 A4)
- Information / instructions for residents after implementation
- Abbreviated instruction with QR code for instruction video (sticker in the installation cabinet) - craftsmen sticks the sticker and give an explanation again and ask for experiences so far with the new installations and use - August / September 2016.

Monitoring energy consumption / mapping

- 5 residents have indicated in the questionnaire that they think it is a good idea if smart meters are placed in the home so that we can monitor consumption. This has not been done yet.
- Experiences residents / occupancy satisfaction: Questionnaire sent in May 2016 - little response 7 comments. Residents (very) satisfied with the new facilities and installations. Other residents we have spoken share this opinion.
- Sound board group of residents involved in the plans for the homes in advance and during implementation. They also explained to the sound board group what was going to be done during the renovation with the expectation that they would catch up with other residents about this.

- A number of residents have pulled the plug from the heat recovery unit for various reasons: the device consumes electricity, the device makes noise. Some residents opened the window to ventilate instead.
- Most residents are happy with the substantially improved comfort, the beautiful new window frames, wide window sills, doors, entrance, balconies, stairwell and the new intercom system.
- A number of residents do not (yet) know how to deal with the installations, despite manuals, personal explanations, etc. A number of residents still lower the temperature at night. There are people who suffer from the 'sound' of the heat recovery unit. This problem has now largely been resolved. Was a misalignment of the heat recovery unit. Some residents do not know how to deal with the ventilation button 0-1. Some residents are afraid of opening windows and doors 'that is not allowed'.
- There were problems with the incorrect opening and closing of the new windows and doors. In the meantime solved and the craftsmen trained by WEBO to be able to repair this themselves. This turned out not to be so easy.
- Not everyone is vacuuming/cleaning the filters in the heat recovery unit.
- New tenants do not understand that there are only two radiators in the house. Not all colleagues in the Housing company are aware of the installations in the home. The housing company is going to get started with information that goes with the offering of the houses, with a short explanation.
- Other remarks, complaints:
 - 'Heat recovery makes too much noise'
 - 'After the renovation, I hear the neighbours better' (note: this can happen because of the improved noise insulation of the façade, before renovation outdoor noise 'maseked' the indoor noise).
- Other remarks, pros:
 - 'This winter only twice the heater on'
 - 'Apartment stays cool in the summer'
- Over score satisfaction of renovation: 7.8 out of 10.

Results of questionnaires (18 respondents)

Question	Answer	Comments
Living comfort improved	69% yes	Improved in particular: draft, wind chill, air quality, heat recovery system and mechanical ventilation and valves, triple glazing, wooden frames, facade storage and roof insulation Less or not demonstrably improved: light, central heating boiler for hot water, summer climate by and night ventilation hatch
New installations an improvement?	79% yes	
Do you vacuum the filters in the heat recovery unit regularly?	57% yes	The filters are replaced during maintenance of the heat recovery unit, but interim cleaning is necessary
Easy to use	93 % yes	
Did you watch the instruction movie?	64 % yes	
Noise pollution installations	79 % no	
Living comfort score	8,4	
Satisfaction with parts of the 18 respondents (number x in brackets): staircase (10), new balcony (10), storage room (12), entrance (12), green (8)		
Relevant comments (number x in brackets): Summer cooling tricky (1), summer night shutter always open (3), system is not used as it should (4), sound inside stronger due to insulation (2), system makes noise (3), need for verbal explanation about the heat recovery unit (3) new tenants ?, too hot inside (2), the system uses as required (1), floor insulation against noise pollution desirable (1)		

Users scores survey 2015/2017

Monitoring moments	2015	2016	2017
Number of observations	4.0		17.0
Total number of houses	6.8		8.1
Satisfaction noise in the house	3.8		5.9
Satisfaction level in which the house is isolated	3.5		8.4
Satisfaction maintenance on the outside	4.3		7.8
Satisfaction maintenance on the inside	5.5		7.5
Satisfaction bathroom	7.0		7.3
Satisfaction Kitchen	6.8		7.4
Satisfaction Toilet	7.3		7.1
Satisfaction burglary safety of the house	5.0		8.2
Satisfaction security of stairwell-gallery	4.7		7.6
Satisfaction lighting of stairwell-gallery	6.0		7.0
Satisfaction cleanliness of stairwell and/or gallery	4.3		7.5
Satisfaction entrance of the building	5.0		7.6
Size of the garden			
Size balcony			7.8

The point of attention remains: noise of the neighbors hearable

Additional information

Family composition on average 1.1 (in total 9 children with 18 respondents).

40% of the respondents are often at home and during the evening. 92% of the respondents use a normal amount of water (number of showers).