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DEMOHOUSE

Design and Management Options for improving the energy performance of Housing

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT

Thematic Priority 6

Deliverable 1C

Barriers of sustainable and energy conscious renovation related to the pilot projects

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ÉMI

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Executive summary

The EU supported project DEMOHOUSE aims at demonstrating the potential of energy efficient renovation of residential buildings. In order to achieve this goal, a number of pilot buildings in different European countries (Denmark, Austria, Greece, Spain and Hungary) are being renovated under sustainable criteria.

At the start of the project, the State of the Art of renovation in a number of European countries was studied and reported in D1: *'State of the Art'*. In this report as many as 92 barriers to energy efficient renovation were identified and described. The current report discusses which of the barriers found in D1 apply to the 5 renovation projects and what solutions were found to overcome these barriers.

In the pilot projects, the main technical barriers were related to the appearance of the building, limited information about the original structure, limited space for new installations and the high demand for manual work. These could be overcome by careful design and application of innovative materials, technologies and high level of prefabrication.

The greatest barrier of energy efficient retrofit in every country was the shortage of financial resources. Besides state subsidies, Energy Services Companies – ESCOs and Third Party Financing are a feasible option to overcome this barrier.

Regarding legal-organisational barriers, some partners encountered resistance or low motivation on the part of the decision makers. Organising workshops and showing best practice examples could help a better acceptance of similar projects.

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1 Introduction

For the successful implementation of energy efficient measures in building retrofit, barriers must be defined and strategies must be provided to overcome these barriers. We classified the barriers into four groups in D1A – State of the art: technical, socio-economical, legal and organisational and other barriers. These groups were further divided. In the technical category, for example, we distinguished between architectural and constructional barriers. Certain barriers are general in nature and apply to every country, but some of them are specific to a nation or region.

The solutions for the problems might be different in every case, usually it is possible however to give some general recommendations. The barriers and recommended solutions related to the pilot projects are summarised in the Table in the Appendix. For every pilot project we'll summarise:

- Barriers encountered and solutions adapted;
- the solutions not adapted and the reasons;
- recommendations for future projects.

2 Austria

2.1 Solutions adapted

In the Austrian demonstration building measures in general can be in split up into following aspects:

- Additional planning and management measures in comparison to the common Austrian building practice
    - Thermography of the existing building
    - Dynamic thermal simulation
    - LCA (Life cycle assessment) of the building materials
    - Calculation of different scenarios for energy consumption, CO_2 and the environmental performance of the building materials
    - Alternative tender for above mentioned scenarios
    - Forced involvement of the tenants
- Technical solutions
    - Improvement of the thermal quality of the building envelope, providing an energy demand for heating of less than 30% of the required legal standard
    - Application of ecological building materials (e.g. cellulose fibres for insulation of the flat roof)
- Monitoring
    - Thermographic analyses in different construction phases and after construction have been carried out to detect any malfunctions
    - A meter for monitoring district-heating consumption has been installed in the building. The meter will be used for reading the district heating consumption after the renovation. The readings will be done on a monthly basis, and compared to the calculated values
    - Meteorological information (Ambient temperature, relative humidity, solar radiation) for the Austrian demonstration building will be monitored based on hourly generated data by Meteonorm

- Questionnaire for the tenants

2.2 Solutions not adapted

To find the best solution for the final design of the pilot building several scenarios with a mixture of measures have been developed. . They are discussed in detail in deliverable 15: *'Alternative designs for pilot projecs'*. Measures like improvement of the thermal quality of the building envelope, as well as high efficient, renewable energy systems for hot water consumption and electricity have been analysed.

2.2.1 Passive house standard – heat recovery system

The most ambitious scenario has been a renovation to passive house standard, with an energy demand for space heating of 15 kWh/m2/year. Besides forced improvement of the thermal quality of the building envelope, heat recovery is necessary to achieve this standard. Three concepts have been studied:

- Centralised systems – one heat exchanger for all flats of a block (staircase)

- Semi decentralised systems – heat exchanger or ventilator in every flat

1) Central external- and exhaust air ventilation, centralised ventilators and heat exchanger for each flat in the basement.

2) Central external- and exhaust air ventilation decentralised ventilators and centralised heat exchangers for each flat in the basement.

- Decentralised systems – one heat exchanger for every flat

In the Austrian Demohouse project, a decentralised concept with a counter flow heat exchanger was suggested for construction by the scientific partners, thinking this to be the most feasible solution. First offers of HVAC companies pointed out prices around € 9.000.- for one flat, which means additional costs over € 115.000.- for the whole project. Unfortunately, the cost effective heat recovery unit, developed by the Danish partners, was not available at the start of the renovation works. Because of the limited financial budget (in social housing projects investments for renovation have to be done by the "renovation- and upgrading contribution", levied by the housing company, max.1,32 Euro per m2 and month) the landlord ENW renounced heat recovery. Furthermore renovation to passive house standard in Austria is not state of the art. There are only a few smaller renovation projects in passive house standard in Austria, with 127 flats occupied by 310 inhabitants, the Demohouse project would have been the largest renovation to passive house standard in Austria. On the other hand tenants comprise all age groups with some overrepresentation of the group of 50-60-year-old people and there also is a rising proportion of immigrants and asylum seekers living in the building. This circumstance means high risks for implementation of new technical systems, like decentralised heat recovery systems, as intermediation of this new techniques to this user groups is much more complicated, than to people with a better social background.

2.2.2 Biomass CHP

Main part of the CO_2 reduction in the Austrian Demohouse project is caused due to the production of heat and electricity with the combined heat and power plant (CHP plant), using vegetable oil (e.g. oil from canola, corn) to operate. Within alternative/regenerative and highly efficient technical systems for producing heat for these buildings and the utilisation for hot water (constant consumption) a biomass-CHP seems best. Due to operating the plant with vegetable oil, low emissions of this system are the result. A second benefit is the green production of electricity, which can reduce electricity produced of fossil resources.

Detailed facts of the planned and tendered biomass CHP:

37 kW electrical output, 236 MWh green electricity

62 kW heat output, 400 MWh heat per year for hot water

Estimated investment costs: 114.000 Euro

Planned oil price: 0,45 - 0,50 Euro per liter

Tendering results of the biomass CHP:

The best offer for the investment cost was 123.985 Euro, which would be still in the budget frame, but main problem occurred concerning the oil price, as the price for vegetable increased from estimated 0,45 - 0,50 Euro per liter to 0,69 - 0,85 Euro per liter. Due to this the heat price (running cost minus green electricity remunerations) is 0,108 Euro/kWh, whereby the planned costs was 0,053 Euro/kWh (which is equal to the existing district heating price). As the Austrian Social housing law (WGG – Wohnungsgemeinnützigkeits-gesetz) does not allow higher running costs after renovation, the biomass CHP cannot be adapted in the Austrian Demohouse project.

2.3 Recommendations for future projects

As renovation to passive house standard is not state of the art in Austria, the selection of adequate existing buildings feasible for passive house renovation is very important for landlords. Not only technical aspects concerning building physics and building services have to be considered, but also social aspects have to be taken into account. Passive house technology is a new heating system (air based system with heat recovery) for almost all tenants, which asks for special interest and awareness to achieve the planed targets. First steps for bringing passive house renovation onto the market should be done by smaller units with occupants of good social background, having forced awareness for energy issues.

To force passive house renovation and to overcome problems with higher construction costs involved with this technology, an Energy Performance Contracting (EPC) model might be a solution. For passive house renovation projects EPC has to focus on the energy system (HVAC) and on the building itself, to achieve the targets.

A possibility to overcome the before mentioned problems might be an Energy Performance Contracting (EPC) model. EPC is working particularly well for upgrades of building systems (Heating, ventilation, cooling, air conditioning, lighting, etc.) and for control and management measures. Guaranteed savings range from 15 to 25 % of the previous energy consumption. The contractor performs a detailed feasibility study. The result is a package of recommended upgrading measures, their aggregated costs and their aggregated savings. Once this is accepted, the energy performance contractor implements the energy savings measures, along with a monitoring regime that enables the levels of savings achieved to be explicitly identified. In contrast to other outsourcing contracts EPC is a guarantee to achieve the energy savings. If the measures fail to produce savings the contractor pays a penalty. Thus, Energy Performance Contracting creates incentives for the ESCO to provide quality products and services over the lifetime of a project.

3 Greece

3.1 Solutions adapted

Architectural and constructional barriers: In general no architectural and constructional barriers were encountered as the Greek 'DEMOHOUSE' project is a new to built construction. Monitoring after the completion of the building envelope showed that the buildings' construction meets high levels of air tightness and thermal insulation as it was predicted during the design stage. Also, all sustainable measures were implemented with no particular difficulty.

Socio-economic and managerial barriers: All new Greek 'DEMOHOUSE' buildings are subject to sale; therefore the clients are a critical element of the project. The latter show a great interest for the implemented sustainable measures, are very well informed and have different demands regarding the design and the quality of the dwellings. As a result, some delays were encountered because of modifications required by the future tenants. Since, the progress of the construction of the dwellings is related with the actual sales, priority is given to the dwellings that are sold and time is pressing for inhabitance. The housing demand is affected by the ongoing financial conditions and the particularities of the area.

Legal and organizational barriers: No bureaucratic barriers were encountered and no legal schemes delayed the Greek 'DEMOHOUSE' project.

3.2 Solutions not adapted

As the Greek building is a new building, there were no particular barriers and all the solutions were adapted.

3.3 Recommendations for future projects

The project team had to overcome some financial related problems regarding the costs of the energy measures: some energy measures were more expensive that what it was estimated at the beginning of the project. Specifically, for the Greek 'DEMOHOUSE' project, high investment cost was attributed to the Building Management System of each dwelling. A solution to this would be a better market research prior to any design and final decisions. Also, the lack of similar demonstration projects in Greece and any difficulty in the construction/ implementation of sustainable measures were overcome by a strong sense of collaboration between experts on sustainable measures and the builders.

4 Spain

4.1 Solutions adapted

The Spanish pilot project is a very old building located in a historical area of Bilbao and constructed in the early 20th century; therefore many technical difficulties arose during the renovation process due to lack of information about the original construction, loading capacity of the frame, preservation of external façades, limited space availability for new installations (ducting, fans,...), etc.

Refurbishment works were carried out floor by floor. The structure was reinforced, as well as the facades, but the whole internal layout was renewed. In order to ensure the structural security of the building, layout redistribution of each floor, starting from the lower storeys, was supported by secondary movable scaffolding which allowed propping up each element of the building. In addition, although exploratory studies were carried out prior to reinforcement, many unexpected problems have been detected in the framework (due to the very old age of the building, almost 100 year old), which have been solved as the works went along. This was particularly critical in the foundations of the building. Consequently a special attention was paid during the works and a supporting steel structure was constructed to reinforce the original wooden frame.

The implementation of sustainable measures in renovation activities requires a completely different approach from new buildings, adapting the solutions to the constrictions of the building (architectonic, technical, …). This is especially crucial in buildings located in historical areas, where other additional criteria must be considered, such as aesthetical aspects that must be preserved (e.g. not invasive elements for the aesthetics of the façades and even of the roof). That was the case of the Spanish pilot project, where thermal insulation was based in internal solutions to avoid changes in external façades of the building.

Concerning the social aspects, the Spanish renovation project is encouraged by the local authorities, with the intention of being an example for future similar renovations in Bilbao. The building is located in a degraded area, where the Bilbao Council is trying to develop and reactivate socio-economically. Thus the pilot building, further than being only a model for sustainable measures implementation, it is planned to be occupied by low-income young people (supported with subsidies) aiming a social regeneration of the neighbourhood through the integration of new inhabitants not belonging to discriminated social groups.

4.2 Solutions not adapted

It was also particularly important in these old buildings the availability of space for installations (e.g. storage tank of solar equipment), ducting, wires,…; which required a careful preliminary design involving interior spaces redistribution, ducting adapted to shafts dimensions, etc. Connected to this barrier it was considered the possibility of implementing the heat recovery ventilation system developed by the Danish partners. Unfortunately, two reasons arose to reject this idea:

- Although the dimensions of the systems are quite small and easily installable, the space of the dwellings and the service ducting space in the Spanish building are really small and it was extremely difficult to install such a ventilation system.

- Secondly, Bilbao climate is mild and up to this moment heat losses through ventilation have not been considered significantly in Spanish buildings (there are other priority aspects). In fact, there is another factor related to a cultural reason: the occupants perceive the mechanical ventilation systems in residential buildings as something artificial (and probably unhealthy) since they are used to natural ventilation by opening the windows.

4.3 Recommendations for future projects

In general, energy savings potential in Spanish Demohouse building comparing to standard renovation is really huge, since traditional practices are very simple (e.g. poor insulation) and energy saving awareness is still incipient in buildings renovation. The promising preliminary results on energy savings and the direct transferability/repeatability to many potential building renovations show a very hopeful scenario for housing renovation in Bilbao (and even in the Basque Country).

5 Hungary

In Hungary, the largest obstacles to the renovation were financing issues. Due to the cut of central subsidy, the Local Authority of Újpest could not finance the renovation. There were also political problems, as there was an election during the planning period and the decision-maker board changed. Unfortunately, due to the financial problems the pilot project could not be realised in the framework of Demohouse. In similar cases, a solution could be to apply for a Private Public Partnership scheme.

5.1 Solutions adapted

The following barriers has been overcome in the design process:

- Technical barriers:
  - The building is not a historic building, it was still the goal however to retain the original look to some degree. Some parts of the façade were covered with stone, here the external insulation was problematic. A solution could have been to remove the cladding and to apply a similar material after the insulation.
  - In energy efficient renovation, the limited space for new installation systems is a general problem, which can be solved through careful design.
  - We designed solar systems for the roof, however, the orientation of the roof was not ideal. This was solved by designing a flat roof area.
  - The high demand for manual labour could have been reduced by applying more prefabricated elements. For example, a prefab lightweight and energy efficient rooftop apartment with steel load-bearing structure and light-weight partition walls was designed.
  - The application of innovative insulation materials was planned. As the thickness of the polystyrene thermal insulation could have a negative influence on fire propagation, the increase of the U-value with the same thickness could be achieved by applying a material with higher heat resistance.

- Socio-economic barriers:
  - The high investment costs of the renovation are large obstacles. The state subsidy system is not very reliable in Hungary, the conditions and available funds are changing fast and the availability of bank credits is limited, which makes the long-term planning very hard. Third party financing and establishment ESCOs could be a solution.
  - As the pilot building is not inhabited, there are no problems with noise and dust during the renovation and convincing of the tenants.
- Legal and organisational barriers:
  - Decision makers, local authorities and housing corporations often have doubts about new technologies, they insist on traditional, well-proven solutions and the personal engagement is also missing. This barrier can be overcome by arranging information days, workshops and presentation of best practice examples.
- Other barriers:
  - The image of renovation needs improving. In Hungary, new buildings are generally preferred. Best practice examples can show that nearly the same level of comfort and energy efficiency is possible with renovation as well, and existing buildings have an added value (infrastructure, vegetation, atmosphere).
  - Short term thinking prevails among stakeholders, which can be changed again by arranging workshops and showing the long-term benefits. Long-term state subsidies can also help.

5.2 Solutions not adapted

As the project has been postponed there is no information for solutions not adapted.

5.3 Recommendations for further projects

We think that a long term commitment from the Local Government would be important for further projects to carry out research and demonstration over several election periods. The change of the decision makers could otherwise threaten with loss of interest.

More intensive discussion with the relevant decision makers and local trainings could help a better acceptance of similar projects. The lesson has been learned from this project that a stronger commitment would be very helpful for the future research and demonstration projects in Hungary.

Also, using solar systems could be more favourable with a better oriented building (roof slope close to South).

6 Denmark

6.1 Solutions adapted

In the Danish demonstration project we have the following aspects which have been possible to implement.

Additional planning and testing compared to normal standard:

- Use of energy signature for existing buildings
- Thermography of existing building
- Blowerdoor test of existing building and test apartment

- Optimisation of insulation measures and low energy windows
- Optimisation of energy efficient ventilation with heat recovery and testing in practice
- Innovative solar energy solutions (solar thermal and PV)
- Different calculations of alternatives with respect to energy savings and economy for the users
- Involvement of tenants including tenant and housing organisation response on developed and tested HRV solutions in full scale

Technical solutions

- Improvement of building and use of heat recovery ventilation with low electricity use and no noise
- Demonstration of innovative solar energy solutions
- Energy quality control in practice

Monitoring

- Blowerdoor tests, thermography and energy signatures used to document energy quality
- Monitoring of tested HRV systems
- Both detailed monitoring of innovative technologies and of overall energy use, also here use of energy signature method
- Filled in Green Build Questionnaire
- Filled in Green Diploma

6.2 Solutions not adapted

It was not possible to realise a passive house renovation, but new low cost HRV systems have been implemented with costs of around 3.000,- Euro per dwelling. At the same time a good airtightness gives good options for energy savings for district heating.

6.3 Recommendations for future projects

With the realised low cost HRV solutions there is a good chance of getting this technology to be used more frequently in future housing renovation projects.

The used energy quality control and Green Diploma labelling will be recommended for future renovation projects.

7 Conclusions and recommendations

In the pilot projects, the main technical barriers were related to the appearance of the building, limited information about the original structure, limited space for new installations and the high demand for manual work. These could be overcome by careful design and application of innovative materials, technologies and high level of prefabrication.

The greatest barrier of energy efficient retrofit in every country was the shortage of financial resources. Besides state subsidies, Energy Services Companies – ESCOs and Third Party Financing are a feasible option to overcome this barrier.

Regarding legal-organisational barriers, some partners encountered resistance or low motivation on the part of the decision makers. Organising workshops and showing best practice examples could help a better acceptance of similar projects.

APPENDIX: Table of barriers of sustainable and energy conscious renovation related to the pilot projects

1.	TECHNICAL BARRIERS								
		Countries	A	DK	E	GR *	H	Strategies overcome barriers	Action specific
1.1	Architec-tural barriers	to retain the architectural characteristics, the original look and style of the building	+	+	+	+	+	Attention on similar appearance	
		installations changing the appearance and aesthetical quality of the building	+	+	+	+			
		Protected facades, to keep the historic authenticity of the restoration of historical buildings	+	+	++	++	+		No changes on windows appearence
		Renovation should follow urban rehabilitation and the surrounding buildings in morphology			+	+			
		problem of techniques, building physics and organization related to inside thermal insulation	+	+	++		++	Higher attention on other elements	
		requirement of the zoning plan for different utilisations for special areas	+						
		external insulation on facades are not possible for the brick masonry buildings					+	Outside insulation	Removal of the stonee facade
		limited possibilities of changes in blocks with internal courtyards			+				
		limited available space for the new installation systems (e.g. ducts / fans for heat recovery ventilation, etc.)	+	+	++	++	+	Careful design	
1.2	Construc-tional barriers	limited loading capacity of the frame			++			Upgraded of the frame	New steel structure and reinforcement (ES)
		high demand of manual labour	++	+	+	+	++	Higher level of prefabricated and dry works	Timber prefab (DK) Steel attic structure (H)
		high extra cost (diagnostics, temporary equipments)	++	+	+	+	+		
		wrong estimation of costs / unpredictable minor details may change the cost calculation	+	+	+	++	++	Better design methods	
		lack of plans or unproper plans of industrialized buildings constrain interventions							
		district heating systems designed for larger capacities							
		avoiding noise, dust, heightened security measures causes complex, time consuming, expensive construction management, especially if occupants are living in the building during renovation period.	+	+		+	+	Choosing proper technics	Preference of use of dry technic

		the builder-owner often concentrates only on the primary reason for renovation (e.g. damages) and wants to get it done as quickly as possible.	+	+		++		Raise the awereness of the owners for longer term benefits	Intensive communication, best practice examples
		high cost, technical problems and lack of space for installing required new elevators	+		+	+	+	Seeking state/regional support for accessibility	Recontruct the staicase (H) tender for elevator construction
		selection of the best technique (risk of damage of other parts of the building or adjacent buildings)	+	+	++	+	+	High attention on design	
		high costs of the diagnosis and renovation planning due to lack of knowledge about the foundations			++	+			
2.	SOCIO-ECONOMIC BARRIERS								
		Countries	**A**	**DK**	**E**	**GR**	**H**	**Strategies overcome barriers**	**Action specific**
2.1	Eligibility of the subsidies and finance	lack or limited eligibility of subsidy systems	++			++	++	Finding outer systems	Esco's involvement, PPP
		high investment cost of sustainable measures	++	+		++	++	Third party financies, ESCO's involvement	Workshop with the owners
		strong conditions / limited availability of bank credits			+		++	Searching other "taylor made" alternatives	Negotiation with financing instutions
		large gap between housing / construction prices and household incomes, no financial sources of inhabitants for investing or for paying back credits	++				++	Seeking special support from the Local governments	Negotiation with financing instutions and local governments
		people are still looking at the state for subsidy and avoiding financing of investment from loans					++	Local support for vulnerable people	Discussion with local goernment and proposal setting
		opportunities of co-financing measures by the state budget are very limited	++	+			++	Lobbying	
		the boards of housing cooperatives and flat owners associations are generally not widely skilled in how to renovate buildings					+	More information about best practice	Intensive discussions and workshops with the stakeholders
		lack of support of thermorenovation measures		+			++	Lobbying, regional actions	Discussion with Local governments
		lack of sufficient support for demonstration projects	+	+		++	++	Lobbbying, higher involvment of supplier	Focused discussion with potential supplier
2.2	Afforda-bility of rent or housing prize after renovation	heavy increase of rents and housing prices in projects with comprehensive renovation activities	++	+	+			Special attention on vulnerable tenants	Helping tenants for induvidual support
		the increased housing price and rent may prevent the owners of applying new technologies in renovation	++			++		Information on the benefits	Workshops with the tenant, raise the level of the tenant democracy
		more expensive local amenities, higher building taxes and higher services charges	+		++				

2.3	Mobility in relation to the renovation	low level of mobility and people (especially old generation and lower income strata) not willing to move out during the reconstruction					++	Attract people to move	Special attention and program of the local government
		low level of mobility to move to other dwellings					++	Attract people to move	Special attention and program of the local government
		satisfying changing social demands					+	Flexible –open planning of the dwelling	Opportunity for later merging of the flats/rooms
		changing age-structure of the inhabitants					+	Forecast setting	Focused surveys and studies
		problems of social integration		+			+	Higher attentions for involving the teanant in the decision process	Local information office, Workshops
		“gentrification” and immigration in old parts of the town cause social conflicts			++			Action from local government	Discussion with local government
2.4	Tenants behaviour	low level of cooperation of tenants	+	+	+	+	+	Attracting the tenants	Set a strategy for commnication
		to secure existing usage rights	+	+	+	+		Clear rules	Communication of rules
		lack of awareness of the new systems’ function related to energy efficient measures	+	+	+	++		Raising the awereness	Information on Internet, flyers, face to face
		anti-social behaviour of certain groups, specific ethnic groups or immigrant groups	+		++			Active social policy	Communication on mather language, special events
		lack of care and pride in property by the tenants		+	+			Raising the conscious	Communication of best practice examples
2.5	Tenants’ opinion about the benefit of the renovation	Lack of sufficient knowledge or other fears inhibit the decision process of renovations	++		+	+	+	Higher involvement of the stakeholders	Workshops, Internet
		Ecological arguments suppressed by other criteria	+	+	+	+	+	Transparences of the criterias and priorities	Workshop with stakeholders
		lack of participation of the tenants in decision-making			+			Attract tenants for higher participation	Special events, promotion
		Nuisance of construction site	+	+	+	+	+	High care of working circumstances	Put on the priority list on contractor tenders
		tenants feel that energy saving measures are implemented at the expense of indoor space	+						
		doubts about new technologies	+	+		+	+	More and proper information	Set comminication strategy
		Perception of uncertainty caused by the new situation	+		+			Clear explanation	
		Fear of complicated handling of innovative facilities	+				+	Training	Set information material

		low willingness for investments	+	+		+	+	Seeking third party finances	Workshop of possible ESCO's involvement
		Pessimistic estimation of the regional development	+						
		fear of unsound renovation	+				+	Transparent Quality Assurance	Survilience
		fear of conflicts with tenants/co-owners/ administration	+					Finding new way of cooperation	Workshop, tenant represenative
		time pressure	+	+	+	++	+	Proper design, dry and fast technology	
2.6	Vulnerable tenants' group	vulnerable people (aged, disabled, unemployed, low-income, etc.) do not want to bother with renovation	+	+	+	+		Special attention and program	
		lack of information for vulnerable people					+	Special attention and program	
		low expectations of comfort derived from previous culture and experience	+	+	+	+	+	More information about success stories	Communication of Best Practice examples
		resistance to change of certain groups	+	+	+	++		Clear decision rules	Workshops
		lack of special participation of vulnerable people in decision making					+	Find way for better involvement	Finding relevant representatives
2.7	Environ-ment	lack of safety / high crime rates,	+		+	+		Special attention on rasing of safety feelings	CCTV system in use,
		low valuation of housing after its renovation due to its location	+		+	+	+	Insisting to a wider revitalisation program	Tenant –local government forum
		Lack of complex urban renewal programs					+	Insisting to a wider revitalisation program	Tenant –local government forum
3.	LEGAL AND ORGANISATIONAL BARRIERS								
		Countries	**A**	**DK**	**E**	**GR**	**H**	**Strategies overcome barriers**	**Action specific**
3.1	Demand of high agreement level	the opposition of single persons can interfere with the renovation process	++	+					
		the lack of information is a barrier of agreements	+	+		+		Better comminication	Local office
		groups with very different interests and socio-economic position	+		++	+	+	Better knowledge and understanding the phenome	Socio-economic suvey Proactive tenants meetings
3.2	Lack of personal engagement of the decision	decision makers have no personal engagement	+				++	Higher publicity	Intensive discussions with the decision makers
		housing corporations / local authorities have doubts about new technologies	+			+	+	Better technical knowledge	Informational days, Best practice examples
		housing corporations / local authorities are afraid to carry out complicated renovations	+			+	++	More detailed information	Workshops

	makers	low encouragement in renovation activities	+				+	Raising awareness	"success stories" workshops
3.3	Bureaucra-tic administra-tion for getting subsidies	bureaucratic administration for getting subsidies can affrey owners or decision makers and inhibit renovation				+		Logistical help	
		bureaucratic administration of the ownership status of organizations				++		Logistical help	
		bureaucratic procedure can be difficult to some social groups			+			Special attention on this group	Worhop with the stakeholders
4.	OTHER BARRIERS								
		Countries	**A**	**DK**	**E**	**GR**	**H**	**Strategies overcome barriers**	**Action specific**
4.1	Barriers related to innovative solutions	lack of users' interest inhibit innovative solutions	+	+			++	Better information chain	Training for tenants
		Information deficits of planers / dwellers / landlords inhibit innovative solutions	+				++	Better information chain	Training for stakeholders
		builders prefer traditional solutions in order to minimize risk and maximize profit	+	+		+	+	Underlying the benefits and reduce the risk	Best Practice examples
		strong financial barriers of R&D and innovation				+	++	Seeking for tenders	
		lack of performance based regulation		+	+		+	Information on design phase	Communicate the PB regulation
		Innovative solutions conflicts with preserving architectonic heritage			+			Finding acceptable compromise	Workshop with all thwe stzakeholders and authorities
4.2	The image of renovation	Renovation has worse image than new building	+	+	+		+	Attract stakeholders	Best Practice workshop
		building owners have strong need of security	+	+					
		architects prefer designing new buildings	+	+		+	+	Showing the benefit of proper renovation	Best Practice workshop for architects
		building owners lack confidence in new, still unknown services	+	+	+		+	Offering follow up system	Measurements of relevant datas
		lack of best-practice examples		+	+	++	++	International cooperation	More information on running/finished projects
		false image based on bed experience with renovation					+	Offering follow up system	Measurements of relevant datas
		The idea of "new is better"			+	+		Showing the benefit of proper renovation	Best Practice workshop for the stakeholders
4.3	Counter interest groups	short time speculative interests of manufacturers / developers / builders / owners inhibit sustainable and energy efficient renovations	++				++	Clarify the hidden interest	Workshop with the stakeholders
		aversion of tenants because of rents increasing		+				Fair rent system	

4.4	“Bad practice examples”	“bad practice examples” threaten new candidates of renovation (e.g. incorrect application of energy-saving measures)					+	Offering follow up system	Measurements of relevant datas
		lack of information about new technologies, education and demonstration about BAT		+		+	++	Communicate more information	Workshops, internet
		lack of personalized attention or social support of the dwellers					+	Better knowledge and understanding the phenome	Socio-economic suvey Proactive tenants meetings

* In Greece, the barriers refer to existing buildings in general, as the pilot project is a new construction.