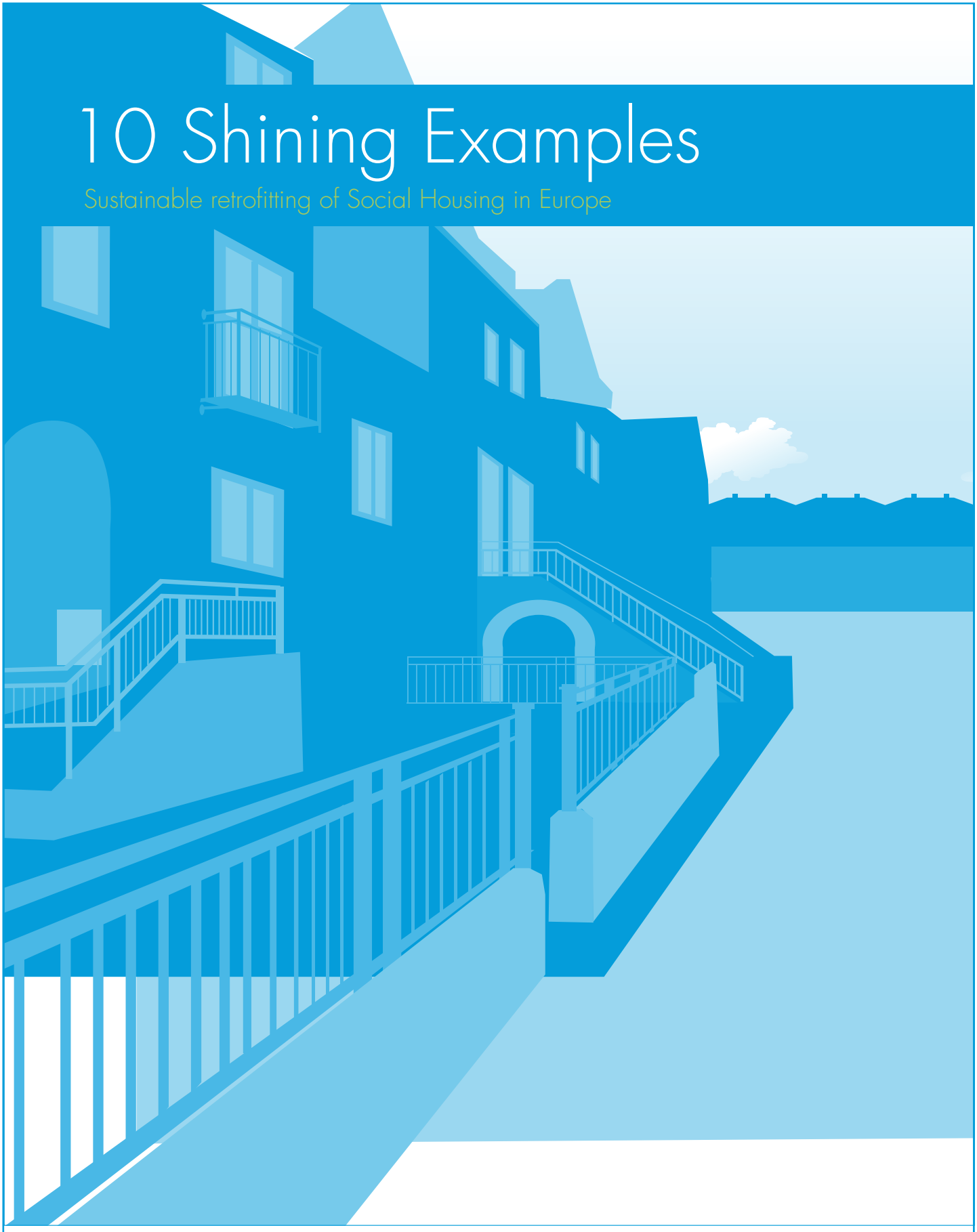
10 Shining Examples

Sustainable retrofitting of Social Housing in Europe



ROSH
Retrofitting of Social Housing

Dublin City Council
Comhairle Cathrach Bhaile Átha Cliath

Codema
Sustainable Dublin

ROSH Project

The ROSH project – Retrofitting of Social Housing - is a European co-operation project for the development and marketing of integrated concepts for energy efficient and sustainable retrofitting of social housing.

10 demonstration projects were selected from 5 partner regions to showcase advanced sustainable retrofitting concepts. For the purpose of the project "social housing" comprises multi-family houses or apartment buildings for low-income households. Monitoring and evaluation of the demonstration projects also forms part of the ROSH project.

The demonstration projects were planned in close co-operation with regional market players such as housing companies, local authorities and tenant associations. Support was provided through information services about detailed retrofitting concepts, the development of financial models, and active support in the implementation process.

The implementation of the demonstration projects is imperative to achieve the expected results and outcomes, which include:

- A 30% reduction in energy demand from previous/current status:
- Contribution to implement the European Performance of Buildings Directive
- High level of replication and transferability
- Effective removal of market barriers
- Increase of social benefits
- Identification of Planning & legal barriers

This brochure introduces the reader to the 10 demonstration projects, with brief description of our activities and resulting benefits. For further information on particular demonstration projects, contact details are provided. For further information on the ROSH project in general, or products of the project see:

www.rosh-project.eu

The project **ROSH** is supported by the **Intelligent Energy – Europe (IEE)** program of the European Union promoting energy efficiency and renewables. More details on the IEE program can be found on:

http://ec.europa.eu/energy/intelligent/index_en.html

Summary of Demonstration Project

The scheme at Bridgefoot Street was constructed in 1964 and comprised of 143 Dublin City Council flats at Bridgefoot Street, Bonham St. and Island Street set out in five inter-connecting blocks. The complex suffered from a number of defects including roof leaks, dampness, condensation and difficulty with heating. It was recognised that major work was needed to bring them up to modern standard of comfort, security and energy efficiency. The flats were in very poor condition, with little to no insulation in the building fabric, single glazed windows and no heating system except for an open fire place. The original layout for the regeneration plan was developed by Dublin City Architects Division by Kieran Kavanagh and Killian Skay and resulted in a major refurbishment of the south facing block of flats which houses 32 units.

Notable features:

Orientation: South-facing aspect retained to optimise passive solar gain.

Heating system: Highly efficient conventional natural gas boilers replaced solid fuel open fires.

Balconies: South facing balconies are enclosed and incorporated into living space. This overcomes the problem of heat loss from overhanging floors and ceilings due to walkways.

Windows: New high performance windows are double glazed, argon filled, low-e, timber frame, reducing the U-value from 5.0 W/m^{2}K to 1.5 W/m^{2}K.

Fabric elements: Additional wall insulation reduced wall U-values from 1.90 W/m^{2}K to 0.2 W/m^{2}K. Significant roof insulation was also added to reduce roof U-values from 1.94 W/m^{2}K to 0.16 W/m^{2}K. The upgrade of the wall, roof and ground floors where possible resulted in fabric elements with U-values reduced by a factor of 3.

Smart Card: User-friendly smart cards allow residents to pre-pay for their gas consumption, allowing them to budget on a weekly basis. This also helps create an energy awareness among the residents of their fuel consumption.

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW kWh/m^2/yr	885.28	94	90%
CO_2 emission Kg/m^2/yr	310.8	18.7	94%
Type of Heating system	Open fire	Central gas fired heating	-
Type of DHW system	electric	Gas & electric	-
Monitoring system	Codema installed temperature & humidity loggers in 5 of the flats, fuel metering data also collected by codema		

Figures above are asset based, and are the theoretical figures for the heating requirements of the flat. Initial monitoring results indicate actual use of 115 kWh/m^2/yr.

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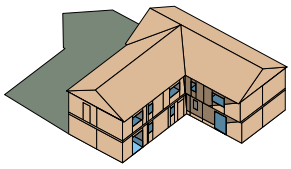
Summary of Demonstration Project

The Bunratty Road Complex was constructed in 1967 and comprised of 24 buildings 2 storey each, with 144 units in total. The redevelopment of Bunratty Road involves the renewal of the site and the provision of 174 units, including the refurbishment of 72 units to 48 larger units each with own door access, private open space. The flats have been unoccupied for some time and are in poor condition with little to no insulation in the building fabric, single glazed windows and a heating system (gas boiler) which is due for replacement. The refurbishment of these flats brings significant improvement to the building fabric by greatly increasing the insulation levels and improving the U-value of the building fabric.



<u>Notable Features</u>:

Wall: The walls will be drylined with 75mm polyiso insulation board and will improve the U-value from 1.84 W/m^{2}K to 0.26 W/m^{2}K

Floor: The U-value of the floors will be improved from 0.60 W/m^{2}K to 0.24 W/m^{2}K by installing 65mm polyiso insulation board.

Windows: Soft low-e windows with a minimum 12mm argon filled gap will replace the single glazed windows reducing the U-value to 1.95 W/m^{2}K from 4.80 W/m^{2}K.

Roof: fibreglass insulation with a thickness of 230mm will be installed at ceiling level improving the U-value from 0.60 W/m^{2}K to 0.16 W/m^{2}K

Renewable Energy: Solar panels will provide for heating domestic hot water and single glazed windows replaced with low-e argon filled double glazed windows.

Heating system: A suitable efficient heating system will be installed - gas fired central heating system with a condensing boiler- to replace the open fire place.

The energy efficient and renewable refurbishment of Bunratty Street was awarded funding under the House of Tomorrow Programme which is administered by Sustainable Energy Ireland.

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW kWh/m^2/yr	353	85	76 %
CO_2 emission Kg/m^2/yr	70	17	76 %
Type of Heating system	Gas central heating/open fire	Gas central heating (new condensing boiler)	-
Type of DHW system	Gas & electric	Gas & electric	-
Monitoring system	No monitoring of existing buildings: it is proposed that monitoring of fuel consumption will be carried out after refurbishment		

Figures above are asset based, and are theoretical figures for the heating requirements of the flat.

codema Sustainable Dublin

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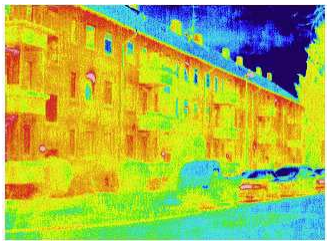
ROSH Retrofitting of Social Housing

Summary of Demonstration Project

The building, located in Hanover in the district *Mittelfeld,* was built in 1951 and consists of 30 flats (46 m² living space, 4 separate entrances, three floors). The district rose after the Second World War to provide housing space for refugees and displaced persons. Nowadays *Mittelfeld* rather represents a social weak point and has been supported since 1999 by the programme *Soziale Stadt* (social city) aiming at a positive district social development.

The owner of the building is GBH, a housing association founded in 1927 and owner of 17,000 apartments, houses and industrial areas in the city of Hanover. Before the present retrofitting measures, just few energetic interventions had been done (some windows were replaced, minimal insulation of the attic and of the gable side). Thus the building needed maintenance actions; moreover, carried out energetic measures proved their economically feasibility. The retrofitting actions have been planned, tendered and implemented within the ROSH duration.



Before refurbishment

Notable features:

Outer walls have been insulated with a thermal insulation composite system (140 mm EPS, 0.035 W/K and 6 mm silicone plaster); U-value was reduced from 1.66 W/m²K to 0.22 W/m²K. Moreover, balconies were demolished and replaced with new, thermally-broken ones.

New **windows** are double glazed, low-e, PVC frame, reducing U-value from 1.8 W/m²K to 1.3 W/m²K

Insulation of the **attic floor** was provided with 240 mm PS board (0.035 W/K) and 19 mm chipboard (additional insulation to the existent one).

The gas central **heating** and the decentralized domestic hot water production were not modified; however, a hydraulic balance of the heating system is foreseen.

The energetic relevant costs of the retrofitting amount to €355,682 which corresponds to €256.56 /m² living space.

After refurbishment

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered energy consumption for space heating & DHW kWh/m²/yr	202.5	74.8	63%
CO_2 emission kg/m²/yr	88.1	44.4	50%
Type of heating system	Gas central heating	Gas central heating	
Type of DHW system	Gas central per dwelling	Gas central per dwelling	
Monitoring system	No monitoring yet; it is proposed to meter the total heat consumption in the building.		

target

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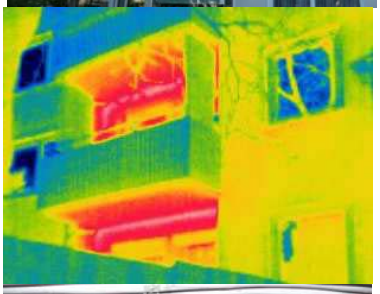
ROSH Retrofitting of Social Housing

Summary of Demonstration Project



The building complex Eulerstraße 11, 13 and 15 in Hanover is constituted by three multi-family houses built in 1959. They have respectively 8, 8 and 7 apartments each, divided into 4 floors. Each multi-family house has a usable floor space of approx. 380 m² while the flats' living space is on average 60 m².

The owner (private person, 81 years old) decided to retrofit the three buildings after having participated in one of engineers' office hours organised by ROSH partner IFB.

There are several reasons for the refurbishment of the three buildings on the part of the owner. Among others the better lettability of the single apartments as well as the valorisation and value added of the buildings. Furthermore the environmental aspect is also important for the building owner.

The below described retrofitting measures were planned between end of 2007 and middle of 2008. However, these activities have been postponed for approximately 1 year due to the comprehensive planning requested by the possible loft conversion. The IFB supported the building owner during the planning phase and will follow the realisation of the retrofitting till its completion.

Notable Features:

The outer walls will be insulated with a thermal insulation composite system (160 mm, 0.032 W/K) including a better insulation of the gable wall (U-value will improve from 1.2 to 0.2 W/m²K).

The insulation of the steep roof surface foresees 180 mm while insulation of cellar ceiling 60 mm (0.035 W/K). The U-values will reduce respectively from 1.0 to 0.24 W/m²K and from 1.4 to 0.4 W/m²K.

All windows will be replaced by double pain low-e glazing.

The owner still considers whether to convert also the loft.

The low temperature gas boiler feeding the central heating system will be replaced by a gas condensing boiler with solar thermal plant for hot domestic water and heating support.

ENERGY RELATED INDICATORS	Initial situation	After refurbishment *	Reduction %
Delivered energy consumption for space heating & DHW kWh/m²/yr	268	66 *	75 %
CO_2 emission kg/m²/yr	67	14.2 *	79 %
Type of heating and DHW system	low temperature gas boiler	gas condensing boiler with solar thermal plant (for DHW and heating support)	-
Monitoring system	The monitoring concept will be finally set up with the start of construction.		

* Calculated values according to ROSH project status 30.6.2008

IFB BAUFORSCHUNG

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ROSH Retrofitting of Social Housing

Summary of Demonstration Project

The multi-family house was erected in 1966 according to state-of-the-art construction in those days. The building was structurally sound and suitable for energetic improvements. Before its reconstruction thermo technical lacks were causing mould and condensation.

The outer walls of the building consist of vertical coring bricks (30-40 cm), its ceilings of reinforced concrete plates. It had box-typed windows with single glazing. The heating of the building was supplied by a district heating (radiators with thermostats) with a central hot water conditioning and a conventional two-pipe-system.

With the high-quality retrofit the energy consumption for heating was reduced by 77%. This reduction was achieved by a high-quality insulation of the building envelope, the installation of windows with passive house standard (U-value (total) = 0.80 W/m²K) and a non-central ventilation unit with heat recovery (64% efficiency). As all the inhabitants of the building were involved into the decision process right from the beginning, the retrofit was always very much appreciated.

Notable features:

Heating system: Central heating system with biomass district heat

Ventilation system: Installation of single room ventilation units with heat recovery (64% efficiency)

Windows: New passive house windows triple glazed reduced the U-values from 2.60 W/m²K to 0.80 W/m²K.

Fabric elements: Additional wall insulation reduced wall U-values from 0.85-1.23 W/m²K to 0.20 W/m²K. Significant roof insulation reduce roof U-values from 1.50 W/m²K to 0.24 W/m²K and cellar-ceiling from 1.15 W/m²K to 0.21 W/m²K.

Thermal bridges: Insulation of the balcony-plates and bearing-outs.

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW kWh/m²/yr	157.0	36.0	77%
CO_2 emission kg/m²/yr	7.45	1.70	77%
Type of Heating system	Central heating system	Central heating system with biomass	
Type of DHW system	Central hot water system	Central hot water system	
Monitoring system	AEE arranged a Blower-Door-Test and made Thermographic pictures. We measure the energy consumption currently.		

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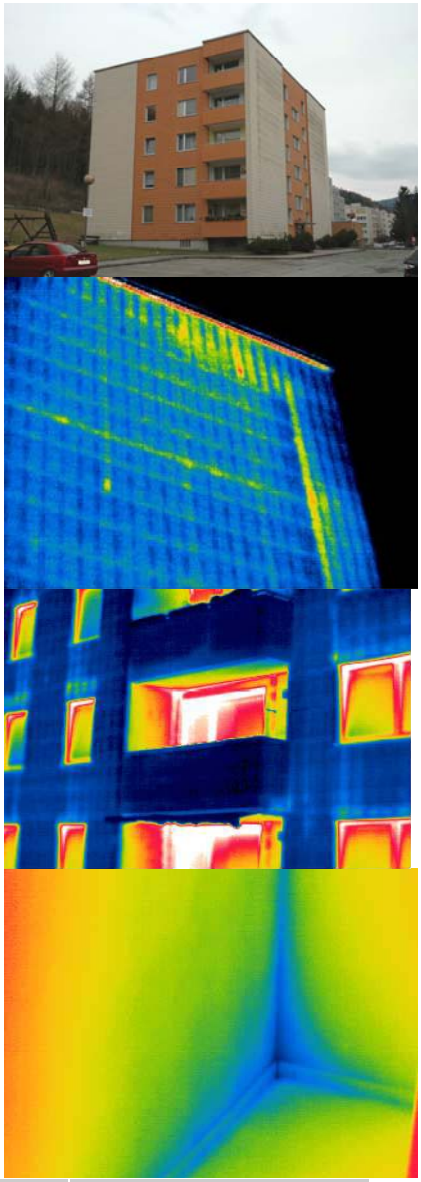
Summary of Demonstration Project

The multi-family building was constructed in 1979. It consists of two buildings with a total number of 40 flats, every flat is owned by a private person. Refurbishment activities have to been approved by a majority of the owners, only in case of improvement measures an unanimous decision of the owners is necessary. The association of flat owners is composed of elderly and in general poor people.

The building has been in poor condition since only maintenance repairs have been carried out. Thus, the thermal-energetic standard of the buildings has not corresponded to the currents standards. Although some parts of the outer walls have been insulated, in some flats mildew has appeared and windows have become loose. In total the thermal comfort in flats has been not adequate in terms of current standards. Due to decentral heating systems with electric power for heating and domestic hot water energy costs have been relatively high.

At the beginning of the decision process a common discussion by the flat owners did not appear to be forthcoming. Some of the flat owners opposed any refurbishment, some argued for a smaller renovation, some supported a comprehensive refurbishment.

At first the flat owners have been convinced of the needs of a refurbishment by thermografies of the buildings. In the second steps different scenarios have been calculated to explain the economic and ecologic effects of refurbishment activities. This easy to understand comparison has lead to a decision of the flat owner to a refurbishment of the weakest parts of the building at first. Further renovation activities may follow later on.



Notable Features:

Insulation of outer walls:	12 cm mineral wool
Insulation of top floor ceiling:	20 cm mineral wool
Insulation of cellar ceiling:	8 cm mineral wool
Windows:	replacement of all windows
Entrance door:	replacement of entrance door

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW kWh/m²/yr	111	42	62 %
CO_2 emission Kg/m²/yr	30	11	62 %
Type of Heating system	Electric power	Electric power	
Type of DHW system	Electric power	Electric power	
Monitoring system	Individual monitoring by flat owners		

Grazer ENERGIEAgentur

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ROSH Retrofitting of Social Housing

Summary of Demonstration Project

The plaster on the exterior walls of the 3 buildings sited in Via Adamello, Novara, is peeling off and refurbishment measures can no longer be put off.

At the same time, renovation of this plaster represents an excellent opportunity for improving insulation of the buildings. As such, A.T.C. Novara has decided to take on this project and indeed, maintenance measures of the buildings are currently in progress.

Another refurbishment opportunity arises from the local "district program", which has been launched by local authorities. This financing scheme supports ecological and energy saving actions in the construction sector.

The overall technical project comprises maintenance of the plaster and of the roof as detailed below.

Notable features:

Walls: improving the insulation of the walls ("cappotto") Polystyrene panels, 8cm thick, reduce the U-value from 1.08 W/m^{2}K to 0.33 W/m^{2}K

Roof: insulation of the roof, substitution of asbestos roofing.
A double layer of wood fibre (5 + 5cm), added to the attic floor, reduces the roof U-value from 1.36 W/m^{2}K to 0.31 W/m^{2}K

Heating system: A.T.C. Novara is planning additional maintenance measures, particularly with regards to the heating system

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW kWh/m^2/yr	172.00	100.00	41.86
CO_2 emission Kg/m^2/yr	29.70	17.38	41.48
Type of Heating system	3 Central gas heating system	1 Central gas heating system	
Type of DHW system	Individual, not central	Individual, not central	
Monitoring system	- -	- thermograph - consumption data	

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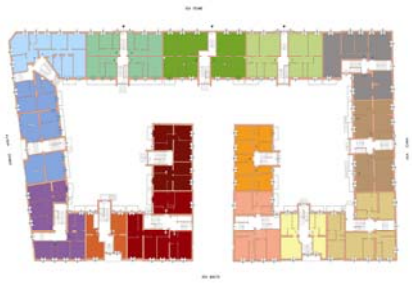
Summary of Demonstration Project



ATC Asti is a public body, managing and owning approx. 1,700 social housing units in the province of Asti, Italy. Currently, little public structural funds for ordinary refurbishment are available at national level. Thus, maintenance measures of social housing buildings hardly ever consider energy efficiency. Nevertheless, ATC Asti has decided to replace conventional boilers with condensing ones, as well as to carry out the thermal insulation of the roof. The roof area of the entire building complex is around 3,650m². Refurbishment measures will consist installing a 10cm thick insulating layer and a waterproofing sheet. No thermal insulation exists either. Thus possible future retrofitting measures may include: substitution of windows, installation of energy saving light bulbs after improving electricity wiring, new condensing boilers, thermal insulation of walls, introduction of a centralised hot water (solar) system in "Quartiere Strada Volta. The financial plan still needs to be drafted.

Notable features:

First step of retrofitting

Roof: wood fibre insulation panels, 8cm thick layered on the top of the roof, completed with a waterproofing layer and a 4cm light concrete layer reduce U-value to 0.38 W/m^{2}K

Heating system: individual boilers will be gradually replaced by natural gas condensing boilers. The action includes the installation of thermostatic valves, and thermostats.

Second step of retrofitting

Walls: insulating material shall be blown into the wall gap in order to reduce the U-value

Windows: old windows will be replaced by double pane low-e glazing

DHW system: solar thermal systems

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
*Delivered Energy consumption for space heating & DHW kWh/m^2/yr	No initial monitoring due to individual system	The project is in engineering phase	First step: 15% Second step: 30%
CO_2 emission Kg/m^2/yr			First step: 15% Second step: 30%
Type of Heating system	Individual natural gas boilers	Individual natural gas, condensing boilers	
Type of DHW system	Individual natural gas and electric boilers	Individual natural gas and electric boilers	
Monitoring system	After retrofitting works will be implemented a monitoring system		

*Theoretical hypothesis due to the lack of information related to initial energy consumption

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Summary of Demonstration Project

The social building Chodkiewicza Str. 11 in Gdańsk was built in about 1960 as a hostel for workers, now it belongs to Gdańsk municipality which was the decision maker of this refurbishment. The main reason of the refurbishment was to carry out the general repair because of a bad condition of the building and conversion of hostel rooms to the independent separate flats for temporary living. The minimum floor area of a single flat and the flat fittings were planned according to the Polish regulation on minimum standards. There were 3 flats, 70 hostel rooms and 20 common rooms (kitchens, bathrooms, club rooms) before refurbishment, now there are 73 separate flats.

The other purpose of the refurbishment was to meet requirements concerning the thermal protection which are currently in force in Poland.

23% of investment costs was covered by ministry of infrastructure as a subsidy.

Notable features:

Heat source: Highly efficient, fully automatic heat substation replaced the low efficient old one.

Heating system: Heating installation (pipes, radiators and valves) was replaced. Thermostatic valves were installed on radiators.

DHW system: DHW installation (pipes, fittings) was replaced.

Fabric elements: Additional outer wall insulation with 12 cm of foamed polystyrene reduced gable wall U-value from 1.02 W/m^{2}K to 0.25 W/m^{2}K and longitudinal wall U-value from 1.11 W/m^{2}K to 0.26 W/(m^{2}K). 23 cm of granulated mineral wool was also added to reduce roof U-value from 2.5 W/m^{2}K to 0.19 W/m^{2}K. Additional floor insulation with 10 cm of foamed polystyrene and replacement of other floor layers reduced floor U-value from about 1.7 W/m^{2}K to 0.3 W/m^{2}K.

Windows: New high performance windows are double glazed with PVC frame, reducing window U-value from 2.6 W/m^{2}K to about 1.9 W/m^{2}K.

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW kWh/m^2/yr	320.32	162.99	49.1
CO_2 emission kg/m^2/yr	78.42	39.90	49.1
Type of heating system	Central heating supplied by DH substation		
Type of DHW system	Centralised DHW preparation in DH substation		
Monitoring system	The heat meter in the substation measures total heat consumption in the building. Readings are taken every month.		

Figures above are based on heat consumption in period of 2003-2005 (initial situation) and in 2007 (after refurbishment) recalculated using standard climatic data, energy and CO_2 are calculated using unit area in m^2

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Summary of Demonstration Project

The multifamily building Sambora Str. 6A-C in Gdańsk was built in 1977 as a municipal building, but now belongs to condominium (19 flats are private, 8 are municipal). There are 27 flats with 1025 m^2 of floor area. The building did not meet the requirements of the regulation concerning thermal protection which are currently in force.

The main reason of the refurbishment was to reduce heat costs with the possibility to obtain a loan (covering 80% of total investment costs) and subsidy (25% of the loan amount) for thermomodernisation works according to the thermomodernisation law. The additional reason was to make necessary repairs. The refurbishment measures had been selected on the basis of the energy audit. The most important selection criterion was to obtain more than 25% energy savings for heating and hot water production according to the thermomodernisation law.

Above: Before refurbishment

Above: After refurbishment

Notable features:

Heating system: Installation was rinsed. Section control valves were installed on risers. Thermostatic valves were installed on radiators. Thermal insulation of heating pipes was repaired. Heating installation was balanced after the thermomodernisation of the building envelope.

Fabric elements: Additional outer wall insulation with 12 cm of foamed polystyrene reduced wall U-value from 1.18 W/m^2K to 0.26 W/m^2K. 16 cm of granulated glass wool was also added to reduce roof U-value from about 0.7 W/m^2K to 0.22 W/m^2K. New roofing was made also.

Windows: Luxfer tiles in staircases with U-value = 4.55 W/m^2K were partly covered with insulation and partly replaced by new windows. New high performance windows in staircases and basement are double glazed with PVC frame, reducing window U-value from 5.1 W/m^2K to about 1.5 W/m^2K.

Doors: New high performance doors made of aluminium and double glazing replaced the old ones.

ENERGY RELATED INDICATORS	Initial situation	After refurbishment	Reduction %
Delivered Energy consumption for space heating & DHW $kWh/m^2/yr$	378.01	309.45	18.1
CO_2 emission $kg/m^2/yr$	92.54	75.75	18.1
Type of heating system	Central heating supplied by DH substation		
Type of DHW system	Centralised DHW preparation in DH substation		
Monitoring system	The heat meter in the substation measures total heat consumption in the building. Readings are taken every month.		

Figures above are based on heat consumption in 2005 (initial situation) and in 2008 (after refurbishment) recalculated using standard climatic data, energy and CO_2 are calculated using flat area in m^2.

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BEFORE REFURBISHMENT CO_2 TONNES / YEAR	AFTER REFURBISHMENT CO_2 TONNES / YEAR	SAVINGS CO_2 TONNES / YEAR	REDUCTION %
Bridgefoot Street, Ireland			
606.68	32.41	572.72	94%
Bunratty Road, Ireland			
163.31	39.66	123.65	76%
Beuthenerstra e, Germany			
122.14	61.55	60.58	50%
Eulerstra e, Germany			
93.93	19.91	74.03	79%
Gasen, Austria			
5.07	1.16	3.91	77%
Kerpelystra e, Austria			
90.99	33.36	57.63	62%
Facciate via Adamello, Italy			
344.52	201.61	142.91	41 %
Quartiere via Malta, Italy			
		Target savings of 15 -30%	
Chodkiewicza, Poland			
177.15	84.87	92.28	49%
Sambora, Poland			
94.85	77.64	17.21	18%
Total CO_2 savings:			**1,145 CO_2 tonnes/year**

The CO_2 calculations above are estimated savings. Further information on individual demonstration projects are provided within the brochure together with the appropriate contact details.

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