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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 1
State-of-the-Art and Best Practices in the renovation sector in the participating countries

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Executive Summary

The EU- Demohouse project is a specific targeted research and innovation project supported by the EU – 6th Framework programme. It started in October 2004 and is ongoing for 4 years until October 2008. Demohouse is here an acronym for Design and Management Options for Improving the Energy Performance of Housing. ECN from Holland is coordinator and there are realised demonstration projects in 5 countries – Denmark, Austria, Hungary, Spain and Greece, with main focus on housing renovation.

The State of the Art report is the first task and the first deliverable in the WP1 of the DEMOHOUSE project. The *scope* of this report was to identify the barriers for sustainable, energy conscious renovation in the participating countries: Austria, Denmark, Greece, Hungary, The Netherlands, Poland, Spain and the Basque Country and Sweden. The *objective* is to make a State of the Art analysis about the renovation practice in the country including housing statistics in general and related to renovations, best available technologies in renovation, the housing subsidy systems in general and related to energy-conscious renovation and the barriers of renovation.

The first section of this report addresses the analysis of the ***renovation need and practice of the countries*** participating in the project. After analysing the main *housing statistics*, we can conclude that the economic background of the countries strongly determines housing conditions. Some correlation can be seen between GDP per capita and the number of dwellings per 1000 inhabitants and a strong correlation is shown between GDP per capita and average useful floor area per dwellings of the total dwelling stock. (However, this correlation is much slighter in case of new construction.)

As regards the age of the housing stock, in most of the countries a relatively small part of the dwelling stock was constructed before 1919 and slightly more between 1919 and 1945, especially in Denmark, Poland and Sweden. Between 1946 and 1970 there was a housing boom in all countries and about one third of the stock was built in this period. This housing boom was going on also between 1971 and 1980 in the strongest rate in Spain and Greece. A large part (20-30%) of the housing stock was built after 1980 in Austria, in Hungary, in the Netherlands and in Poland. In the countries of the former Eastern block the rate of housing construction was much higher before the political changes of 1989-1990, and in these countries a decline of housing construction can be seen after 1990. In summary, between 70 and 90 % of the housing stock of the examined countries was built before 1980 and most of this stock needs minor or major renovation.

On the issue of *distribution of housing types*, detached and semi-detached family houses are dominating in Hungary and in Greece. In Austria, Denmark, Spain and Sweden a balanced distribution of housing types can be seen. In the Netherlands low-rise row houses are dominating. Poland has the largest rate of multi-dwelling houses.

In summary of *building technologies*, brick and stone wall structures are dominating in every country, especially in the building stock built before 1960. From 1960 concrete-based constructions and industrialized technologies became widely used in all countries. Timber frame technologies were used in buildings older than 100 years in Spain and currently this technology is most popular in Sweden and rarely used in other countries.

Comparing the *ownership structures* in the countries, an extremely high owner-occupied sector can be seen in Hungary (93%) and also in Spain (82%), especially in the Basque Country (90,5%). In Greece half of the dwelling stock is owner occupied and the other half is private rental. In Poland also about half of the stock is owner-occupied and there is no information about

the ownership structure of the other half of the stock. A more balanced ownership structure can be observed in Austria, in Denmark, in the Netherlands and in Sweden, where also about half of the stock is owner-occupied and for the other half there is a balanced distribution of private rental and social rental housing. The strongest social rental stock is in the Netherlands (36%).

Analysing the *thermal insulation of the building envelopes*, we can note that more than 25 % of the gross energy consumption is the operational energy consumption of buildings in Europe, which has also a consequence of huge amount of emissions. Opposite to the other branches of the economy, where a technology can be changed after 10-15 years, the situation in building sector is much harder: on the one hand for the households there are neither technical nor economical possibilities to implement measures with one concentrated action, on the other hand the buildings' physical lifetime is about 100 years, thus the changes and the increasing of the proportion of new buildings are very slow. This means that the architect's decisions can influence a country's energy, economical and ecological position even for a century and the present situation is mostly determined by the building activity of many previous decades. On the other hand it must be seen, that besides of the new buildings the energy conscious retrofit of the existing ones is of prevailing importance.

In all of the countries the building stock built before the 70-ies (in some countries before the 80-ies) had no thermal insulation or very poor insulation and this stock should be renovated on this aspect. It is shown by experience, that calculated data are even not reliable. One of the reason of these problem is the use of design input data of the recent practice and regulations such as the surface conductance, sorption isotherms, porosity and moisture transfer coefficient. There is significant interrelation between these phenomena and the multidimensional heat flow in constructional joints. The above phenomena have several consequences, one of them being the necessary air change rate. Lower surface conductance increases the risk of mould growth, which can be compensated by more intensive ventilation, resulting in higher ventilation heat loss. Hygienic consequences should not be forgotten, as well. Due to the ageing and fabric damages of existing facades reconstruction is inevitable from the points of view of fabric protection, safety, aesthetical requirement. The rational way of the reconstruction is to combine it with added thermal insulation and new surface finishing – in such a way several problem of durability of constructional joints, air tightness and weather proofness, condensation and mould growth can be solved.

A variety of *heating and DHW systems* are existing in the participating countries, including district heating, central heating with boiler, individual heating of dwellings and premises and other solutions. The modernization of heating and DHW systems is a main challenge in renovation in all countries.

As regards the problem of substandard dwellings, the different definitions make comparisons hardly possible. The lack of installations like WC and/or bathroom is considered as substandard in all countries. In this aspect the worst situation is in Poland (13%), still significant development is needed in Hungary and in Greece and some development is needed also in Denmark. In Austria, Spain, the Netherlands and Sweden almost all dwellings has basic installations. In several countries low technical condition, the lack of drainage and excessive population density is also considered as substandard. Owercrowding is a special problem in Hungary and in Poland. In summary, in the analysed countries still a notable part of the dwelling stock cannot meet the basic quality requirements. We can find that the largest proportion of substandard dwellings is in Hungary and in Poland.

As regards data about the renovation practice there is restricted information on the renovated dwellings as a percentage of the housing stock in the countries. The major types of renovation works are heightening, completion, new roofing, construction of passenger lift, creating new

bathrooms and showers, connection to gas net, connection to water distribution and drainage, redevelopment of water and sanitation installations, renewal of electric lines, renovation of facade, renewal of windows, insulation measures, modernising heating and hot-water supply systems, implementation of central heating, connection to district heating, modification, enlargement or separation or merging of dwellings, etc. The most common measures are different in the countries, but modernization of heating and establishing modern appliances, renewal of facade and renewal of windows. In all countries there is a high potential for energy-related renovations. Joint to these works maintenance works like painting or tiling are mostly done. In most of the countries the majority of the above listed renovation works were partial renovations initiated by the individual users and the energy saving measures are not at the level of the BAT. These housing investments are strongly related to housing mobility as maintenance works are conducted when moving in. Larger, coordinated measures are more common in Austria, Denmark and in the Netherlands, but best practice examples can be also seen in the other countries. In most of the countries few data and figures are available of the turnover of housing renovation and mainly estimations can be done (e.g. in Hungary investments in housing renovation and maintenance are equal to 1,6-1,7 % of the GDP).

Although the majority of renovation has not been directed to energy saving or sustainability, renovation often lead to potential energy savings. The installation of individual water and heat meters in the buildings supplied with district heat, improving the air-tightness of doors and windows or changing the whole units, modernization of heating networks and thermal insulation measures on the building envelope are quite commonly applied. Public support to insulation, energy saving and other ecological solutions can largely inspire this kind of measures. In some countries (Austria, Denmark) the owners are often interested in ecological, integrated solutions (e.g. solar energy for DHW, heat recovery ventilation system, etc)

Several organizational schemes of the renovation practice can be seen in the participating countries. Three main groups of actors can be identified in the renovation practice: owner(s) of the building, inhabitants which can be owners themselves or tenants and companies that are in charge of the administration. Generally housing administrations play a crucial role for renovation decisions. And it is their task to propose necessary renovation measures. Organizational schemes depend on the ownership structure. Individual dwellings are renovated generally by the owners. Local authorities, housing associations or corporations renovate their housing stock and tend to renovate in blocks. Decision making and agreements are critical issues, especially in case of block of freehold flats of many individual owners.

As regards the second section of this report, **best available technologies**, we can conclude that the status and also the strategies can be partly based on general European characteristics and partly on regional characteristics. The following statements can be made:

1. ENERGY AND WATER SUPPLY

- Rational use of energy is important in every country
- There is a strategic aim in every country to cover an increasing rate of energy use from renewable sources.
- There is a need to reduce transmission losses.
- The possibility of supplying energy by biomass or co-generation should be increasingly considered.
- An increasing use of PV systems in energy supply is an important aim in every country.
- The implementation of intelligent building energy management systems should be increased
- In the supply of domestic hot water, the use of solar energy should be increased in every country and a strategic aim is to make this as a standard solution.
- In water supply the possibilities of using rainwater should be considered.

2. THERMAL INSULATION

- thermal insulation is everywhere necessary but the optimal rate of it can be different also depending on regional climatic conditions. In the countries having winter temperature often below 0°C, we can have an aim for example for walls to have a U value of 0,2.
- In some countries, e.g. in Poland or in Hungary a strong improvement of thermal insulation is needed in the existing building stock and this is the most important issue in the renovation practice. This regards also doors and windows, the majority of which should be changed in these countries. (In new construction much better doors and windows are used).
- A special attention should be on avoiding thermal bridges.

3. VENTILATION
   - buildings should be airtight and ventilation should be solved in every country,
   - the provision of good ventilation is everywhere important, but the use of heat recovery ventilation systems is more optional.
   - the rate of required ventilation in winter (with special regard of moisture problems) and summer (cooling) is depending on the climatic factors.
   - as a strategy, the aim of increasing the use of renewable energies for ventilation is relevant in every country.

2. OTHER ISSUES
   - The practice of shading can be also improved in all countries and there is a need of innovative shading devices,
   - In the renovation practice the provision of extra spaces (where it is possible) can be a great advantage and provide added values (e.g. roof apartments, new balconies, etc.)
   - Selective waste management system should be introduced are increasingly used in all countries

Table. Main issues, strategies, barriers and application of best available technologies

Main issues	***Strategies***	***To be applied in***	***Main barriers***
1. ENERGY & WATER SUPPLY	*1.1. Rational Use of Energy*	*all countries*	*Lack of awareness*
	1.2. Increasing rate of renewable and alternative energies (solar, biomass, co-generation)	*all countries*	*Lack of awareness*
			Installation cost
			Lack of subsidies
			Technological barriers
			Lack of suitable space
			Unfavourable appearance
	1.3. Reducing transmission losses	*all countries*	*Lack of innovative systems of energy supply*
			Insistence to well-known solutions
	1.4. PV implementation	*all countries*	*Installation cost*
			Unfavourable appearance
	1.5. Implementing intelligent building energy management systems	*all countries*	*Lack of awareness*
			Cost
	1.6. Solar systems for DHW as standard solution	*all countries*	*Installation cost*
			Lack of suitable space
			Unfavourable appearance
	1.7. Rainwater reuse	*all countries*	*Technological barriers*
			Cost
2. THERMAL INSULATION	*2.1. Increasing the level of thermal insulation, better U values*	*all countries, but different level*	*Changing appearance in cases*
			Cost
	2.2. Changing doors and windows (thermo-glazing)	*all countries, but different level*	*Changing appearance in cases*
			Cost
	2.3. Avoiding thermal bridges	*all countries*	*Structural barriers*
3. VENTI-LATION	*3.1. Ensuring airtightness*	*all countries*	
	3.2. Ensuring proper ventilation rates	*all countries*	*Cost of ventilation systems*
	3.3. Using PV assisted heat recovery systems	*all countries as an option*	*Lack of available technologies*
	3.4. Use of renewable energies for ventilation	*all countries*	*The same as in 1.2.*
4. OTHER ISSUES	*4.1. Better shading, innovative shading devices*	*all countries*	*Cost*
			Lack of innovative technologies
	4.2. Provision of extra spaces	*all countries*	*Lack of suitable spaces*
			Structural barriers
			Changing appearance
	4.3. Implementing selective waste management systems	*all countries*	*Lack of awareness*