ECN

Energy research Centre of the Netherlands

Examples of refurbishment

WP2 overview of refurbishment projects for the InoFin project

Supported by the European Commission

Composed by M. ten Donkelaar

InoFin

Tailored Financing Schemes for Social Housing Refurbishment

Intelligent Energy Europe

February 2007

Acknowledgement

The data of the different refurbishment projects, shown in this document, is collected within Work Package 2 of the project "Innovative Financing of Social Housing Refurbishment in the Enlarged Europe" (InoFin). The European Commission supports this project under the Intelligent Energy Europe Programme. We are grateful to the European Commission for part funding this work. The study is jointly conducted by the InoFin project team and is registered under ECN project number 7.7735. This document contains examples of refurbishment projects from the Netherlands, the Czech Republic, Poland, Latvia and Bulgaria.

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Introduction

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1. Examples of refurbishment projects

This annex includes 3 examples of successful refurbishment projects carried out in three of the InoFin countries, the Netherlands, the Czech Republic and Latvia.

1.1 The Netherlands - Veenendaal

Between July 2000 and March 2002 Patrimonium Woonstichting, a Dutch housing cooperative in the town of Veenendaal (30 km east of Utrecht), refurbished two apartment buildings at the location Tarweveld/Gersteveld, each containing 75 dwellings with a floor area of 95-100 m^2.

With this refurbishment they had three goals in mind.
1. Replacement of an out-of-date heating system.
2. Lengthen the life span of the buildings with 15 years.
3. Accomplish major energy savings.

The refurbishment plan originates in the need to replace the worn out collective heating boiler. Instead of simply replacing the old boiler for a new one, the housing cooperative made use of this change to combine it with several other improvements.

The refurbishment project
The project started with the replacement of the old boilers with new, very efficient condensing boilers. The old heating pipe system and radiators were not well suited for these new boilers. To improve energy savings, new piping and radiators, adjusted for the new heat capacity, were installed. The hot tap water supply was also changed. Electric boilers and geysers were replaced with a collective system combined with individual solar water heaters (2.25 m^2 each) for every apartment. A universal control unit was installed. This unit controls the room temperature (room thermostat) and minimal tap water temperature. It also monitors the heat obtained per apartment for individual payment. To improve living conditions, a balanced mechanical ventilation system was installed in all dwellings. The housing cooperative gave tenants the opportunity to suggest other improvements in their apartment, such as a new kitchen unit, so these could be combined with the other construction works.

Before and after refurbishment, space heating was and is based on a collective system, maintained by the housing cooperative. They were and are responsible for charging the heat taken by the tenants. This requires a good monitoring system. Because of this, the cooperative has good insight to the effects of the energy saving measures. The use of natural gas before refurbishment was about 1450 m^3 on average per dwelling.[1] Because of the measures taken this has decreased by about 30%. In kWh/m^2 year; this means about 125 kWh/m^2 before and 90 kWh/m^2 after refurbishment.

Financial aspects of the project
The total costs for the project were € 1.24 million. This means that the average costs per apartment were € 8,327 (excl. VAT about € 85/m^2). An amount of € 1,044 per apartment was subsidized because of the use of solar energy. The remaining investments were done by the housing cooperative. Their benefit from the refurbishment is mainly the lifetime extension of about 15 years. This means revenues from rents for an additional 15 years. Because of this integral approach, no rent increase was necessary to finance the refurbishment.

[1] Before the refurbishment, in some apartments, hot tap water was made with an electric boiler. The electricity, expressed in gas equivalents, is included in the average gas consumption. Cooking gas is also included.

Creating support to the tenants

At first, the tenants were not enthusiastic about large-scale refurbishments. They were satisfied with their apartments, their neighbourhood and their comfort. Plans for refurbishment came as a surprise for some tenants. Intensive consultation with tenant representatives showed them the comfort improvement and financial benefits of the project. Comfort is improved because of: a more optimal space heating with smaller radiators, better measure and control equipment, more living space in the kitchen without boiler or geyser, no toxic emissions from a geyser in kitchen, unlimited hot tap water and better air quality because of ventilation. Financial benefits came from a decrease in gas use and no electricity use for hot tap water. Tenants have to pay their heat in advance. The cooperative promised beforehand they would charge less in advance directly after the refurbishment. This convinced people that the project would really be beneficial for them. To limit the nuisance from construction works, all construction work inside a single apartment was concentrated in two days. To achieve this, the new heating pipes were not build inside apartments or boxrooms, but on top of the building roofs. With this method, a large part of the heating system could be constructed without any discomfort for the tenants.

Main drivers leading to success

The integral and strategic approach is the main driver for success in this project. Energy saving is seen as part of a broader goal to lengthen the life span of buildings. This generates income and saves investments on the long term, which can be used to finance the improvements. This Quality profile approach is becoming more common by housing cooperatives in the Netherlands. Creating support with tenants is another driver for success. This support was obtained with a considered approach and good information supply. An additional advantage is that demolition costs were avoided as well.

Re-applicability

All technical installations are well available and conventional. The implementation differs on some points from conventional methods, for instance the two-day approach and the choice to improve already satisfactory apartments. But both the technical installation as well as the implementation can be copied in other projects, in the Netherlands or abroad, without major problems. Lengthening the exploitation of buildings can be a good approach to generate money for energy-saving investments.

Figure 1.1 *Solar water heating system in apartment building in Veenendaal (NL)*

1.2 The Czech Republic - Rumburk

The town of Rumburk is located on the Northern border of the Czech Republic. Due to cold winds blowing from the north, there is a colder climate than it would be expected for such altitude. The number of degree-days of 3700 is slightly higher than the average of the Czech Republic (3500) and the average heating period is 244 days.

The social dwellings refurbished here consist of two houses with a flat roof and four floors and 66 flats. The house was built in 1978 using common technology of concrete panels for the outside façade and load bearing structure while partitions were built using porous concrete panels. The owner of the house is the municipality of Rumburk.

In the year 1997 the Czech Energy Agency provided a grant to demonstrate possible improvement of energy characteristics of the house. In addition, a double-sloping roof with an additional floor of new flats replaced the flat roof.

Technology implemented

The pilot project included the following items:

- Outside walls - Thermal insulation of frontal and gable walls were insulated using 70 mm thick polystyrene boards.
- Doors and windows - Old windows were replaced by new plastic ones with U = 2,1 $W.m^{-2}.K^{-1}$, with silicon EUROSTRIP sealing, doors having brush insulation.
- Roof - Old flat roof was replaced by double-sloping roof with an additional floor of new flats built in. The thermal insulation was done using 150 mm thick polystyrene boards.
- Inner space - the floor above not heated with underground space was insulated using 50 mm thick polystyrene boards.

Financing

Basic data on rehabilitation of social house in Rumburk are presented in the following table. Total investment costs were CZK 9 million (€ 300,000) of which about one third was covered by the Czech Energy Agency grant and the rest came from the municipality budget. This amount corresponds to CZK 135,000 per dwelling (€ 4,500).

Saving achieved

The implementation of energy saving measures resulted in reduction of specific energy consumption per unit of floor area by about 45%. Nevertheless specific consumption for space heating is still 95 kWh/m^2.

Table 1.1 *Refurbishment data of the project in Rumburk, CZ*

		Data before rehabilitation	Data after rehabilitation	Difference
Heated living area	[m^2]	2,979.8	.	.
Heated total area	[m^2]	3,611.9	5,417.9	1,806.0
Number of flats		66	84	18
Energy consumption for space heating	[GJ/yr]	2,258.6	1,859.6	1,085.0
Specific consumption for space heating	[kWh/m^2]	174	95	79
Specific consumption for space heating	[%]	100	55	45

Replication potential

Combination of house rehabilitation with building additional floor of flats under the roof gives very good economic results and can be recommended.

Figure 1.2 *Refurbished panel building in Rumburk (CZ)*

1.3 Latvia - Valmiera

Successful examples of housing refurbishment in municipalities can be found in the town of Valmiera. Here the municipality gives financial support to energy efficiency measures in apartment buildings and energy efficiency measures have been implemented in several buildings.

In 2005 in Darza street 13, Valmiera, the following energy efficiency measures were performed:

- insulation of walls
- insulation of basement ceiling
- insulation of attic
- closing of unused waste pipes
- change of heat insulation of main heating system pipes.

The total investment was 75,116 Ls (€ 107,300) and 28.2 €/m^2 and this was financed by a commercial bank loan. At the present level heat tariff (2005/2006) of 19.81 Ls/MWh (28.30 €/MWh), the simple payback time is 21.9 years.

Before renovation an energy audit was performed. Data from the energy audit and data gathered after energy efficiency measures have been applied can be seen in Table A.2.

Table 1.2 *Refurbishment data of the project in Valmiera, LV*

		Before renovation (data from energy audit)	After renovation
Average energy consumption for heating demand recalculated to standard year*	[MWh/yr]	587.88	414.64**
Specific heat consumption	[kWh/m^{2}yr]	166	117
Average room temperature	[^{o}C]	20	21

* number of heating days: 203; outdoor temperature in heating season: 0^{o}C, average room temperature: +18^{o}C.

** provisional data as data were gathered during the last month of heating season 2005/2006.

As the data in Table A.2 show, heat energy consumption has decreased by 173.2 MWh/yr, which presents energy savings of 30%.

Figure 1.3 *Refurbished panel buildings in Valmiera (LV)*

1.4 Poland - Warsaw

This project concerns the process of energy efficiency refurbishment of a building owned by a housing cooperative, located at Bukietowa Street 8 in Warsaw. The building described was constructed in 1963 with typical panel technology. It has 48 dwellings, 2400 m^2 usable area and is occupied by 98 persons (most pensioners and low income families). For the refurbishment, use has been made of funds from the Polish Thermo-modernisation Fund.

Figure 1.4 *The building in Bukietowa street (Warsaw, PL) before refurbishment, April 2003*

This formerly municipally owned building was transferred to cooperative ownership in 1994 after introduction of the Law on Ownership of Dwellings. This law states that the housing cooperative is created automatically after sale of dwellings in municipally owned buildings. The building was managed by the municipal housing management, which limited its activity to control the existing installations and carrying out small repairs.

Since the activity of the municipal management was not satisfactory to most of the dwelling owners, and the charges collected from them covered more administration than maintenance cost, the assembly of dwelling owners took a decision (by majority of votes) in 2002 to replace the municipal management by a private licensed manager. At this moment the share of private ownership of dwellings in the building was app. 60%. The remaining dwellings belonged to the municipality and were occupied by low-income families.

Project approach

Under leadership of the private manager of the building a 5 years investment plan for the building was prepared, where one of the main subjects was energy efficient refurbishment.

The total cost of the refurbishment project was app. € 96,000 and was covered in the following manner: € 20,000 was collected by the association prior to loan application, the BISE Bank issued a loan of € 76,000 for 5 years, the BGK reduced the loan by 25% = € 41,800 the remaining part of the loan in amount of € 57,000 + interest was repaid to the BISE Bank till end of 2005.

This project was one of the first performed by housing cooperatives under the state system of support to energy efficient retrofitting of buildings. Till mid 2006 app. 2000 buildings of housing cooperatives in Poland have used the system for their convenience.

Results

The building described was constructed in 1963 with typical panel technology. The calculated heat demand for heating purposes prior to refurbishment was 230 kWh/m^2/yr. The scope of energy efficient refurbishment measures covered were:

- Replacement of central heating installation by new fully automated one (pipes, radiators, thermostatic valves).
- Insulation of external walls with 13 cm of styrophoam.
- Insulation of windows above staircases with polycarbonate panel.
- Insulation of roof with 12 cm of mineral wool.

These refurbishments led to a decrease of the calculated heat demand to 110 kWh/m^2/yr.

The yearly heating costs of the building prior to refurbishment was € 19,520 (€ 33.6 per household monthly, 0.67 €/m^2/month) and after refurbishment it was 40% lower, e.g. € 11,520 (€ 20 per household monthly, 0.40 €/m^2/month). It means that the difference in amount of 0,37 €/m^2/month was the real cost savings, which was higher than the required monthly repayment rate of the loan set by the bank for 10-years loan (after deduction of bonus) to 0,24 €/m^2/month.

One year after accomplishing the project the association decided to introduce a heat accounting system based on heat cost allocators installed on heat radiators and thanks to this a further 5% heat cost saving was achieved in the next heating season.

As the monthly charge for the renovation fund of one household (dwelling) was increased at the beginning of the process from 0.40 €/m^2/month up to 1 €/m^2/month it was possible to repay the loan in shorter time (1.5 years) and to reduce this charge to the level necessary to cover current maintenance cost e.g. 0.20 €/m^2/month. The heat comforts in dwellings increased, meaning that the problems with under or over heating of spaces were removed.

According to real estate specialists the market value of dwellings in this building is higher by 10% than the market value in twinning buildings, which are not refurbished.

Figure 1.5 *The building in Bukietowa street (Warsaw, PL) after refurbishment, Oct. 2003*

The ten years payback period of the investment is representative for energy efficient measures in multifamily buildings in Poland if the measures are designed in a complex manner. This project was replicated in 2000 cases in Poland and the system applied in Poland may be of interest in other Central and Eastern European countries.

Lessons learned

- The state has established a system of support to finance existing residential housing by flat-owners. It was not sure that it would be accepted at such a large scale. The system is transparent and affordable for all social groups including vulnerable households being under municipal care.
- The argument of high heat prices in connection with very bad technical conditions of buildings is sufficient to find consensus among the housing cooperative members on mobilization of own sources and taking the loan.
- The most important lesson is that the frameworks of any public aid should be established in a transparent and affordable manner.

1.5 Bulgaria - Zaharna Fabrica

The objectives of this project were to carry out a renovation and further maintenance of a multi-dwelling building in which the flats are owned by the inhabitants, overcoming the problems that arise from the low incomes of the owners and their different interests. The renovation also had to lead to a lower energy consumption and improvement of the living comfort of the flats.

The project included also a whole reconstruction of the roof. On the last floor (attic) there were two common premises that were transformed in small flats. The rent of these new flats helped in the reimbursement of the loan.

The project was initiated and realised by Bulgarian Housing Association in partnership with two Dutch Housing Cooperatives, De Nieuwe Unie - Rotterdam and Woondrecht - Dordrecht. Before the realisation of the project, an association of owners was established in the building.

The refurbishment has been financed by the owners through a 20-year loan from banks from the Netherlands as they offered lower interest rates. The monthly payment of the loan is 700 BGN (approximately € 350), but half of this amount is ensured by the rent of the two new flats erected in the attic.

The refurbishment of the building included: thermal insulation of external walls, new water proofing and thermal insulation of roof, installation of new double glazed windows with PVC frames, thermal insulation of basement ceiling, improvement of the heating system, whole reconstruction of the attic including transformation of two common premises into small flats.

An energy monitoring was done before and after the refurbishment. After the renovation the building received an energy certificate A. Integrated characteristic requirement for certificate A is 121.7 kWh/m^2 per year, the building reached a characteristic of 105.6 kWh/m^2 per year.

Table 1.3 *Refurbishment data of the project in Zaharna Fabrica, BG*

Energy consumption before renovation [kWh/m^2 per year]		Energy consumption after renovation [kWh/m^2 per year]	
Heating	162.6	Heating	60.2
Hot water	30.5	Hot water	43.8
Integrated energy performance	194.1	Integrated energy performance	105.6
Percentage of energy saved 46%			

Figure 1.6 *The building Zaharna Fabrica (BG) after refurbishment*

Main features and lessons learned

- The project can easily be replicated in the neighbouring buildings, as they are of the same type of construction.
- The inhabitants are satisfied with the results, the renovation lengthens the life span of the building with 40 years, the insulation of the external envelope leads to a better comfort and energy saving.
- For the realization of refurbishment of a multi-dwelling building it is necessary to involve all owners and to organise them in an association.
- The costs of refurbishment can be, at least partially, covered by an extension of the building. Most of the buildings could be extended with an additional floor.
- The financing institutions should be flexible when giving loans for such projects, most of the owners are of low or medium incomes and the banks should take this into account.