Description of the pilot sites and description of the baseline

(deliverable D5)

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For further information on the project or on products of the project see: www.fresh-project.eu

Intelligent Energy Europe

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

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1 SYNTHESIS

This document presents the pilot sites which will be used to implement comprehensive energy refurbishments through energy performance contracts in the frame of the FRESH project. It is based on the submissions of the project partners and does not aim to provide all technical details on each pilot site.

The pilot sites presented hereunder are the following:

- in France, 67 dwellings in 4 multifamily buildings located in Schiltigheim (near Strasbourg, Alsace);
- in the United Kingdom, a retirement home with 39 dwellings located in Preston (North-West);
- in Italy, a multifamily building with 13 dwellings located in Reggio Emilia (Emilia Romagna).

Bulgaria does not have a pilot site.

Table 2.1 - Building description

The following table summarises the information related to the pilot sites.

	France	Italy	United Kingdom
Building owner	ICF Nord-Est	Municipality of Reggio Emilia	Places for People
Location	Schiltigheim	Reggio Emilia	Preston
Year of construction	1987	1981	1986
Number of dwellings	67	13	39
Number of buildings	4	1	1
Living surface	7,012 m²	1,140 m²	2,028 m²
Heating system	Electric, Individual	Gas, collective	Gas, collective
Hot water system	Electric, Individual	Electric, Individual	Gas, collective
Ventilation system	Mechanical	Natural	Natural

Table 2.2 - Main features of the building components

This table summarises the features of the buildings which impact on its energy performance.

	France	Italy	United Kingdom
External wall	Concrete without insulation	Concrete with 3 cm insulation	Brick with internal cavity insulation
Roof	Insulation on the attic floor	Concrete with 3 cm insulation	250 mm mineral wool insulation
Floor	Heavy concrete	Concrete with 3 cm insulation	Concrete with 50 mm insulation
Windows	Double glazed windows (1987)	Single glazed windows	Single glazed windows

Table 2.3 - Energy consumptions

The following energy consumptions are provided in kWh/m².a of primary energy. They take into account climatic variations and therefore do not refer to a specific year, even when they are based on actual consumptions. It should be noticed that each country has different climates, calculation methods, and that reference surface are often not calculated in the same manner[1]. It is therefore very difficult and not relevant to compare the energy performance of the pilot sites presented in this document.

Data is in kWh/m².a	**France**	**Italy**	**United Kingdom**
Heating	164	141	349
Hot water	66	21	60
Ventilation	10	0	N/A
Common areas	8	N/A	N/A
Total	**247**	**163**	**409**

[1] For more information, see the "Survey on social housing" produced in the frame of the FRESH project, available at www.fresh-project.eu.

2 BASELINE METHODOLOGY

2.1 MAIN ISSUES

The definition of the baseline of current energy consumptions is one of the major challenges for the establishment of an EPC, in which the energy savings they generate over a given period should pay investments back.

As explained in the International Performance Measurement & Verification Protocol (IPMVP)[2], it is essential to conduct a thorough analysis of the baseline consumptions and the conditions in which they are incurred. Those conditions are often ignored and taken as underlying assumptions in the modelling of energy scenarios.

In the case of an EPC with a long duration, modifications in the conditions and the underlying hypothesis for the use of the building can lead to important variations in energy consumptions, which have to be neutralised in order to assess the actual performance delivered by the ESCO. Therefore, the baseline and its underlying assumptions should be analysed with care and validated by the SHO and the ESCO during the contract negotiation phase.

The present document proposes to base the assessment of the baseline on the general methodology developed in the IPMVP, which provides a set of useful concepts and indicators, which should be adapted to the specific context of social housing. Nonetheless, it should be noted in all cases that housing is less subject to major changes in the use of the building than offices or industry buildings.

The methodology proposed hereunder does not mean to be comprehensive and give an answer to all questions raised by the establishment of the baseline. It is up to the social housing operator and the contracting ESCO to agree on the analysis of a set of parameters and make the most relevant choices according to their objectives and specific situation.

2.2 BASELINE CONTENT

The baseline should provide information about each use in several aspects:

- energy consumption, either in total or per m²; final energy should be used for the purpose of energy performance contracting, even though primary energy and greenhouse gas emissions should be assessed as well.
- energy costs as invoiced to tenant
- subscription costs, which may be important in the case of electricity or individual gas systems
- operation costs (e.g. daily maintenance and conduct of HVAC)

2.3 BASELINE PARAMETERS

The baseline should define very precisely the uses it includes and the different parameters, which they are based upon. Given the differences between national contexts and technical constraints of the buildings, it is not possible to provide a set of parameters valid for all situations.

2.3.1 Baseline period

The baseline period should be representative of the general energy consumptions of the building. In housing, the major changes are linked to seasons, both for climate reasons and for vacancy linked to vacation periods. All things equal, it can be assumed that energy consumptions are statistically the same in a given period every year.

[2] The IPMVP 2009 version is available at www.evo-world.org

In order to have a clear baseline, energy consumptions should be assessed over a period of one year at least, ideally 3 years. In cases of individual HVAC systems, the baseline consumptions are usually simulated and cover one year; nevertheless, individual bills should be confronted with the theoretical consumptions.

The beginning and the end of the year should be detailed. In case the available data does not cover one full year, statistical adjustments should be carried out based on an acknowledged methodology.

2.3.2 Heating

Energy consumptions for heating are always included. The main parameters to provide are:

- The heated surface and/or volume.
- Internal temperature provided in the dwellings: in average 1℃ results in 7% more energy needs, but this can go to 15% in low energy retrofits. Internal temperature can be different between dwellings or between rooms in the same dwelling. The major challenge is to have a good knowledge of the actual temperature in the dwellings, which may depend on tenants (if they have control over it), but also on the position of the dwelling (solar inputs / bad balance of water pipes). The easiest way is to measure temperatures in a sample of dwellings.
- Variation of temperatures during the day or week: it is quite frequent to decrease heating during the night, which can save up to 10% of energy. The periods should be described.
- Official heating period: there may be obligations for the SHO to heat during a certain period, which means internal temperatures may be lower than the official temperature in the month before or after the heating period. This may change in the EPC (low energy buildings have a shorter heating period due to reduced heat losses) but has to be identified.

Heating energy consumptions are also heavily dependent on climate (see further).

2.3.3 Hot water

Models generally use standard ratios for energy consumption due to hot water: volumes of hot water produced at a standard average temperature vary according to the surface of the dwelling, the number of rooms or occupants, depending on national calculation tools.

Unlike heating, it has often been noted that there are significant differences between the foreseen and actual hot water consumptions, both before and after retrofit. This is true at the individual level but also at the level of the building, due to the behaviour of social housing households, which may differ from standard due to cultural and economic reasons. Nevertheless, technical features also have a significant impact.

For the establishment of the baseline, the following parameters should be considered:

- Amount of hot water used (litres per year per dwelling, ideally per occupant): there is no possibility to control this parameter, although it has the biggest impact of all. Depending on the building, hot water meters may be available, or hot water may not be separated from cold water (in which case standard ratios can be used),
- Sanitary equipments (taps, toilet flush, shower), which can reduce significantly water consumption (between 30 and 60%) and usually depend on the SHO. Measurements could be made to define the level of water requirement based on a standard use, but so far this does not seem possible at a reasonable cost. Average water saving rates could be applied with caution.
- Level of water pressure, which can be controlled by the SHO. A pressure over 3 bars is not necessary and entails waste of water resources
- Temperature of hot water; control on this parameter depends on national practices and the technical features of the building (individual or collective hot water). The temperature can be measured at the departure of the boiler, or at the tap in kitchens and bathrooms (which may have different legal obligations, e.g. in France 50℃ in bathrooms and 55℃ in kitchens).
- Performance of occupant's equipments, which may require more or less water at different temperatures: dishwasher, washing machine… this parameter is usually deemed to be out of control and standard features should be used.

2.3.4 Cooling

Cooling is rarely provided by the building in social housing and usually is installed by tenants and included in appliances. It should be included in the uses if it is installed.

2.3.5 Ventilation

The ventilation system is a source of heat loss for the building, especially after retrofit of the building envelope. It also uses energy it there is a mechanical ventilation system.

The parameters to be assessed are the following:

- Ventilation system: single / double flow, hygroregulated (at centralised or decentralised level), with or without heat recovery…
- Air renewal rates can be measured in litres per hour and square meter (l/(h.m²)), cubic meters per hour and square meter (m3/(h.m²)) or heated volume per hour (vol/h). Those figures could vary according to the rooms but in housing this is not the practice.

2.3.6 Air tightness

The air tightness of a building measures the level of heat losses through air leaks in the building envelope.

In existing housing stock, air tightness is quite poor but does not have a significant impact on energy consumptions because heat losses are mainly through the envelope and thermal bridges. Yet after the retrofit air tightness can have an increased impact and it may be relevant to measure it, especially in cases when the SHO carries out renovation works on the façade, which could reduce air tightness.

Air tightness can be measured through blower-door tests. The standard method has been defined by the Passiv Haus Institut[3] and measures air leakage through the n50 ratio, which is the air leakage measured when the air pressure is increased by 50 Pa. It is measured in m3/(h.m²), but national regulations do not all use the same methods and there is no use in applying the same methods to all buildings in the sample.

2.3.7 Auxiliaries

Auxiliary systems such as engines or circulation pumps for hot water can be included in the baseline or not. If they are included they should be described (number, power, duration of use).

2.3.8 Lighting in the dwellings

Lighting may be taken into account in calculation methods. If it is so, it is usually through standard ratios based on standard light levels in the dwellings and standard light bulbs.

Unlike office buildings, it is quite hard to force occupants to modify the lighting equipments of their dwelling. Besides, lighting is included in electricity bills, which are not available to the SHO. The implementation of metering systems for lighting would not be cost efficient and EPC's will most probably exclude lighting in social housing.

If lighting is included in the baseline, the assumptions used by calculation models will have to be agreed upon with the ESCO, whatever changes it brings in the retrofit.

2.3.9 Common spaces

Energy uses for lighting, lifts, intercom, etc., should be analysed too. Those uses are easily controlled and could very well be included in the baseline. Therefore the baseline should provide information on the material used, and if relevant the frequency of use.

[3] www.passiv.de

2.3.10 Domestic appliances

Domestic appliances include all energy consumed by occupants and not included in the above categories: cooking, multimedia…

Those uses are usually excluded from the baseline as they are considered to depend too much on the occupant's behaviour.

2.4 STATIC FACTORS FOR NON PERIODICAL ADJUSTMENTS

The IPMVP methodology defines two types of adjustments on actual energy consumptions:

- periodical adjustments to independent variables
- non-periodical adjustments due to changes in the static factors.

Independent variables are parameters that are heterogeneous to the building, whereas static factors are endogenous.

Most of the parameters defined for the baseline are static factors, which may be used for non-periodical adjustments. On top of those, we propose to include in each category the following parameters.

2.4.1 Use of the building

The destination of the building has a major influence on the use of energy. A residential building can often include a part of the surface dedicated to other uses. It should be detailed from the beginning whether the building is only used for housing, or if there are other uses such as:

- offices,
- commercial premises,
- collective areas available for tenants, especially in sheltered housing
- premises reserved for the use of the social housing operator (e.g. local caretaker's office)

Based on this, the baseline can be established for all parts of the buildings, or it could be decided to exclude surfaces dedicated to other uses than housing. Even in case other uses are excluded from the baseline, they should be detailed enough in order to determine in how far they can interact with the foreseen energy saving measures. For instance, long-term vacancy in commercial premises on the ground floor (a frequent case in social housing) will result in a reduction of the temperature of those premises and increase the heating requirement in the dwellings located above.

2.4.2 Typology of dwellings

The types of dwellings impacts energy consumptions: for the same living surface, an apartment with two or three rooms will not have the same number of occupants, and energy consumptions will not be the same. The number of apartments should be provided together with their

2.4.3 Level of occupancy

The level of occupancy impacts energy consumptions: more occupants will result in lower energy need for heating, but in higher consumption of hot water in proportions that vary from one building to another. Therefore the total number of occupants in the building is an important parameter.

It is rarely possible to have an exact knowledge of the level of occupancy of a building. Indeed the SHO can rarely keep track of:

- The actual number of occupants in the dwelling, which in some cases is hidden from the SHO.
- The presence time of occupants in the day, week and year: a retired person stays longer at home than a working adult, a railway employee can be away several days a week, a student may be away for long periods… This can only be seized through surveys at the time of establishment of the baseline, but it will be very difficult to adapt them in the duration of the EPC.

2.4.4 Vacancy rate

The rate of empty dwellings is a well-identified figure. SHO and ESCO can reach agreement about the exact accounting method for vacancy, the easiest being a ratio as follows:
(number of vacant day-dwellings) / ((number of dwellings) x 365)

More complicated methods could take into account the surface of the vacant dwellings. They do not seem relevant because dwellings are quite similar.

2.4.5 Social and economic profiles of occupants

The type of people living in the building generally determines behaviours in terms of energy consumption.

It is not possible to give general rules at the European or even national level, but a good analysis of occupants' profiles can provide hints on their current use of the dwelling and their capacity to change behaviours in the future. For instance, in many cases elderly people tend to save energy if they pay for it, but are very reluctant to stop ventilating by opening the windows if a double flow ventilation system is installed; this would require a specific education campaign, or to use different technical solutions.

Social and economic profiles can be assessed in statistical terms through:

- Age distribution: 0-18, 18-25, 25-65, 65-75, over 75 years old
- Education levels: primary, secondary, licence, beyond licence
- Shares of long-term employed, short-term employed, unemployed, retired, and youth

Beyond statistics, it often happens that a lot of occupants in a social housing estate share a common history (e.g. they used to live the same district which was demolished 30 years ago), a common social background linked to an industrial sector or common ethnic origins.

2.4.6 Behaviour of occupants

The behaviour of occupants can cause major changes between the theoretical and the actual energy consumptions of a dwelling.

In the establishment of the baseline, occupants' behaviour should be analysed in order to see if they use correctly their dwelling. Behaviours such as opening the windows can be linked to cultural habits but also result from too high temperature or lack of ventilation leading to moisture.

It is not possible to control occupants' behaviour, but many actions can be undertaken, ranking from education and training to automatic control on window opening. The EPC should in all cases be accompanied by such actions, implemented either by the SHO or by the ESCO.

2.5 INDEPENDENT VARIABLES FOR PERIODICAL ADJUSTMENTS

The following parameters will be used to adjust the targets of energy consumptions on a periodical basis.

2.5.1 Climate

Energy consumptions depend on local climate, which varies each year. This major parameter is seized through the number of heating degree-days required, which is an official data published every year at national level. It should be noted that degree-days are not calculated in a harmonised manner across Europe, the reference temperature for instance can be 18℃ or 18.5℃.

Adjustments should be carried out each year on a date defined in the EPC.

2.5.2 Energy prices

Energy performance contracts are usually based on the economic value of energy consumptions, which depends mainly on energy prices. Energy prices vary from one energy source to another.

The calculation of the baseline should use the local energy prices.

Adjustments should use the most relevant price index available, which can be national, international, or local in the case of a regulated market. They can be planned once a year or several times a year depending on the arrangements in the EPC.

2.6 SYNTHESIS OF BASELINE PARAMETERS

The following table summarises the parameters, which should be assessed and described along with the provision of current energy consumptions. It does not include parameters, which are judged not relevant because of the impossibility to measure them accurately, too high costs of measurement, too little impact and/or lack of control.

Parameters	Description
Independent variables	
Climate	Annual heating degree-days The reference temperature for degree-days should be provided
Energy prices	Detail prices used for each energy source in €/kWh.
Baseline period	Start and end of the baseline period (ideally 3 years). If it does not cover the full year, adjustment method should be detailed.
Heating	
Energy consumptions for heating	kWh/m².a
Heat production system	- Equipment - Installed power - Age - Efficiency on higher heating value (%)
Heated surface and/or volume	Expressed in m² or m3
Internal temperature	- Detail if there are different differences between rooms - Detail if there are differences between dwellings
Permanence of internal temperature	Detail if the temperature is allowed to decrease at night or during some periods of the day, week or year
Official heating period	Detail if the internal temperature obligation is limited to certain period of the year
Hot water	
Energy consumptions for hot water	kWh/m².a
Hot water production system	- Equipment - Installed power - Age - Efficiency on higher heating value (%)

Parameters	Description
Amount of hot water consumed	Expressed in: - litres per year (per m²) - litres per year per dwelling - ideally litres per year per occupant This figure can be obtained: - through statistical values if bills are not available - by metering hot water at the collective or individual level - by metering water consumption at the individual or collective, and applying statistical ratios to estimate the amount of hot water.
Sanitary equipments	Detail whether sanitary equipments are designed to reduce water consumption
Level of water pressure	Expressed in bars.
Temperature of hot water	This can be measured: - at the departure from the boiler - at the tap, eventually with a distinction between kitchens and bathrooms
Cooling	
Energy consumptions for cooling	kWh/m².a
Cooling system	- type of system - installed power - efficiency
Ventilation	
Energy consumptions for ventilation	kWh/m².a
Ventilation system	- type of system - installed power - efficiency in W/m3
Air renewal rates	Expressed in l/(h.m²), m3/(h.m²) or vol/h
Air tightness	
Air leakage	Can be assessed through the n50 ratio or any other method established in national regulations. Air leakage is expressed in m3/(h.m²) under a certain additional air pressure in the dwelling expressed in Pa (50 Pa for n50). It is usually useless to measure it for existing buildings.
Auxiliaries	
Energy consumptions for auxiliaries	kWh/m².a
Auxiliaries installed	- Equipments - Installed power - Age
Lighting in the dwellings	
Energy consumptions for lighting	kWh/m².a
Lighting equipment	Detail the number and power of light bulbs, or state that these data are based on statistical values in calculation models
Common spaces	
Energy consumption for common spaces	kWh/m².a

Parameters	Description
Equipments in common spaces	Detail for lighting, lifts, intercom, and any other equipment using energy: - equipment - installed power - age
Use of the building	
Use of the building	Detail: - Share of building surface used for non residential purposes - Inclusion or exclusion of non residential premises in the baseline - Potential impact on energy consumption
Typology of dwellings	Detail: - Number of 1,2, 3, 4, 5, 6-room dwellings - Average living surface for each
Actual number of occupants	Total number of known occupants
Estimated presence time of occupants	Presence time can vary during the day, week or year. This is a qualitative information obtained through surveys and knowledge of occupants' employment status
Vacancy rate	Vacancy rate of dwellings over the analysed period
Social and economic profiles of occupants	- Age distribution: 0-18, 18-25, 25-65, 65-75, over 75 years old - Education levels: primary, secondary, licence, beyond licence - Shares of long-term employed, short-term employed, unemployed, retired, and youth - Common social, economic or ethnic backgrounds
Behaviour of occupants	Describe any specific behaviour leading to overconsumption of energy

3 FRENCH PILOT SITE

3.1 PROJECT DATA

Owner:	ICF Nord-Est
Location, address:	32 rue Léo Lagrange, 67 300 Schiltigheim
Region:	Alsace
Surroundings:	Urban environment, facing railway tracks
Climate:	Continental climate (Climate zone H1)
Year of construction:	1987
Year of renovation:	None
Typology of dwellings:	1 one-room flat (29m²) 7 two-room flats (61m²) 20 three-room flats (76m²) 23 four-room flats (96 m²) 11 five-room flats (119 m²) 2 six-room flats (124 m²)
N°of buildings:	4
N°of levels:	4 or 8
N°of dwellings:	64
Living surface:	5,725 m²

Energy consumptions:	**Final energy**
Heating:	247 kWh/m².a
Hot water:	24 kWh/m².a
Cooling:	0 kWh/m².a
Ventilation:	4 kWh/m².a
Common areas:	3 kWh/m².a
Total:	278 kWh/m².a 31 €/m².a

3.2 PRESENTATION OF THE LOCAL AND ENVIRONMENTAL BACKGROUND

- Over 1,750 hours of sunshine, 3.1 Wh/m².day of solar energy received on the ground;
- No sunshields;
- Alsace has a good access to biomass due to the large forests surrounding it (Vosges). A biomass plant could be implemented;
- There is no district heating network available.

3.3 BUILDING COMPONENTS

Components	Description:	U value	Thickness
External wall	Concrete	3.704 W/m².K	20 cm
Roof	Inclined, mineral wool on the ground in bad state	0.22 W/m².K	25 cm
Floor	Heavy concrete	2.27 W/m².K	20 cm
Windows	Double glazing 4-6-4, (1987), with rolling blinds	3.10 W/m².K	4 cm

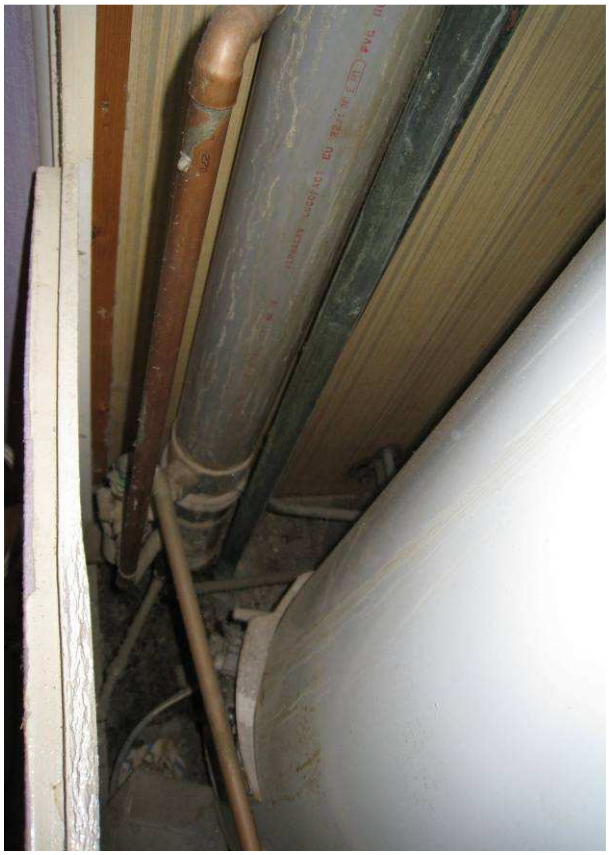
3.4 BASELINE PARAMETERS

Parameters	Description
Independent variables	
Climate	3079 heating degree-days (base 18℃) in ave rage for the period 1951-1980. The actual 2,827 heating degree-days in 2009 have been neutralised.
Energy prices	Electricity: 0.1125 €/kWh
Baseline period	The baseline period is one year, because actual energy consumptions are not available. Theoretical consumptions match the sample bills, which were obtained from tenants.
Heating	
Energy consumptions for heating	247 kWh/m².a This is a theoretical value.
Heat production system	- Individual heating - Basic electric radiators, one per room, dating from construction.
Heated surface	6,781 m² (gross surface)
Internal temperature	19℃ is the official temperatu re used for simulations. In reality most tenants heat around 21℃, because o f a very bad building insulation resulting in cold wall sensation.
Permanence of internal temperature	The 19℃ temperature is supposed to be constant in the simulation models.

Parameters	Description
Official heating period	Not relevant because heating is individual
Hot water	
Energy consumptions for hot water	24 kWh/m².a This is a theoretical value.
Hot water production system	- Individual electric hot water - Boilers are over 15 years - 150 litres tanks in average, badly insulated - Tenants can regulate water temperature, which usually results in too high temperature and energy waste.
Amount of hot water consumed	Simulation models assume that the amounts of water consumed per day at 60℃ are the following: - 1-room: 40 l - 2-room: 55 l - 3-room: 75 l - 4-room: 95 l - 5-room: 125 l - 6-room: 145 l Individual bills are not available.
Sanitary equipments	Sanitary equipments are standard and do not save water.
Level of water pressure	Not available at this stage.
Temperature of hot water	Simulation models are based on 50℃ in the bathroom and 55℃ in the kitchen. The actual temperature is not available as it is regulated by tenants. This probably results in lower efficiency.
Cooling	
Energy consumptions for cooling	0 kWh/m².a
Cooling system	There is no cooling.
Ventilation	
Energy consumptions for ventilation	4 kWh/m².a
Ventilation system	- Mechanical controlled ventilation system installed at construction - Self-adjusted - MCV extractors are in good state, they were replaced a few years ago - 3 boxes with 129 W set power, capacity 556.3 m3/h (smaller buildings) - 1 box with 374 W set power, capacity 1606.5 m3/h (bigger building) - Entry air vents are in bad state - Extraction air vents are in bad state (no maintenance by tenants)
Air renewal rates	N/A
Air tightness	
Air leakage	N/A Not relevant before refurbishment, given the very bad state of the building envelope.
Auxiliaries	
Energy consumptions for auxiliaries	0 kWh/m².a
Auxiliaries installed	There are no auxiliaries
Lighting in the dwellings	

Parameters	Description
Energy consumptions for lighting	N/A
Lighting equipment	N/A
Common spaces	
Energy consumption for common spaces	3 kWh/m².a
Equipments in common spaces	This energy consumption includes all common uses such as lighting and intercom, but not the lifts. It is based on actual energy consumptions. Lighting is provided through neon lights on command.
Use of the building	
Use of the building	- 100% housing
Typology of dwellings	- 1 one-room flat (29m²) - 7 two-room flats (61m²) - 20 three-room flats (76m²) - 23 four-room flats (96 m²) - 11 five-room flats (119 m²) - 2 six-room flats (124 m²)
Actual number of occupants	Declared: 202 persons. 11% of dwellings are under-occupied (less occupants than what the dwelling would allow).
Estimated presence time of occupants	Presence time can vary during the day, week or year. This is a qualitative information obtained through surveys and knowledge of occupants' employment status
Vacancy rate	Vacancy is not taken into account in theoretical energy consumption. Vacancy rate was at 2.58% in 2008, 2.02% in 2007.
Social and economic profiles of occupants	
Age of the head of household:	- 0-30: 16% - 30-40:23% - 40-55: 42% - 55-65: 11% - 65+: 8%
Number of children per household:	- None: 39% - 1 child: 17% - 2 children: 20% - 3 children: 9% - 4+ children: 14%
Activities of tenants	- Long-term employed: 25% - Short-term employed: 36% - Unemployed: 20% - Retired: 11% - Not active: 6% - Other: 2%
Resources compared to income thresholds for social housing	- 0-20% of thresholds: 33% - 20-40% of thresholds: 17% - 40-60% of thresholds: 17% - 60-80% of thresholds: 6% - 80-100% of thresholds: 6% - 100-120% of thresholds: 8%
Specificities	17% of tenants are railway employees
Behaviour of occupants	Tenants usually heat at 21℃ rather than 19℃.

3.5 PICTURES OF INSTALLATIONS:



4 ITALIAN PILOT SITE

4.1 PROJECT DATA

Owner:	Municipality of Reggio Emilia
Location, address:	Via Maramotti, 25, 42100 Gavassa, Reggio Emilia
Region:	Emilia Romagna Region
Surrounding	Urban environment
Climate:	E (heating from 15 October to 15 April, 14 hours a day
Year of construction:	1981
Year of renovation:	None
Typology of dwellings:	8 one-room flat (about 83m²) 5 two-room flats (about 47m²)
N° of levels:	3
N° of dwellings:	13
Living surface:	1,140 m²

Energy consumptions:	
Heating:	141.16 kWh/m².a
Hot water:	21.35 kWh/m².a
Cooling:	0
Ventilation:	0
Common areas:	N/A
Total	163 kWh/m².a 13 €/m².a

4.2 PRESENTATION OF THE LOCAL AND ENVIRONMENTAL BACKGROUND

It is technically possible to implement solar thermal panels for sanitary hot water, as well as photovoltaic electricity production, although this would require further study.
No available biomass or district heating.

The presence of sunshields :

- South exposition: 25% during winter, 50% during summer;
- East exposition: 0;
- West exposition: 25% during winter, 75% during summer;
- Nord exposition: 0;
- Horizontal exposition: 25% during summer, 0 winter.

4.3 BUILDING COMPONENTS:

Components	Description:	U value	Thickness
External wall	Panel precast concrete slab, with thermal insulation in polystyrene 3 cm	0.67 W/m².K	24 cm
Roof	Precast concrete slab, with thermal insulation in polystyrene 3 cm	0.34 W/m².K	31 cm
Floor	Panel precast concrete slab, with thermal insulation in polystyrene 3 cm	1.35 W/m².K	29 cm
Windows	Windows simple glass	3.3 W/m².K	4.5 cm

4.4 BASELINE PARAMETERS

Parameters	Description
Independent variables	
Climate	2560 heating degree-days based on 20℃ insi de temperature and -5℃ outside (Italian law)
Energy prices	0,08 €/kWh gas
Baseline period	To be provided if the baseline based on actual consumptions. If not, precise it.
Heating	
Energy consumptions for heating	141.16 kWh/m².a
Heat production system	- Generator Ferroli Pegasus F2-85, year 1998, rated output 93,5 kW, output 85 kW, good condition. - Only on-off control with temperature set point on the generator no individual control - Distribution : pipes without insulation - Balancing: presence of 3 ways valve near the generator. - Collective control: presence of temperature probe to adjust the generator. - estimated performance (from audit) 0,83 - Radiators, one per room, dating from construction
Heated surface	1,140 m²
Internal temperature	20℃
Permanence of internal temperature	14 hours/day

Parameters	Description
Official heating period	15 October – 15April
Hot water	
Energy consumptions for hot water	21.35 kWh/m².a
Hot water production system	- Independent electric boiler with 80 litres accumulation system. - different periods about 10 years old - Very low efficiency
Amount of hot water consumed	at the moment unknown
Sanitary equipments	at the moment unknown only estimated from UNI11300
Level of water pressure	at the moment unknown
Temperature of hot water	60℃
Cooling	
Energy consumptions for cooling	0 kWh/m².a
Cooling system	None
Ventilation	
Energy consumptions for ventilation	0 kWh/m².a
Ventilation system	There are no ventilation equipments
Air renewal rates	In the calculation model the renewal rates is 0,5 vol/h during winter
Air tightness	
Air leakage	Bad level of the windows
Auxiliaries	
Energy consumptions for auxiliaries	N/A
Auxiliaries installed	N/A
Lighting in the dwellings	
Energy consumptions for lighting	N/A
Lighting equipment	N/A
Common spaces	
Energy consumption for common spaces	N/A
Equipments in common spaces	N/A
Use of the building	

Parameters	Description
Use of the building	100% social housing
Typology of dwellings	Total 13 dwellings: 5 two-room flats (47.09m²) 2 four-room flats (82.79 m²) 6 five-room flats (83.93 m²)
Actual number of occupants	Declared: 40 persons.
Estimated presence time of occupants	Presence time can vary during the day, week or year.
Vacancy rate	Vacancy rate was at 2 empty dwellings in year 2010
Social and economic profiles of occupants	
Age of the head of household:	- 0-30: 0% - 30-40:27% - 40-55: 46% - 55-65: 9% - 65+: 18%
Number of children per household:	- None: 27% - 1 child: 27% - 2 children: 0% - 3 children: 37% - 4+ children: 9%
Activities of tenants	- Employed: 50% - Unemployed or with social problems : 40% - Retired: 10%
Resources compared to income thresholds for social housing	In order to obtain a social dwelling, the ISE AND ISEE indices have to be between €34,308.60 and €17,154.30. In order to remain in the dwellings, ISE must be lower than 51,462.90 and ISEE lower than 34,308.60 (ISEE). FASCIA Protezione 1: ISE < 34.308,60 € e ISEE < 5.000 € FASCIA Protezione 2: ISE < 34.308,60 € e ISEE < 6.500 € FASCIA Protezione 3: ISE < 34.308,60 € e ISEE < 7.500 € FASCIA Accesso 1: ISE < 34.308,60 € e ISEE < 10.000 € FASCIA Accesso 2: ISE < 34.308,60 € e ISEE < 12.500 € FASCIA Accesso 3: ISE < 34.308,60 € e ISEE < 15.000 € FASCIA Permanenza 1: ISE < 51.462,90 € e ISEE < 20.000 € FASCIA Permanenza 2: ISE < 51.462,90 € e ISEE < 25.000 € FASCIA Permanenza 3: ISE < 51.462,90 € e ISEE < 34.308,60 € FASCIA inadempienti ISE: utenti senza dichiarazione ISE FASCIA occupanti senza titolo: utenti senza titolo per occupare l'alloggio FASCIA Area di Decadenza: ISE > 51.462,90 € o ISEE > 34.308,60 € FASCIA Decaduti: utenti dichiarati decaduti dai Comuni - 82% of tenants are in the threshold Fascia Protezione 1 - 18% of tenants are in the threshold Fascia accesso 3
Behaviour of occupants	- Tenants usually heat at 21℃ rather than 19℃.

4.5 PICTURES OF INSTALLATIONS

5 UK PILOT SITE

5.1 PROJECT DATA

Owner:	Places for people
Location, address:	Rutland street, Preston, Lancashire
Region:	North west of England
Surroundings:	Urban
Climate:	Cool temperate – Midlands, UK
Year of construction:	1986
Year of renovation:	None
Typology of dwellings:	Self-contained single-bedroom flats
N° of levels:	3
N° of dwellings:	39
Living surface:	2028 m²

Energy consumptions:	
Heating:	286 kWh/m².a
Hot water:	70 kWh/m².a
Cooling:	0
Ventilation:	N/A
Common areas:	N/A
Total:	356 kWh/m².a 14.24 €/m².a

5.2 PRESENTATION OF THE LOCAL AND ENVIRONMENTAL BACKGROUND

- The area is built-up and suburban in character. As such, there is no opportunity for the use of horizontal coil ground source heat pumps. A vertical solution could be adopted if a ground survey found no obstructions. The level of the water table at this location is not known. There are no known heat networks in the immediate area. There are a number of biomass (wood chip) suppliers in the immediate area, several of whom would be able to deliver wood chip to the site.
- Levels of irradiation for Manchester (Aughton) are 2878 kWh/m2 for the SW-facing roof with an incline of 30° according to reference data from CIBSE. 3,222-degree hours with base temperature of 18.5 for Manchester Ringway data taken during the period of 1983-2002. While average wind data per sq km is available for the UK (NOABL database), this information appears to be of very limited use for the sitting of small-scale wind turbines. No measured wind data is known to be available for the site; however, given the built-up surroundings, it is unlikely to be suitable for small wind.
- The southwest-facing roof is not overshadowed.

5.3 BUILDING COMPONENTS:

Components	Description:	U value	Thickness
External wall	12mm gypsum plaster (1300kg/m³) to inside surface. 100mm medium density block. 50mm filled cavity. 110mm brick outer leaf.	0.60 W/m².K	26 cm
Roof	12.5mm plasterboard 100mm mineral wool quilt (thermal bridge at λ 0.13) 150mm mineral wool	0.16 W/m².K	26 cm
Floor	6mm carpet 8mm foam underlay 50mm concrete screed 50mm polystyrene insulation 150mm concrete slab	0.17 W/m².K	26 cm
Windows	Timber (soft) single glazed windows of varying dimensions. NB. We have used an indicative value for windows. However, we are not in possession of a condition report, which could lead to an upward adjustment to this figure.	5.00 W/m².K	
Doors	- 1* UPVC Single door plus fixed panel 2m wide 22mm double glazing (3.1 W/m²K) - 3* solid timber 900mm wide (3.0 W/m²K) - 3* number half single glazed timber doors (3.9 W/m²K)	3.36 W/m².K (weighted)	

5.4 BASELINE PARAMETERS

Parameters	Description
Independent variables	
Climate	3222 degree days with base temperature of 18.5 for Manchester Ringway (average 1983-2002)
Energy prices	40€ / MWh for gas
Baseline period	To be provided provide the degree-days for that period, precise if consumptions have been weighted by degree-days in order to neutralise climate
Heating	
Energy consumptions for heating	286 kWh/m².a

Parameters	Description
Heat production system	- Heat is transmitted by radiators. Their output is unknown and it is assumed that radiators are original to the site, with replacements having been introduced only where required due to malfunction. - There is no centralized control. All radiators are fitted with thermostatic radiator valves in good working condition. - There is a bi-pipe distribution system; there are some distribution issues. - All valves are located within the plant room with some evidence of leaks. The system is configured with 11° Delta T balancing. The plant room houses two 300mm single-louvre vents. - The control valves are limited to dual setting ("on/off"). There is no load adjustment. There is no weather compensation. All equipment within the plant room is approx 23 years old and original to the scheme, prior to the introduction of weather adjustment standards. - The plant and equipment is original to the scheme (1985/86). There are four Hamworthy UR430 Atmospheric boilers feeding one large cylinder/buffer to LTHW that is insulated to a poor quality. The input rate for each boiler is 124.75kW (430,000btu). The output to H2O is 95.8kW. Each boiler runs on a gas flow rate of 11.6m³ per hour at 75%-78% efficiency.
Heated surface	2,446 m²
Internal temperature	We estimate ~ 22-23℃ (with a normal distribution and low standard deviation). However, we have no data to support this.
Permanence of internal temperature	N/A
Official heating period	N/A
Hot water	
Energy consumptions for hot water	70 kWh/m².a
Hot water production system	- Same plant as heating - Water is delivered via a simple series (no loop) to individual cylinders in each dwelling. - There are individual cylinders present in each dwelling. Their capacity is not determined, but their approximate size is 1m x 600mm. Cylinders are insulated to varying levels, but of a poor quality overall. The cylinders do not have individual outflow controls. There appears to be cylinder demand control. However of its settings and functioning are not certain.
Amount of hot water consumed	N/A
Sanitary equipments	- Simple hot and cold taps to kitchen sink, wash hand basin and baths provided to each dwelling (39 dwellings) for a total of 117 draws (no mixing).
Level of water pressure	N/A
Temperature of hot water	- Temperature information is not available, some problems being experienced with hot water distribution.
Cooling	
Energy consumptions for cooling	0 kWh/m².a
Cooling system	None

Parameters	Description
Ventilation	
Energy consumptions for ventilation	N/A
Ventilation system	Small extractor fans in the bathrooms, assumed to operate above a specific fan power of 2 watts per litre per second. There is no central ventilation and the site relies on trickle ventilation.
Air renewal rates	The current natural ventilation is assumed to be in line with regulated demands in 1985/86.
Air tightness	
Air leakage	N/A
Auxiliaries	
Energy consumptions for auxiliaries	N/A
Auxiliaries installed	N/A
Lighting in the dwellings	
Energy consumptions for lighting	N/A
Lighting equipment	- Dwellings o 4 ceiling fixtures per dwelling utilizing unknown lamps (156 fixtures in overall scheme) o 1 fluorescent fixture utilizing 1.5 linear meters of tubing (39 fixtures and 58.5 linear meters in scheme overall)
Common spaces	
Energy consumption for common spaces	N/A
Equipments in common spaces	- Common areas : a mixture of compact fluorescent and fluorescent tube supplying practical and emergency lighting on simple one-gang and two-gang switches: o 32 pendant fixtures utilizing compact fluorescent lamps of unknown wattage o 45 2D fixtures utilizing 38watt lamps o 110 fluorescent fixtures utilizing 115 linear meters of tubing o 12 wall fixtures utilizing compact fluorescent lamps of unknown wattage o emergency lighting is mixed in with practical lighting, but powered separately with batteries – not reported here - Car park o 3 external columns utilizing unknown lamps on sensors o 10 external fixtures on combination of preset and sensors utilizing unknown lamps - Dwellings o 4 ceiling fixtures per dwelling utilizing unknown lamps (156 fixtures in overall scheme) o 1 fourescent fixture utilizing 1.5 linear meters of tubing (39 fixtures and 58.5 linear meters in scheme overall) - Lifts : one 8-person Keighhley lift with a maximum load capacity of 630kg
Use of the building	

Parameters	Description
Use of the building	The building is sheltered housing; it accommodates elderly people. It not only provides housing, but also collective areas and services. (communal lounge , hairdresser , laundry and staff office
Typology of dwellings	Self-contained single-bedroom flats
Actual number of occupants	40 flats (48 occupants)
Estimated presence time of occupants	Occupants are present most of the day since they are retired.
Vacancy rate	The void turnaround rate is 6 % per year These vacancies are predominately customers needing additional health care and sudden deaths
Social and economic profiles of occupants	Elderly retired people (ages range from 60 to 92 years old All the occupants are on the UK government's state pension 85 % of the residents are also on income support 15 % pay their own rent and service charge they are mainly from the northwest of England

5.5 PICTURES OF INSTALLATIONS

Distribution

Boilers

Buffer

Dwelling Cylinder

Balancing

Ventilation

6 GLOSSARY OF ABBREVIATIONS

The following abbreviations have been used in this report:

- CO_2: Carbon Dioxide
- EPC: Energy Performance Contract
- ESCO: Energy Service Company
- EU: European Union
- FRESH: Financing energy Refurbishment for Social Housing, project funded by the Intelligent Energy Europe programme.
- HVAC: Heating, Ventilation and Air Conditioning
- IPMVP: International Protocol for Measurement and Verification of Performance
- N/A: not available
- SHO: Social Housing Operator
- UK: United Kingdom