

ENPIRE

Evaluation Local Projects (D13)



Local Projects

Albertslund (Denmark)

Ávila (Spain)

Breda (Netherlands)

Casale (Italy)

Dublin (Ireland)

Le Grand Chalon (France)

Havířov (Czech Republic)

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1 Introduction

In the ENPIRE project¹ energy ambitions in relation to urban planning are evaluated in the seven participating countries. The purpose is to set up guidelines on how to organise the process of energy and urban planning and how to formulate ambitions and local agreements on CO₂-reduction.

ENPIRE has an active dissemination policy and focuses on local target groups in all 27 EU Member States such as project developers, social housing associations, inhabitants, energy companies and network organisations.

In the seven countries, local urban planning projects with energy saving and CO₂ reduction ambitions were setup. These local projects were important sources of information for trying out and improving the ENPIRE guidelines.

The results of the local projects were evaluated in ENPIRE meetings and brought together in this report. The seven projects are located in:

- Albertslund, Denmark
- Ávila, Spain
- Breda, Netherlands
- Casale, Italy
- Dublin, Ireland
- Havířov, Czech Republic
- Le Grand Chalon, France (project cancelled)

The information in this evaluation report is based on the information provided by the ENPIRE project partners in the form of local energy studies, local project summaries and information sheets and the project presentations in the ENPIRE meetings.

The local project of Le Grand Chalon was discontinued in March 2009 because of political reasons and will be discussed in less detail.

Reading guide

In the early phases of the ENPIRE project draft guidelines have been prepared to guide the process from ambition to decision making and to support the embedding of agreements. The partners and stakeholders used them in the local projects of the ENPIRE project. This evaluation report is structured with the concept guidelines in mind.

Conclusions are reported per paragraph.

The next subjects are described:

- context of the local projects (2);
- energy ambitions and the way they were agreed on (3);
- energy options and first selection of promising energy measures (4);
- the implementation of energy options (5);
- use of the ENPIRE guidelines in the local projects (6);
- lessons learned in the local projects (7).

¹ Energy and Urban Planning in Restructuring Areas

2 Context local projects

The ENPIRE local projects are widely spread over Europe (Figure 1). Countries, backgrounds, climates, local regulations, starting points, stakeholders and plans are all different. The similarity between all these projects is the ambition to save energy and reduce CO₂-emission in renovated and/or new urban surroundings.

The context of the project is decisive for the process and the result of the project. When a renovation of current dwellings is needed, as for example in Havířov, things like extreme insulation, high investments or new energy grids are almost impossible to realise because the monumental status of the buildings, the low rent and the way the exploitation of the heating system is currently organised. In other projects there are more possibilities to apply low energy measures because new dwellings can be built on sites where old buildings are demolished or because the project will be realised on unbuilt areas.

In this chapter the local projects are characterised by a description of the current situation, the plans that are developed, the deciding stakeholders and the legislation that the developers have to deal with in each country.

2.1 Current situation and development plan

The current situation of the sites of the local projects are very different. They vary from areas with dwellings that need to be (partly) renovated or demolished (Albertslund, Breda, Le Grand Chalon, Havířov) to agricultural lands with agricultural buildings (Ávila) or an industrial area with cement industry that has to be demolished (Casale). Only one project is strictly new built and will be realised on a 'green field' (Dublin).



Figure 1 the local projects of ENPIRE are located in Albertslund (Denmark), Ávila (Spain), Breda (Netherlands), Casale (Italy), Dublin (Ireland), Le Grand Chalon (France) and Havířov (Czech Republic).

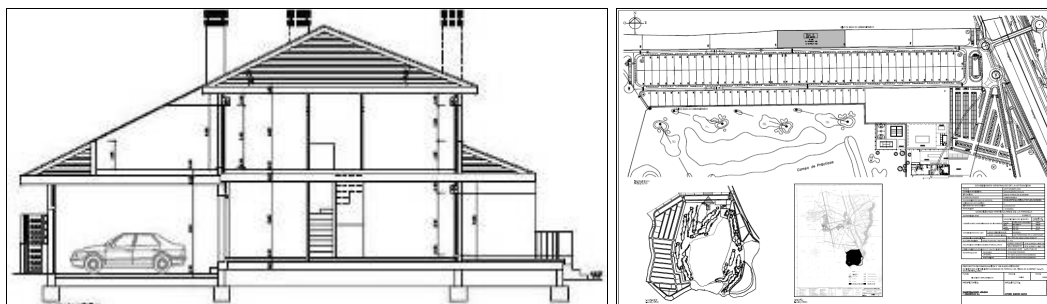
2.1.1 Albertslund, Denmark



The Danish Housing company, BO-VEST, is responsible for the largest and most costly renovation plan for social housing in Denmark. Approximately 2.200 industrialised concrete housing units from the 1960'es in the municipality of Albertslund, will go through a costly urban renewal renovation at an estimated cost of not less than 180.000 Euro per unit. Around € 360 million will be invested, of which € 200 million is available for retrofitting the social housing dwellings.

In the plan the partnership between the housing association, the municipality and the tenants organisation is very important. The "Samrådet" takes care of the communication among partners and has to approve every decision.

2.1.2 Ávila, Spain



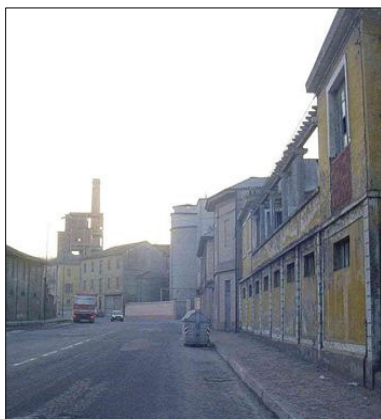
The project in Avila is an urban development project in the rural area of Sanchidrian, which was previously mainly used for agricultural activities. The project will transform the agricultural area into an urban area with more than 200 houses, annexed buildings and a golf ground. This is one of the most normal changes of use in Spain, so it has potential interest to many other projects.

2.1.3 Breda, Netherlands



The Heuvel refurbishment project in Breda comprises a residential area with 3.200 dwellings, built in 1945 – 1960, with a great variety of housing blocks and local facilities. Of these dwellings 2.500 dwellings are owned by housing associations and 700 have private owners. The energy supply is covered by natural gas and electricity. The restructuring process (2005 – 2015) comprises the demolishing of 650 houses, renovation of 650 houses and construction of 950 new dwellings. Furthermore a new retail centre and a new school will be built and an old monumental church will be changed into a multifunctional centre.

2.1.4 Casale, Italy



Ronzone is the district which hosted a cement-asbestos production facility and other cement industries of the Piedmont region. Presently the area has been reconditioned for new use.

After demolition of the abandoned factories, an eco-village will be built, integrating eco-technologies like bioclimatic design, passive solar, PV modules, biomass heating system on the village scale and use of recycled materials for basements, to meet the high standards of an eco-settlement. Presently the main energy carriers are natural gas and electricity.

2.1.5 Dublin, Ireland



Tyrrelstown Housing is a new development of Social Rented, Shared Equity and Affordable Purchase family dwellings by the National Association of Building Co-operatives (NABCo) Society Ltd, a Government approved Housing Body.

The project comprises of the construction of 234 new family homes including both houses and apartments in 2 and 3 storey blocks together with 3 communal welfare facilities including a crèche, community centre, estate management offices and a public park. The site is Northwest of Dublin.

The Fingal County Development Plan 2005-2011 sets out the Local Authority's policies and objectives for the development of the County for a six year period from 2005 to 2011. The Plan seeks to develop and improve the environmental, social, economic and cultural assets of the County in a sustainable manner, and includes specific policies for the improvement of qualitative standards for sustainable building design.

The dwellings will generally be heated by individual high efficiency condensing gas boilers. A percentage of domestic hot water installations will be using solar thermal technology.

2.1.6 Le Grand Chalon, France (project cancelled)



The planned intervention at the heart of "les Près-Saint-Jean" was the demolition of five social housing blocks with 492 dwellings, and the building of 170 new social dwellings and 290 new private dwellings. Refurbishment was planned for three other buildings, a new setting of the lake shore and a new system of pathways, roads and local services.

2.1.7 Havířov, Czech Republic



The buildings are owned by the city of Havířov and managed by its housing company MRA. The dwellings are built in the 1950's. These buildings have a low energy efficiency and are in a bad technical state. Tenants complain about thermal comfort.

Most apartments of the MRA portfolio are regulated rentals (fixed low rent, 85%) which give nonsufficient financial sources for technical renewal of the buildings. In the period 2007-2010 the rent will be deregulated from 19 CZK to 41,6 CZK/m² (0,73 to 1,60 €/m²) and will generate more financial sources for renewal of the housing portfolio. In 1992 this area was declared a protected sights zone, which makes it more difficult to insulate. Hot water (heating, domestic hot water) is supplied by Havířovská teplárenská společnost and NWR energy.

Table 1 Current situation and developing plan of all local projects.

City	Current buildings	Development plan
Albertslund (DK)	Prefab row dwellings (1965-1970)	<i>Renovation</i> The ambition is to develop the most attractive, visionary and modern municipal in the westerly part of Large Copenhagen (Masterplan Syd).
Ávila (ESP)	Agricultural buildings	<i>Demolition agricultural buildings</i> New residential houses with high isolation level on the site of demolished agricultural buildings.
Breda (NL)	3.200 Dwellings of 1950's (most row houses).	<i>Part renovation, part demolition/new</i> Raise value, comfort and give attention to environmental issues, solution of social issues, energy cost, healthy indoor climate.
Casale (I)	Factories cement industry	<i>Demolition factories, new houses</i> Region Piedmont Environment Dept. and the Municipality were the main actors in planning an entirely new look for a polluted area
Dublin (IRL)	None: green fields	<i>New houses</i> A new development of Social Rented, Shared Equity and Affordable Purchase dwellings providing 234 family homes, a community centre, crèche and public park.
Havířov (CZ)	220 Dwellings of 1950's in masonry blocks	<i>Renovation</i> Urban development plan approved in 1999. This plan is regularly updated through amendments. Strategic development plan and community development plan are also available.

CONCLUSION CURRENT SITUATION AND DEVELOPMENT PLAN

The reasons for making project plans differ for each local project. Sites with unused industrial or agricultural buildings for example had potential to be transformed into areas with dwellings or existing dwellings were in need of refurbishment because of the poor quality of the houses (low energy quality, problems with the indoor climate or complaints about thermal comfort) or of social problems in the neighbourhood.

In none of the local projects energy saving or CO₂-emission reduction was the main drive to start making development plans, but was introduced as an important issue. Successful plans will solve the initial problems in an energy efficient way.

In almost all refurbishment projects, the proprietor is a housing association and the problem of "split incentive" has to be solved. The problem is that the housing association invests in energy saving measures but does not benefit from the lower energy bills of the tenants. In most cases the housing associations can not raise the rent to finance the energy saving investments. In the Netherlands this problem will be addressed by new legislation in the near future, but for the time being the split incentive for rented houses remains a major problem in many countries. In the local project of Breda the rent was raised, but the tenants were guaranteed no increase in housing costs (rent + energy).

A related problem is that many of the social dwellings have a low rent and have therefore small room for investments.

The current energy infrastructure is gas and electricity in the Netherlands and a collective heat supply system in Denmark and in the Czech Republic. In the Czech Republic the existing heat distribution system (with relatively high losses) places constraints on the energy reductions that can be achieved. This problem occurs because the heat supply company is not (yet) a partner in the energy planning process for the Sorela area. In other local projects the existing energy infrastructure is not mentioned as an important issue.

In all local projects the decision making process takes several years. This means that the ENPIRE project covers only a short period of time in the whole process of urban planning of the local projects. None of the projects started or finished within the 2-year ENPIRE time frame. This makes it difficult to get a full picture of the whole decision and construction process including the final realisation.

2.2 Stakeholders

In the process of urban planning many stakeholders are involved and they all have their interests and agendas. When something out of the ordinary has to be accomplished, like building very low energy dwellings, it is very important to know who the stakeholders are and what their particular interests and agendas are.

Only if the organisation and the process are clear enough, the stakeholders will be able to work together and identify mutual interests, so essential for realising ambitions.

Stakeholders can be people or organisations that are:

1. directly linked to the dwellings because they live in them (e.g. tenants, home owners, housing associations);
2. responsible for the exploitation of the dwellings and/or the energy system (power company, housing associations);

3. are involved directly with the planning/building process (project developer, builders, architects, consultants);
4. have a more common responsibility as governmental organisation (local, provincial, national).

The first group (inhabitants) is directly confronted with the energy performance and comfort of the dwellings. The parties involved in the exploitation of the buildings or energy systems are involved because they want to offer a product (use of dwelling, energy system) that is financially healthy and therefore price and quality of the product have to be in balance. Parties involved only in the construction of the low energy houses have their focus mainly on realisation of a financially healthy project. If the project is finished, the involvement of these parties normally will end, unless the project developer for example is also the housing company that exploits the dwellings.

The role of governmental organisations is quite different. They have a responsibility to maintain legislation, but can also take a very important role to stimulate involved parties to do more, with a view on broader policy targets such as the mitigation of global warming.

In de the ENPIRE local projects many different stakeholders were involved.

2.2.1 Albertslund

The municipality of Albertslund has a leading role in the ambitions to renovate the current housing stock to very low energy dwellings. The Danish housing company BO-VEST renovates the 2.200 dwellings and agrees to the ambition of the municipality, despite the very high costs of the proposed measures. They expect that the quality of the dwellings will be so much improved and energy prices will be so high, that exploitation in the future is no problem.

Because of the high costs for renovation they are looking for innovative ways to finance measures. One of the things they try to achieve is involving industries in the energy saving sector. The industry could use the PR that will be generated by good realised examples.

The inhabitants have voted for the politicians that stand for use of low energy techniques and are represented in the "Samrådet" that takes care of the communication among partners and that has to approve every decision.

2.2.2 Ávila

The city council of the province of Avila has promoted the actions between the other involved parties.

The city hall of Sanchidrián was the responsible of giving the license to build in its land and has encouraged the improvements in the common areas, mainly due to an economical interest.

Moreover, some professional associations (architects, technical architects and engineers) have taken part in the project to achieve a good spread of it.

The constructor has also had an active position because he was who accepted the improvements in dwellings without any obligation, because are optional measures.

Inhabitants are still unknown, so they do not have an active role in the process.

2.2.3 Breda

The Municipality of Breda stimulates energy efficiency in new buildings and restructuring of neighbourhoods (New Climate Policy Breda, Covenants (voluntary agreements)) also addressing the overall quality of plans (Report Quality Living (Nota Kwaliteit Wonen)).

Inhabitants had a role in the discussions about the setting of ambitions. A very important issue were the total housing costs, being the sum of the rent and the energy costs. Very important principle in the Dutch situation was the possibility to raise rent of dwellings after realising energy saving measures.

In case of projects with energy measures it is important to aim at lower or at least equal total housing costs for tenants. Because of investments the gross rent for the dwellings will rise. The positive effect are the lower energy costs. In Breda the guarantee on total housing cost was a very important reason for tenants to agree with the higher ambition on CO₂ emission reduction.

The tenants had an active role in formulating the ambitions in the covenant that was drawn up for Breda, but not in the energy study and the choice for energy measures.

2.2.4 Casale

The municipality played an important role in searching the best contractors, through the help of the Consulta of Building Developers of the Alessandria Province.

The inhabitants were involved in various meetings from the very beginning of the project, first by asking them how they would like to see their area, and then by showing them the first projects with a special view on environmental protection.

2.2.5 Dublin

National Association of Building Cooperatives (NABCo) Society Ltd are a non profit organisation concerned with the relief of housing needs, poverty and deprivation, through the building and management of houses or apartment blocks. They are the lead developer for this project in partnership with Fingal Co. Council

Fingal Co. Council are the Local Authority responsible for the control of development in this urban area. The role of the Local Authority is to ensure that the energy performance of the new dwellings complies with current planning and building regulations and national policies. They will also be involved in negotiations for additional government funding required to pay for renewable energy systems.

Fingal Co Council (Local Authority). In 2005 Fingal County Council became the first local authority in Ireland to introduce mandatory sustainable building requirements leading to a revision of national regulations.

Tenants will be selected from Local Authority waiting lists at a later stage, so unfortunately it was not possible to identify the future inhabitants to discuss energy policies.

2.2.6 Havířov

Local authority approves of the renovation project and the financing.

SORELA buildings are considered to be a part of history and a sort of cultural heritage of the city. The facades of these building will have to respect certain rules that should be formulated by the authorities. Also the projects have to be submitted for approval of monuments protection authority.

Tenants are informed about the renovation and have few possibilities to decide about the renovation project. All complaints, opinions of tenants are collected constantly by MRA.

- MRA's most frequent activity as for the cooperation with tenants are meetings before the complex refurbishment of the house. At the meetings the tenants are informed about the course and time schedule of realisation of the refurbishment. Representatives of the investor, designer and contractor of the renovation are present at these meetings. The minutes of these meetings are distributed to the tenants of the house. These meetings help to eliminate all complaints of the tenants during the refurbishment. During discussion with the tenants are answered all their questions.
- MRA has an experience with tenants participation from other EU projects like SUREURO. The tenants participation has been an issue in Sumbark renovation project. The municipality together with MRA would consider an agreement with tenants enabling them to be involved in planning, improving and monitoring the projects and clarifying
 - through this agreement the municipal council and tenants want to achieve better ways of cooperation, improving local services and quality of life;
 - how tenants can get involved collectively in local decisions on their housing matters;
 - how the contract is implemented and checked to make sure it is working properly.

Table 2 Stakeholders in local projects.

City	Stakeholders
Albertslund (DK)	<ul style="list-style-type: none"> - Municipality; - Social Housing Association; - Tenants.
Ávila (ESP)	<ul style="list-style-type: none"> - Energy Agency of Avila; - City Council of Ávila; - City Hall of Sanchidrian; - Constructor; - Professional associations related with building sector ((technical) architects, engineering).
Breda (NL)	<ul style="list-style-type: none"> - Municipality of Breda; - Breburg Wonen (public housing/development); - Neighbourhood Council "Heuvelbelang".
Casale (I)	<ul style="list-style-type: none"> - Municipality of Casale Monferrato; - Region of Piedmont; - Consulta of Building Developers of the Alessandria Province; - (project developers); - ATC of Alessandria (Housing Association).
Dublin (IRL)	<ul style="list-style-type: none"> - National Association of Building Cooperatives (NABCo) Society Ltd. (Housing Association); - Fingal Co Council (Local Authority).
Havířov (CZ)	<ul style="list-style-type: none"> - the tenants; - City of Havířov as asset owner represented through MRA Agency; - MRA Agency (housing and facility management company); - Havířovská teplotárská společnost a.s. (heat distributor and owner of secondary heat distribution systems).

CONCLUSIONS WITH REGARD TO STAKEHOLDERS

The main stakeholders in the projects are the local authorities (municipalities, province) and housing associations.

The role of tenants or inhabitants differs strongly per local project. In Havířov they are informed but have no saying and in Albertslund they are represented in the Samråd that has to approve every decision.

The local authorities, builders and housing associations have great need and ambition in raising the quality of dwellings and neighbourhoods to keep a healthy housing stock now and in the future. This concerns the value of the buildings, to provide solutions for environmental and social issues, to control costs and to improve the indoor climate and air quality of the buildings.

The Municipality has a key role in these processes, because they can overlook the larger scale that is important in these matters and because they have ideas to develop an approach for restructuring neighbourhoods taking into account energy costs, CO₂-emissions, living quality for the whole of the community. Also they can influence to a great extent the selection of the energy infrastructure that best addresses the concerns above.

In Ávila the constructor and the professional associations related to the building sector were also given a relevant position in the decision making process.

When considering new techniques, the industry could be a stakeholder.

It is remarkable that energy companies seem to have a relatively minor role in the considered projects while the existing and future energy infrastructure can have a big influence on the feasibility of energy savings ambitions.

2.3 Legislation, standards and policies

In every country the national legislation and local regulations define the minimum demands on energy performance of new buildings. The regulations differ per country and the demand for energy performance for renovation is lower compared to the demand for new buildings. In every local project legislations and regulations are different and also used in a different way.

2.3.1 Albertslund

In Denmark the national regulation is rather weak on low energy demands for retrofit. So the ambitions on low energy standards in Albertslund are defined by the municipal, the social housing sector and the tenants.

The low energy measures have to be balanced to the payback time of the investment.

How it is used

The energy regulations for new buildings are used as an inspiration for setting the standards for renovation. Because of the planning horizon and the rapidly changing regulations, also expected future regulations are taken into account. In the regulations a limit on the energy performance is given in kWh/m².year, depending on the gross heated floor space. A low energy building class 1 has an energy performance that is 50% better than the minimum required and a class 2 building has an performance that is 25% better.

2.3.2 Ávila

In Ávila the following national regulations are important:

- The Technical building code (CTE, Royal Decree 314/2006). This is the main law that fixes the way to build. This Code fixes the minimum requirements in several topics as isolation level, solar energy contribution and built security;
- The Regulation for Thermal Installations in Buildings (RITE, Royal Decree 1027/2007). It affects to the equipments related to thermal generation;
- Energy Certification of Buildings (Royal Decree 47/2007).

How it is used

All the legislation is focussed on the builder, who has to carry out with the requirements when is building. This legislation fixes the minimum to build and the laws allow a better energy efficiency. This energy efficiency level determines the energy label, so it is directly linked with the building quality.

2.3.3 Breda

Energy performance of buildings (EPN)

On building level the Netherlands have developed the energy performance of buildings (EPN). This is a calculation method for building related energy flows based on an energy balance for heating and cooling, the energy use for domestic hot water and the use of electricity for pumps, ventilators and lighting. The energy performance factor (EPC) is the primary energy use of these energy flows, corrected for the effective floor area and the building envelope.

When introduced in 1996, the maximum EPC in the Dutch legislation was 1,6. In the current building regulations the maximum EPC = 0,80. On national level a covenant has been agreed to lower the maximum EPC to 0,6 (2011) and 0,40 (2015).

An EPC of 0,80 is approximately a primary energy consumption of 70 – 75 kWh/m².

Energy performance of locations (EPL)

On location level an energy performance of location (EPL) is developed. The EPL is an tool that calculates the CO₂-emission of a location compared to the reference CO₂ emission of that location.

If the CO₂-emission of the location is equal to the emission of the EPL-reference (EPC 1,0 and gas and electricity as energy infrastructure) the EPL is 6. If the CO₂-emission of the location is zero (0), the EPL is 10. Other values of EPL will be attained by linear interpolation between these two points. Neighbourhoods with houses that have an EPC according to current legislation have an EPL of approximately 6,6.

The calculated CO₂-emissions include the building related energy use according to the method of EPN, consumer-related electricity use (tv's, computers, washing machines, et cetera; demand depends on the size of the dwelling) and public installations (150 kWh per dwelling). The calculation of the CO₂-emission is based on the calculated energy demands and the CO₂-emissions of energy conversions. The energy savings within the energy system and local renewable energy generation are valued.

How it is used

Legal regulations are an essential prerequisite, because they have to be applied. Besides that, they are important as a reference for measuring energy savings.

The predicted future legal regulations are also important because the required EPC values will be lowered within the development time of De Heuvel.

There are plans to meet the problem of split incentives for housing associations in future regulations. These regulations will allow housing associations to raise the rent when energy measures are taken. This means there will be more room for investments. For the tenants this raise will be compensated by lower energy costs. The aim is to keep total housing costs at the same level.

2.3.4 Casale

In Casale several regulations on different levels were applied.

National level

Decree Law aug2005, n. 192, integrated by dec2006, n. 311, relating to energy efficiency in buildings.

Regional level

Piedmont Regional Law n.23 2002 "Regional Energy Plan".

Piedmont Regional Law n. 13 2007 "Energy Efficiency in Buildings".

How it is used

Energy Standard in Northern Italy is currently class C, that in Italy corresponds to <70 kWh/m² per year.

2.3.5 Dublin

In Ireland the following national and regional legislation is relevant to the sustainability and energy efficiency of new dwellings:

National Level

- National Energy Efficiency Action Plan 2007-2020 - Published May 2009;
- Government White Paper, Delivering a Sustainable Future For Ireland 2007 – 2020;
- National Climate Change Strategy 2007-2012;
- National Development Plan 2010 – 2015;
- Planning and Development Act 2000 – National Planning Legislation;
- Building Control Act 2007 - National Building Regulations;
- European Communities (Energy Performance of Buildings Regulations) Adopted for dwellings January 2008.

Regional Level

Local Authorities have begun to introduce additional mandatory minimum energy performance standards for new private residential developments within their own Urban Areas through their county development plans. Recognising that government needs to

lead by example, they have also set higher targets for their own public housing projects including retrofit.

How it is used

The National Energy Efficiency Action Plan 2007-2020, published in May 2009, sets out the Irish Government's plans and actions to achieve its target of 20% energy efficiency savings across the economy by 2020 in accordance with targets set by the European Council in 2007. It is estimated that improvements in the energy performance of the residential sector will contribute 53% of the total national reductions required to meet the overall target of 20% reduction in CO₂-emissions by 2020.

Development of regulations

Newly introduced regulations and expected future regulations show rapid improvements in the energy performance and reduction of CO₂-emissions as follows:

- 2005 Building regulations reference level;
- 2008 40% improvement on 2005 building regulations;
- 2010 60% reduction on 2005 building regulations;
- 2012 Carbon Neutral homes (aspiration);
- 2019 Zero Energy, in accordance with the recently revised European Performance of Buildings Directive EPBD.

2008 Building Regulations

2008 regulations introduced new minimum requirements for air tightness, reduced thermal bridging, efficiency of oil and gas boilers (min 86%) and for a proportion of heat or power for dwellings to be generated from on site renewable energy sources:

- Min. 10 kWh/m².year from solar thermal panels, heat pumps or either biomass boilers or stoves or,
- Min. 4 kWh/m².year electricity from solar photovoltaic or wind turbines.

The 2008 Building Regulations for dwellings, form part of the basis for ambitions of the local project which was originally designed to 2005 regulations. A non binding covenant was also agreed with the stakeholders to achieve a further 25% improvement on 2008 regulations.

In Ireland the Primary energy consumption of new dwellings designed to 2008 regulations is approximately:

- Apartment: 50-75 kWh/m².year;
- House: 75-100 kWh/m².year.

Calculations are made with an indoor temperature in dwellings of 20°C and an energy infrastructure with gas and electricity.

2.3.6 Havířov

In the project of Havířov the next regulations were important:-

- 406/2000 Coll. Act on Energy Management
- 180/2005 Coll. Act on use of renewable sources of energy
- State energy policy vision document approved by the Czech government in 2004

- Territorial energy policy vision document for the city of Havířov und surroundings approved by the Municipal Council in 2005
- regulation no. 425/2004, which determines content of the energy audit
- The legal regulations define the minimum requirements for renovation projects. The U-values are prescribed.

How it is used

The legal regulations define the minimum requirements for renovation projects. The U-values are prescribed.

CONCLUSIONS LEGISLATION AND REGULATIONS

The required level of energy performance and the way it is laid down in legislation, differs per country. The EPC of the Dutch regulations can not directly be compared with the low energy building class 1 of Denmark for example. Sometimes it seems comparable, when performance levels are given in kWh/m² for example, but you don't know what energy flows are taken into account and in what way they have to be calculated.

In general one can say that legislation with regard to renovation projects is less ambitious in terms of energy performance than legislation for new buildings. Of course in renovation projects ambitions maybe more difficult to accomplish because you have to deal with current situation (buildings, energy grids, residents, low rent, et cetera).

An important observation is also that current regulation on energy performance only deals with buildings and not with the energy infrastructure or large scale heating and/or cooling systems.

3 Ambitions and agreements

The stakeholders in the ENPIRE local projects have the ambition to realise a low energy, low CO₂-emission project. The level of energy saving and CO₂-emission reduction is agreed on in the first stages of the project. In the ENPIRE local projects voluntary agreements were made, which means that there are no consequences when ambitions are not realised. An agreement, even a voluntary one, is very important because it focuses all parties on the agreed goals of the project.

In the ENPIRE local projects the ambitions are on such a level that the building process is not standard. Extra efforts and extra investments are needed to develop these projects. Because of that, the agreement must be very clear and all parties should be aware of possible legal and financial consequences. It is very important to have a solid agreement, not only on the final target, but also on the way to cooperate and communicate in the process.

3.1 Ambitions

The ambitions do not only regard energy performance but also directly related subjects as thermal comfort, air quality, living costs et cetera. Each local project used its own tools to formulate the energy performance targets.

3.1.1 Albertslund

Having in mind that most of their building stock has to be retrofitted in the coming 10-15 years and future regulations develop rapidly, the stakeholders had to go further on low energy from the start and it was not enough just to follow current national regulation.

The ambition is to lower the energy performance from 150 to 35 kWh/m².

The final target is not yet agreed on, but parties hope to be able to reach low energy class 1 for new build in the retrofitting. It has to be approved by the tenants and house owners and will in the end depend on the cost/rent.

Indoor climate and comfort

In Albertslund indoor climate and comfort are important. After renovation the indoor climate and comfort will be improved. There is a variation in the building stock, but for the larger part of the buildings, the indoor climate and comfort will be improved by adding window(s) and mechanical ventilation with heat recovery. The project has a focus on creating a unit that could be added to the existing construction. This unit will provide all that is needed to update the building, regarding the indoor climate, comfort and reducing the energy consumption.

Tools

In Albertslund several tools were used, varying from calculation tools as BYG-SOL, PHPP and BE06, but also use experiences from other projects and new economic tools and financing. Besides that the developers do research and development in cooperation with the 'low energy' industries. Results of these investigations are very important to determine the feasible level of energy savings. Very important for them is to learn by doing.

3.1.2 **Ávila**

In Ávila stakeholders were involved on different levels in putting together the ambition for the new buildings. The province of Ávila, the energy agency of Ávila, the city council of Sanchidrian, the builder and the professional associates all were involved in the ambition to reduce energy use.

Energy Agency of Avila – City Council of Avila.

The main aim of the Energy Agency is the promotion of energy efficiency and the use of renewable energy sources within the province of Avila. These recommendations will be useful to achieve an energy decrease around the 30% of the energy consumption allowed by the current law.

City council of Sanchidrian.

A reduction around 50% of the energy bill of the new equipments (public lighting systems and green areas) is expected, so the economical motivation is important enough to them. The city council has also political interest.

Builder – promoter of the new urbanisation.

The builder's motivation to reduce the use of energy lies in the economic profit and a better image in the market. Showing its interest in energy efficiency issues is well estimated by the market. Besides that, also in Spain, the future laws on energy efficiency will develop rapidly and the builder can get an advantaged position related to future laws. Apart from the image, he will be able to justify an extra-cost because of the improvement of quality.

Professional associations related with building sector (architects, technical architects, engineering)

The professional associations did not have a direct impact on the ambitions it self, but have to be selected and informed dependent on the level of the ambitions.

Inhabitants

Inhabitants are not an issue, because they are still unknown.

Process and final target

The ambitions are not yet definite, but are estimated in a pre-conclusion on the bases of building type proposals, analysis of measures and pre-discussion about the results of the analysis.

The pre-conclusion shows that 30% saves can be obtained in buildings, 40% saves can be obtained in lighting system and 40% less energy and water demand of green areas.

Tools

Specific tools and methods used to determine the target level:

- CTE: Lider (<http://www.codigotecnico.org/index.php?id=33>)
- Calener: Calificación Energética (<http://www.calener.com/calificacion.htm>)

3.1.3 **Breda**

In Breda the stakeholders found more common benefits than energy savings only, such as better value, higher comfort, respond to environmental issues, the solution of social

issues, lower energy cost, no increase of total housing costs, a better healthy indoor climate and so on. Because of these common benefits the stakeholders set an ambition together in a covenant and worked well together.

The starting-point is the current Dutch legislation (EPC 0,8) and the predicted development of the EPC (2011:EPC 0,60; 2015:EPC 0,40). For now the municipality of Breda wants more than current legislation. For all new dwellings in the municipality they demand an EPL of 7,2, aiming at EPL 7,4. The new climate policy of Breda speaks of a minimum EPL of 7,2. This matches an EPC of 0,6 and is foreseen for 2011. The stakeholders agreed on this for (re)new(ed) build in a covenant in 2005. The emission reduction compared to 2005 is -45% CO₂, when considering heating, cooling, ventilation and lighting.

For existing dwellings there is no legislation. In Breda the stakeholders agreed in a covenant on energy measurements that have a payback time within the lifetime of the energy measure.

The Housing association WonenBreda has a long term agreement with the national government (Covenant, October 2008), with the housing associations umbrella organisation Aedes and with the tenants organisation Woonbond to realise a CO₂-neutral stock of social housing in 2044. They aim to build only CO₂-neutral new buildings from 2015 onwards. Based on this nation-wide agreement also an energy agreement has been drawn up with the municipality of Breda.

The final target for the new dwellings in the local project of Breda is an EPL of 7,4 that will be very likely be realised with heat pumps, low temperature heating and extra insulation. The definitive decision on the techniques has not been taken yet, because the theoretical assumptions for costs and benefits have not yet been confirmed in real offers.

Tools

The most important tools were the calculation methods for calculating the energy performance of buildings (EPN² to calculate the EPC) and of locations (EPL). Both methods were used to record the demands.

The Toolkit sustainable new buildings was used to generate ideas about usable concepts .

The guidelines of ENPIRE were used to check for ideas to enhance the process and the embedding of agreements.

Indoor climate and comfort

The current dwellings had a bad thermal comfort and problems with ventilation. For all stakeholders, the improvement of the indoor climate, the comfort and the quality of the indoor air all were very important aspects.

Current dwellings with serious comfort problems and poor living quality are demolished and new dwellings were built.

² 'Energie Prestatie Norm' NEN 5128 / NEN 2916 Dutch calculation methods to calculate the energy performance of buildings.

3.1.4 Casale

In Casale an energy ambition was reached for class B (<50 kWh/m² /a), environmental protection, waste disposal, water re-use, greening and economic revitalisation

Indoor climate and comfort

Climate and comfort of inhabitants played a main role in planning new kind of buildings while following energy savings and pollution.

Tools

To determine the target level two calculation models were used:

- "TEP Model" for modelling the residential energy consumption of current buildings;
- the "Energy&Building Model", developed by Softech for modelling the energy consumption and saving, including passive contributions, of residential buildings, following the Italian codes.

3.1.5 Dublin

Both stakeholders have a strong concern for the welfare of the low income tenants who will occupy the dwellings. Fuel poverty is an important issue and it was considered essential to limit fuel costs as far as possible. Fingal Co Council also pride themselves in pioneering low energy government housing in Ireland.

The final targets were determined by:

- The additional requirements of new building regulations which were introduced in 2007/ 2008 after building costs for the project were agreed including: a 40% reduction in energy demand and CO₂-emissions associated with heating, domestic hot water and lighting relative to the original design; that a proportion of heat or power be generated from on site renewable energy sources: min. 10 kWh/m².year from solar thermal panels, heat pumps or either biomass boilers or stoves or, min. 4 kWh/m².year electricity from solar photovoltaic or wind turbines.
- Research into what was practically achievable for an existing outdated design based on recent studies by the Energy Research at UCD;
- Assessing what would be affordable within the limited budget and what if any additional funding might be available;
- The desire to set a good example of energy efficient design in new housing construction by exceeding minimum building regulation requirements.

Revised Building Regulations for dwellings were introduced in 2007 after building costs for the project were agreed requiring:

- 40% reduction in energy demand and CO₂ emissions associated with heating, domestic hot water and lighting. (60% by 2010)
- A proportion of heat or power to be generated from on site renewable energy sources: >10kWh/m²/a from solar thermal panels, heat pumps or either biomass boilers or stoves or, > 4kWh/m²/a electricity from solar photovoltaic or wind turbines.

Indoor climate and comfort

Fuel poverty was a particular concern. It was important that a simple emergency back up heating system was provided where the tenants either had been unable to pay bills in time or where the primary system failed. E.g. fire places for burning solid fuels were provided.

Adequate ventilation of dwellings was another concern as tenants often block background vents leading to condensation problems. Passivents were specified.

Tools

Dwelling Energy Assessment Procedure (DEAP) is the Irish official procedure for calculating and assessing the energy performance of dwellings which is an adaption of the UK's Standard Assessment Procedure. It takes account of the energy required for space heating, ventilation, water heating and lighting, less savings from renewable energy technologies and calculates annual energy consumption and CO₂-emissions. It is hoped that PHPP software will be used by to assess energy and CO₂-reductions.

3.1.6 Havířov

The stakeholders are the Municipality of Havířov and MRA, the agency of the municipality. MRA agency has important role because MRA knows the technical and energy situation of buildings. MRA determines the extend of the renovation on the basis of technical state of building and requirements specified in energy audit. Municipality approves of the renovation project and the financing.

Energy efficiency and environmental issues are defined in the strategic development plan of the city and in the territorial energy vision document. Also higher energy efficiency and CO₂-reduction defined as project targets would facilitate the access to subsidies (subsidy program „Zelená úspora“ – „Green saving“).

The final target is based on technical and economical feasibility. One of the main environmental tasks is to reduce emissions due to traffic and local heating technologies

In energy audit a few most suitable renovation projects is evaluated. For each variant the energy savings, investment, NPV, repayment time and emissions savings are evaluated. The most economically efficient project is recommended.

Evaluating the current state of Sorela buildings the total potential of energy savings was determined in extend of 30-40% per building.

Tools

Information system developed in the project ESAM was used as a supporting tool.

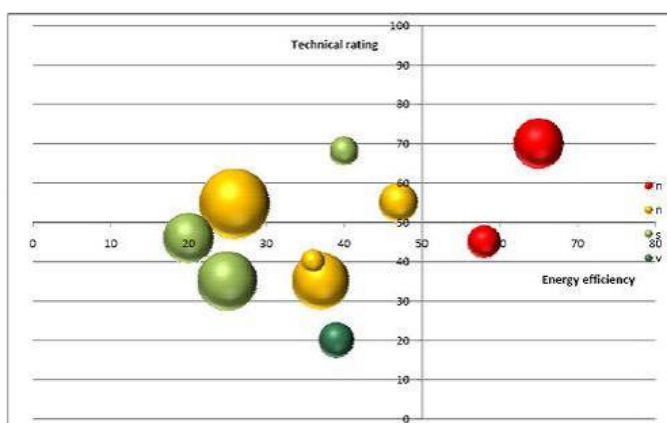


Figure 2 Graphics used in Havířov to present different results, showing In this graph, the colour shows the social performance, the size of the bubble shows the number of buildings. On the abscissa the energy efficiency is shown and vertically the technical performance appears.

Indoor climate and comfort

The indoor climate and comfort is important from the position of the city, because it is one of the targets of the city development strategy. The realisation depends on the level of rentals and available financial sources.

3.1.7 Overview of ambitions in the local projects

Table 3 Ambitions in local projects.

City	Ambition
Albertslund (DK)	Municipality: <ul style="list-style-type: none">- 50% reduction energy consumption buildings in 2020- Conversion energy supply; sun, wind, biomass, etc- Research and development results in possible reductions- Secure buildings for the future- Good economy on the long run for tenants and the municipality- Fulfil visions and CO₂ ambitions
Ávila (ESP)	Energy Agency of Ávila – City Council of Ávila: <ul style="list-style-type: none">- promotion of energy efficiency and renewable energy;- energy decrease 30% of allowed by current law. City Council of Sanchidrian: <ul style="list-style-type: none">- 50% reduction of energy bill of public lighting and green areas;- economical and political interest. Builder – promoter of the new urbanisation: <ul style="list-style-type: none">- economical profit;- better image in the market;- company's advantaged position related to future laws. Professional associations related with building sector: <ul style="list-style-type: none">- member's information.
Breda (NL)	Municipality of Breda / Housing Association WonenBreborg: <ul style="list-style-type: none">- EPL 7,2 (strive for EPL 7,4).
Casale (I)	The municipal building policies act establishes new rules for eco-building and energy saving. In 2001 the General Agreement for the revitalisation of the area from industrial to residential use was signed between the Municipality and the National Government (D.M. LLPP n. 21 del 08/02/2001)
Dublin (IRL)	Stage 1 (mandatory requirement): Improvement of 2005 design to comply with revised 2008 regulations (40% improvement relative to 2005). Stage 2 (non binding covenant): A further 25% improvement relative to 2008 regulations.
Havířov (CZ)	For MRA and municipality is priority to preserve technical state of buildings. But the refurbishment is always done complex, which means it solves both the technical defects and the energy efficiency of the building. The energy is secondary criterion because the owner does not have contribution from it. Energy retrofitting strategy corresponds to recommendations from EA.

CONCLUSIONS AMBITIONS

Energy

The level of ambition will depend on the estimated effort, knowledge and financial support and/or financial construction that is available in the project team. Technical and financial feasibility is of course very important. Subventions are not very widely available.

The level of reduction is usually related to the level of the current level of energy performance of new buildings. The percentage of reduction in the formulated ambitions is in the order of 30-40%.

In Breda the Municipality made a deal with the tenants that the housing costs would be guaranteed at maximum the same level. In that way investments could be financed by higher rents and the lower energy bills would keep the housing cost at the same level.

It is not totally clear for all ambitions which energy flows are involved (heating, cooling, domestic hot water, appliances, lighting), whether reduction on primary energy is meant and in what unity the energy use is expressed (kWh/m², MJ/m², a relative number compared to a reference value (EPC, EPL) et cetera). Besides that the climates and local circumstances are totally different, so it is very difficult to compare results and ambitions between projects.

Tools

Calculation tools are used everywhere to evaluate energy use, investments, exploitation costs, et cetera. Each country has its own tools and no tool was used in more than one country. The exact input and output of each tool is not known. Only Breda (NL) uses a tool that combines the energy use of buildings and of the total project location (EPL).

Indoor climate

Indoor climate and comfort are important factors, especially when looking at renovation.

A possible "rebound effect" that has to be taken into account in this respect, is that the demand for energy in a household may increase after the comfort level has been improved. Examples are a higher indoor mean temperature of the dwelling or a higher use of domestic hot water. These effects have to be taken into account when calculating the realised energy and CO₂ emission reductions.

The indoor climate can become a problem when energy measures are not well implemented. Problems with damp and rot are well known.

In some cases indoor climate and comfort are not discussed explicitly with future tenants in new buildings.

3.2 Agreements and guarantees

To formulate an ambition for realising low energy dwellings is one thing. To make it really happen is the next thing, and that is, as often can be seen, not easy. It is therefore very important to record the ambition in an agreement. The agreement will be more effective when the goals are clearly defined, when there is also an agreement on the way partners cooperate and communicate and when legal and financial parameters have been discussed and largely been agreed on.

The agreement should really be focused on the goal itself and on the process to get there.

3.2.1 **Albertslund**

Albertslund has focused on the environment and had active policy for a long period of time. They are certified to ISO 2001 standards, they do green accounts every year and they have local Agenda offices to guide the citizens. As the local government is chosen democratically, we can assume that the majority of the inhabitants of Albertslund support this approach. This makes a strong combination because the deciding party and the supporting parties all want to achieve the same goals, as far as environmental issues are concerned.

Except for the pilot project, there is not a signed agreement yet. This is expected to be a problem, because all parties are focused on realising low energy renovation in Albertslund.

Tools used

The developing parties used the ENPIRE guidelines on 'Process and on Embedding Agreement' to structure the process.

3.2.2 **Ávila**

There were many problems due to the fact that nobody wanted to have an obligation in the agreement, so the energy agency decided to propose a voluntary agreement.

There is not a guarantee to fulfil the agreement because of this voluntary character. An interesting point is though, that if the promoter assumes an improvement of the energy qualification, there will be an inspection by the regional administration in order to certify that the improvements foreseen in the project are real.

The agreement has a reference of the ambitions established.

3.2.3 **Breda**

The Municipality of Breda stimulates energy efficiency and overall quality in new buildings and restructuring of neighbourhoods by demands in the New Climate Policy Breda and the Report Quality Living (Nota Kwaliteit Wonen). These documents must be used in all development plans with dwellings in the municipality of Breda.

Besides these documents, complementary agreements can be made in covenants (voluntary) or directly with inhabitants for example. In the local project of Breda the housing costs, being the sum of the rent and the energy costs, was a very important issue. The municipality and inhabitants made an agreement in which the municipality guaranteed that the housing costs would not rise after renovation, after which the inhabitants agreed on the low energy approach in the project. Very important principals in the Netherlands are the permission to raise the rent after energy measures and subsidies on rent for people with low income. Apart from that an energy covenant has been signed by the Municipality of Breda and the housing association WonenBredburg, committing to reach 45% CO₂ reduction in retrofitting / refurbishment operations before 2015. A covenant is a voluntary agreement, without consequences if goals are not reached.

There is no guarantee that the goals will be reached, but the chance that these goals will be reached are considered high, because all stakeholders have many mutual interests:

- constant total housing costs, higher comfort;
- positive publicity;
- the main stakeholders work well together and trust each other;
- the goals are financially achievable;

- well known energy saving techniques are used;
- a level playing field has been created, because the regulations (New Climate Policy Breda and the Report Quality Living) concern all parties in the municipality.

3.2.4 Casale

The main agreement was the "Neighborhood Contract" signed between the Municipality of Casale and the Consortium of Building Developers of the Alessandria Province. Based on this General Agreement, the Municipality of Casale signed single Project Covenants with each stakeholder.

The CO2 abatement at least 30% below the current limits was implicit in the agreement of reducing energy consumption below national regulation.

It was necessary to sign covenants with all building companies to get guarantees of respect the ecological rules and standards of the entire project.

3.2.5 Dublin

A non binding, aspirational ambition has been agreed as follows:

"Within the project we have the ambition to achieve a reduction in CO2 emission of at least 25% compared to the Irish Building Regulations. An energy vision study will be conducted to identify available options to achieve this ambition level. On the basis of the study results a decision will be made which improvements can be implemented, given budget and planning limitations."

The ambition will be realised in two stages.

- Stage 1 (40% improvement on 2005 regulations) is mandatory and therefore guaranteed. DEAP software will be used to check.
- Stage 2 a further 25% improvement cannot be guaranteed due to funding difficulties resulting from the global recession.

3.2.6 Havířov

At the present time there is no legal contract, no agreement. This is a matter of discussion among the stakeholders. A voluntary agreement can be achieved.

There is not much experience in this field. It is assumed that a corresponding know how is transferred from other EU countries and implementation guidelines will be elaborated.

CONCLUSIONS AGREEMENTS AND GUARANTEES

All agreements in the project are made on a voluntary basis.

A good set of embedding agreements is very important for successful low energy projects.

The agreement will be more effective when the goals are clearly defined, when there is also an agreement on the way partners cooperate and communicate and when legal and financial parameters have been discussed and largely been agreed on.

The chances for realisation of the ambition will be considerably higher when stakeholders look for other common interests than energy alone. Examples are estate value, comfort, environmental issues, solution of social issues, energy cost, healthy indoor air, publicity.

4 Energy options

Now the ambitions of every local projects are known, the search for energy saving options begins. These options can be looked for in the buildings itself (insulation, low energy ventilation system, low use of electricity), the individual heating system and in solar systems (photovoltaic, solar boilers) or in measures on a higher scale, such as collective heating systems that use residual heat or biomass.

These measures have to be chosen and be put together into useful energy options. Every energy option has its own merits (energy use, financial consequences, effects on comfort and/or air quality).

The possibilities have to be made, discussed and eventually chosen.

4.1 Deciding on energy options

Energy options materialise the ambitions in the project. Many energy measures and combinations of energy measures are possible. Each measure has its own quality in terms of energy saving, effect on comfort, quality of the indoor air, investment, complexity, user-friendliness et cetera. The process of finding the right energy options for a low energy project is complex.

In low energy projects the combination of energy measures is especially difficult, because the techniques are often relatively new and the extra energy saving quality will only be realised if the different techniques fit well together. New techniques are often relatively expensive and unknown (investment, maintenance, conditions for use, effect on energy saving (and thus energy costs), indoor air, et cetera).

The process of deciding on the right energy measures needs a lot of knowledge about energy measures and financing.

In ENPIRE the local projects used ENPIRE guidelines to guide this process.

4.1.1 Albertslund

In Albertslund three very motivated stakeholders wanted to reach the level of low energy class 1. The discussions were not so much about what energy measures would be necessary. More important was the assumption that class 1 had to be reached and the trust that measures could be financed and thus will be realised. At least in the social housing areas they think they can reach the level of low energy class 1 and get it approved by the tenants.

The private housing situation is not yet solved. There is a constant dialog and in the end they will reach a level where energy level is balanced with economy.

The ambitions on CO₂-emissions and energy use have not been modified.

Ávila

The stakeholders look at the project with optimism. Some of the stakeholders have little experience with low energy buildings and were surprised by the fact that simple actions could have so a positive impact in the reduction of energy consumption.

The energy efficiency measures proposed to the promoter have been studied in the dwelling with the energetically most unfavourable building. This is the dwelling with the lowest solar gain, that has, once constructed, the longest face orientated to the north (easterly or westerly north).

During the process, the meetings have not been held with all stakeholders together, but in a separate way, were the energy agency had a joint role amongst all the stakeholders involved.

The ambitions on CO₂-emissions and energy use have not (yet) been modified during the project. Proposed energy efficiency measures will be analysed and the promoter will decide which one to implement, if there is any (voluntary agreement).

The planning process of the project was different from what is customary in Spain, because the introduction of energy issues after the project's design is unusual. Energy issues and considerations are introduced during the design phase of buildings.

4.1.2 Breda

In order to achieve the low energy goals, a three-step strategy (Trias Energetica) is followed:

1. Reduce energy demand, mainly through the reduction of energy losses;
2. Use energy from sustainable sources;
3. For the remaining energy demand: efficient use of fossil energy.

In addition to this strategy flexibility for the future integration of (new) sustainable energy sources is important.

The choice for a certain energy-infrastructure is decisive for the possibility to transport and therefore use energy from renewable sources. The traditional Dutch natural gas infrastructure cannot easily be made to transport renewable gases, whereas a heat grid can transport heat from any heat source.

In the process of finding suitable energy measures, the most promising (renewable) energy sources are selected and a number of energy concepts for the planning area (dwellings) were composed. These concepts were compared on criteria like energy performance, energy consumption, CO₂-emission, investment, user costs and comfort.

The renewable energy sources have been compared on general criteria like local availability, scale and environmental gains, see table. The most promising technologies are then used for further analysis for use in the project area.

Table 4 Illustration of the way Breda compared renewable energy sources.

Technology	Assessment
Photovoltaic cells	Suitable, relatively costly, attractive feed-in subsidy available
Solar thermal energy	Suitable
Wind energy, small scale	Less suitable: low yield in built environment, limited height of buildings, in development
Geothermal heat pump (depth ca 20 tot 120m)	Potentially suitable, depends on local soil conditions. Preferably collective system with open ground water source. Threat: local soil contamination.
Biomass	Large-scale CHP not possible because of small scale, environmental regulations and planning. Chance for small-scale (CHP) pellet stoves. Disadvantage: environmental permit necessary, storage room.
Waste heat / large-scale CHP	Not available in vicinity, project too small to connect to current heat grid
Local combined heat & power (CHP)	Less suitable because of small number of full load hours and relatively small environmental advantage
Geothermal (depth ±2 km)	Not available in vicinity, scale of project too small for new initiative
Hydro power	Not available in vicinity

Comparison of energy concepts

In the local project of Breda several realistic concepts for the housing plan have been composed. The concepts are a combination of energy saving measures and (renewable) energy technologies. The reference option (current regulations) has good thermal insulation, efficient natural ventilation, low-temperature floor heating, efficient condensing boiler for heating and domestic hot water and a natural gas infrastructure. Five concepts were designed to be compared with the reference situation.

The energy concepts are compared on a number of criteria. The quantitative comparison is represented in the following table.

Table 5 Illustration of the way Breda compared different energy concepts.

Parameter	Reference	Variant 1 energy efficient + solar boiler	Variant 2a individual geothermal heat pump	Variant 2b collective geothermal heat pump	Variant 3a individual geothermal heat pump	Variant 3b collective geothermal heat pump	Variant 4 collective solar boiler
Primary energy [kWh/m ² .year]	74	51	46	45	31	32	34
EPC [-]	0,78	0,55	0,51	0,50	0,39	0,40	0,42
CO ₂ -emission [kg/m ² .year]	15,3	10,4	11,5	10,9	7,8	7,6	7,0
Investment per residence [€]	6.250	12.900	13.850	10.850	16.250	13.250	19.100
User cost [€/year]	1.074	857	667	1.072	490	908	968

The ambitions on CO₂-emissions and energy use have not (yet) been modified during the project.

The planning process of this project was not that different from what is customary in the Netherlands. The possible difference is the energy study, that is common in the Netherlands but not obligatory.

There is good cooperation between the Municipality of Breda and WonenBreda.

4.1.3 Casale

The Consulta of Building Promoters in Alessandria Province is an association of building companies that occupies an important role in studying and experimenting for energy saving techniques, so the stakeholders play themselves the role of promoting eco-compatible kinds of small buildings and flat blocks.

The decision making process has proceeded due to the presence of standards for regulation in funding, the presence of the authorities, which have had a continuous control.

Moreover there is a strong political will of going on and improving the environmental scenario of the area.

Provided that levels of insulation are better to the new regulatory Italian levels getting the 50 kWh/m²y, the extra passive solutions provide a further 30% abatement

At the moment no changes were made to the project since the initial stage.

The planning process our project was different from the common planning in public administration. The workshops have been an example of "best practice" dissemination.

The Design Ateliers, organised with the participation of city officers, local professionals (architects and engineers), organised in 3-4 design tables, had the role of revising the selected project, with the participation of local designers, developers, builders.

4.1.4 Dublin

Several options for reducing primary energy consumption and CO₂-emissions were discussed with University College Dublin (NUID) Building Research Group and technical solutions were discussed with the project's engineers and consultants.

For the Stage 1 ambition (40% improvement on 2005 regulations,) Solar Thermal systems were considered to be the most appropriate, cost efficient and least disruptive technology to install in the majority of dwellings at the advanced construction stage of the project.

Evacuated collector tubes were chosen rather than flat plate collectors since they are more suited to the Irish Climate, operating better in overcast conditions (flat plate collectors rely more on direct sunlight). Evacuated tubes are also much less dependent on orientation than flat plate collectors which was important for Tyrrellstown where the majority of houses have east and west facing roofs.

The Stage 2 ambition, a further 25% improvement on 2008 regulations was considered more difficult to achieve with the existing design and may need to be reduced due to funding and practical difficulties. Options under consideration are:

- Provision of shelter belt (tree) planting to reduce wind speed and permeability of cold air into dwellings;
- Installation of sealed stoves in open fire places;
- Provision of internal shutters to windows to reduce heat losses at night;
- Provision of external shading devices to reduce overheating in summer;
- Use of trombe walls and improved cross ventilation in apartments to take maximise solar gain;
- Provision of additional insulation to apartment party walls shared with common areas;
- Reduction of areas of north facing glazing to common stair cases, replace with more insulating 'Oculux' or 'Kalwall' for example.

4.1.5 Havířov

The project is not far enough to fill-in this part of the local project.

CONCLUSIONS DECIDING ON ENERGY OPTIONS

In most local projects there was enough information about energy measures and their consequences.

All local projects consider energy saving options on building level.

Possibilities for saving energy or reducing CO₂-emissions through measures outside the building, for example by applying collective installations with sustainable energy carriers, are seldom considered.

Ambitions on CO₂-emissions have not been changed during the process on choosing the energy options. This may be caused, at least partly, by the fact that most projects haven't reached the building phase.

Financial aspects are extremely important for all partners in the process. Subjects like investments, subsidies, maintenance and energy costs, financial constructions have to be dealt with. Especially the interests of the different partners in the process all have to be considered. The problem of split incentive for example that is a subject in many projects have to be solved.

4.2 Promising energy measures

4.2.1 Albertslund

From the start of the project a low energy class 1 was aimed at (50% reduction compared to current regulations). In renovation projects it is difficult to reach low energy class 1. Despite the fact that the final economy and budget of the project are still not definite, the stakeholders are optimistic about realising low energy class 1 dwellings. The next energy measures seem to be promising:

- Prefabrication of wall insulation units;
- Prefabricated solar prism which for example can provide the existing building with PV, solar collectors, windows or room for installation of technical equipment that update the building;
- Low cost ventilation systems;
- New products that can be used and will be available when working with the building industry: Danfoss, VELUX, Rockwool, different contractors.

4.2.2 Ávila

Introducing any of the energy efficiency measures that will be proposed dwelling to be constructed might get a better energy qualification than the initial one: qualification C. Promising options proposed to the promoter:

1. Improvement of thermal layer (windows, walls, roofs...):
New Energy qualification of dwelling: B / Energy & CO₂-emission saving: ≈ 14%
 - Low emissive glass (4-12-6) in each window of the building;
 - Change of extruded polystyrene insulation, from a coefficient of 0,037 W/m²K, for another type with lower coefficient of 0,029 W/m²K;
 - Increase the thickness of the roof's insulation by 1 cm.
2. Improvement of heating equipment and heat distribution systems: Central heating
New Energy qualification of dwelling: B / Energy & CO₂-emission saving: ≈ 14%
 - Radiators are changed by radiant floor;
 - Standard heaters are changed by condensation heaters.
3. Improvement of heating equipment and heat distribution systems: Renewable boiler
CO₂-emission saving: ≈ 61%
 - Change of conventional fuel boilers for ones that use locally produced biomass. Biomass is widely available in the area.
4. Improvement of thermal layer + Central heating
New Energy qualification of dwelling: B / Energy & CO₂-emission saving: ≈ 24%
 - Combination of Action 1 (Thermal layer) + Action 2 (Central heating).
5. Improvements of the interior lighting by use of:
 - low consumption lamps instead of incandescent lamps;

- fluorescent lamps with electronic ballast;
 - compact fluorescent lamps in the kitchen;
 - LED's in interior lightning.
6. Improvements of the exterior lighting by use of:
- high pressure sodium lamps;
 - light flux regulator for exterior lighting system;
 - an astronomical clock;
 - solar lamp post.
7. Replace of non-potable water by rainwater.
Water savings: ≈ 50% approximately

All the energy efficiency measures proposed above have been studied in terms of energy and economics and will be proposed to the promoter. He might apply to the design on buildings those ones he considers according with his criteria.

Table 6 Illustration of the way proposed energy measures in Ávila..

PROPUESTA EN PROYECTO	PROPUESTA DE MEJORA	ESTUDIO ECONÓMICO – ENERGÉTICO						CALIFICACIÓN ENERGÉTICA	
		Consumo combustible (kwh/m ²)	Emissiones CO ₂ (kg CO ₂ /m ²)	Ahorro anual de combustible (kwh/año)	Ahorro económico	Sobrecoste	Amortización (años)		
Vidrio doble 4-8-4. Transmitancia= 2,91 w/m ² ·K Poliestireno expandido de 0,037 w/m·K	Vidrio bajo emisivo 4-12-6 Transmitancia = 2 w/m ² ·K Poliestireno expandido de 0,029 w/m·K	PROYECTO ORIGINAL	108,80	25,00	1.719,01	85,09 €	941,00 €	11,06	En Proyecto C
		MEJORA DE LA ENVOLVENTE	94,90	21,80					Con mejoras B
Caldera convencional de gas natural Radiadores como elementos terminales	Caldera de condensación de gas natural Suelo radiante como elemento terminal	PROYECTO ORIGINAL	108,80	25,00	1.941,62	96,11 €	888,00 €	9,24	En Proyecto C
		MEJORA EN CALDERA Y ELEMENTOS TERMINALES	93,10	21,80					Con mejoras B
Envolvente térmica, caldera y elementos terminales de las dos situaciones de partida anteriores	Envolvente térmica, caldera y elementos terminales de las dos propuestas anteriores	PROYECTO ORIGINAL	108,80	25,00	3.363,82	166,51 €	1.829,00 €	10,98	En Proyecto C
		MEJORA ENVOLVENTE Y SISTEMA DE CLIMATIZACIÓN	81,60	19,10					Con mejoras B
Caldera convencional de gas natural	Caldera individual de pellets	PROYECTO ORIGINAL	108,80	25,00	-2.250,79	- 111,41 €	2.390,00 €	--	En Proyecto C
		MEJORA DE LA ENVOLVENTE	127,00	9,70					Con mejoras A

4.2.3 Breda

The most promising option is the option with better thermal insulation and a low temperature heating system with an electric heat pump for heating and cooling. The energy and CO₂ performance are very good and the user cost are relatively low.

The implementation of a collective heating or cooling system may have consequences for the urban area development plan. Collective options have to be studied in the early stages of the development process.

The most important bottlenecks are that these techniques are less suitable in current dwellings and that soil has to be suitable for storing heat and cold. Current soil pollution can be a bottleneck. This will be subject of further investigation.

4.2.4 Casale

The ecologic village includes the following:

- High standard passive solutions: greenhouses and solar collectors on dwellings;
- Adoption of PV modules for dwellings electricity needs;
- Use of rainwater for irrigation, reduction of water flows, use of grey water;
- Waste management, waste island;
- Reduction of electromagnetic fields with installation of circuit breakers in bedrooms.

4.2.5 Dublin

The most promising option with corresponding reduction potentials seem to be the introduction of renewable systems including solar thermal collectors for individual dwellings and apartments.

Initial results will be presented shortly in a feasibility report including cost information.

The final options have the stage 2 ambition have not been selected yet. The main bottleneck will be funding.

4.2.6 Havířov

In Havířov the measures are known on a detailed level:

- insulation external walls 100 mm, roof 100-120 mm and basement ceiling 60 mm;
- new windows with $U = 1,4 \text{ W/m}^2\text{K}$ and new entrance doors $U = 1,4 \text{ W/m}^2\text{K}$
- adjusting hydraulic balance of heating system;
- energy saving indoor lighting;
- energy conscious behaviour of the tenants will be educated through leaflets.

RES are not locally available.

CONCLUSIONS PROMISING ENERGY MEASURES

Most energy options are on building level: higher insulation level, better glazing, better ventilation system (not always considered), more efficient heat production.

Energy options considering the energy grid or collective sustainable techniques are not considered in most of the local projects. Such techniques can be a very good solution for very low energy projects.

Others than the traditional power company, as the housing association Wonen Breburg in Breda (NL) for example, can take over the exploitation of collective heating and/or cooling systems.

Energy saving on lighting is an option but will be dependent on preferences of the inhabitants, so its effects are more uncertain.

In agricultural areas biomass could be an option, like in Ávila.

Sometimes attempts are made to stimulate energy conscious behaviour of tenants.

Financing the investments is the main bottleneck. The low rent in rentals is a problem if this can't be raised. The split incentive problem must be solved. In Breda for example the municipality and the tenants agreed on constant housing costs (rent + energy costs).

5 Implementation of energy options

Implementation of energy options is very important, because for a chosen energy option the real energy use depends on the way it is constructed, installed and used. Inspection on the building site could generate information on the process of constructing and installing. Monitoring gives information on the way the energy options function.

There is no local project that has reached the implementation phase. The local projects of Albertslund, Breda and Havířov have ideas about monitoring the energy use of the project.

Table 7 Implementation of energy options in the local projects.

City	Implementation energy options
Albertslund (DK)	Two apartments have finished in Bjørnenskvarter.
Ávila (ESP)	No implementation of energy options yet and no monitoring foreseen.
Breda (NL)	No implementation of energy options yet.
Casale (I)	No implementation of energy options yet. Dwellings will be equipped with heating measuring systems. Data are managed by a central unit that provides both heating distribution and energy counting. The energy use will be measured and the energy savings and the CO ₂ -emission reduction will be calculated.
Dublin (IRL)	Installation of solar panels will commence shortly.
Havířov (CZ)	The buildings themselves – envelope+ heating + HDW efficiency.

5.1.1 Breda

WonenBreborg will exploit the heating system themselves and therefore they are a small power company for their own small collective systems with heat pumps. They will sell heat to their tenants and know the energy use of their dwellings. Because of that, they also have a notion of the realised energy savings.

5.1.2 Havířov

The achieved reductions will be monitored through MRA SW tool. Energy consumption data from the past years of all buildings chosen for the project are available. They will be exported from the database and compared with new data obtained after the energy efficiency upgrade of the buildings.

CONCLUSIONS IMPLEMENTATION

The local projects in ENPIRE have not reached the phase of realisation and therefore can not give information on the implementation of energy options. Two projects have plans to monitor the energy use, which will provide useful information in the future.

6 ENPIRE Guidelines

Two draft guidelines that have been produced in the first phases of the ENPIRE project: Draft guidelines on process (WP3, D08) and Embedding agreements (WP5, D09).

Those draft guidelines have been used in the local projects. This paragraph describes shortly in what way the guidelines have been used and how the guidelines can be improved. This input will be used to finish the guidelines.

6.1.1 Albertslund

It has mostly been used as inspiration and to add points to local development in Albertslund

I think it is good guidelines in the process of focus on energy optimising in a large building retrofit project.

The guidelines must be written in a way that they can easily be adapted to the local process.

In Albertslund we have a situation where the municipal has the ambitions and leadership on energy reduction. So the context is defined and it can be difficult to introduce other guidelines and methods.

6.1.2 Ávila

The guidelines about Embedding Agreements were taken into account.

The main difference between the process meetings according to the guidelines and in the local project of Ávila was that in Ávila there were no central process meetings. Meetings were held separately with the different partners, where the energy agency was the connecting party.

Another difference is that in Spain professional associations are the main actor in the process.

6.1.3 Breda

In the project the draft guidelines on Process and on Embedding Agreement are used as a check for ideas and forgotten elements.

The search for mutual interests between partners in a project is a very important element to enhance the chances of also realising high ambitions. Also making agreement with the developers and social housing companies on a local level is important.

6.1.4 Casale

From the draft guidelines, the settings starting from Embedding Agreement were extrapolated.

In particular the approach to Local WP6 project, showing the steps for developing a project.

The draft guidelines on Process and on Embedding Agreement were useful for setting up a new procedure, based on collaboration between various partners and the application of new technologies.

6.1.5 Dublin

In accordance with the Guidance in the Embedding Agreement, a preliminary meeting with NABCo was arranged to discuss the formulation of a new policy and guidance (or vision) document for the Association which could be distributed among their numerous smaller member groups nationwide.

It is too early in the process to provide feedback at this time.

6.1.6 Havířov

The guidelines are followed . The vision document has not been finalised yet.

It is too early to judge upon these guidelines

CONCLUSIONS ENPIRE GUIDELINES

Guidelines have been used as an inspiration.

Guidelines have not been used literally, but useful parts have been taken out. Examples are the structure of the report summary of the local projects, presentations of de the local projects, this report, the stakeholders involved in the several processes et cetera.

Some projects were in the early stages of the process and haven't been able to use parts of the guidelines for the simple fact they hadn't reached the accompanying phase.

Improvements could be made to adjust the guidelines to the target group. Now the guidelines are in the form of a presentation, whereas it could be a nice folder or brochure, which also could be a digital one.

7 Lessons learned

7.1.1 Albertslund

Albertslund focuses on the process and the stakeholders. From other projects they know that the involvement of partners and a clear process are important. The guidelines can be helpful in this process.

Another important lesson learned is to ensure that the project is well financed through ESCO models.

In the projects has been a focus on making sure that the energy efficient solutions were integrated in the existing building. Even though the focus was on integrated solutions the two first finished projects had some minor mistakes with badly placed ventilation ducts.

7.1.2 Ávila

Economical issues have a main importance to choose what options have to be considered
Voluntary agreements are well accepted by everybody

Use of the software developed by the Housing Minister and therefore only valid for Spain.

7.1.3 Breda

An energy study considering energy and CO₂ reduction measures on all levels (surroundings -> buildings) and reporting relevant parameters (investments, user cost, energy use, CO₂ emissions, EPL (NL), et cetera) generate a broad range of ideas to meet the ambition. The chance that a good solution will be considered and realised are higher.

The choice for well known techniques improve the chance of realisation.

Also check the consequences of choices over longer periods of time. Predicted effects in 5 years, 10 years, 20 years, et cetera.

If there is also attention for common gains of the stakeholders (including neighbourhood groups), there will be more common interest to realise the project and the chances of realising the project are bigger.

A good project manager is very important.

It is relevant to clearly formulate the cooperation between parties in projects and subprojects in the total site development. Because of the long span of the total site development (5-20 years), private parties can withdraw.

In renewed build areas with remaining street patterns, the possibilities for energy measures that depend on sun orientation are possibly limited.

Control of total housing costs.

Exploiting your own energy system can open more possibilities for energy systems. The extra you get is monitoring information.

This project is an example for the rest of WonenBredburg. The approach is not common within the organisation. A successful application of this project could persuade the board of WonenBredburg to make this is common approach for more similar future projects.

Low temperature heating makes the heating system suitable for many techniques including techniques that use renewable energy (solar, ground, et cetera).

The local authorities can stimulate energy saving projects by responding to future developments of energy legislation.

Combine energy ambitions with other, often directly linked issues as comfort, a healthy indoor environment and improvement of living quality.

In this project the energy investments will be (partly) financed by raising the gross rent of the dwellings. For tenants the total housing costs will not rise because of the 'Woonlastengarantie' (the Municipality of Breda guarantees no rising of total housing costs).

The energy studies must be executed in the early stages of the project, because collective systems must be dealt with in the urban area development plan.

7.1.4 Casale

The ability to collaborate and integration among services can help achieving savings of natural resources and materials and improving the urban quality of life.

In order to develop on a large scale, projects should be implemented within a common methodology for planning, supported by local regulations, such as local building regulations, providing for reductions in charges for eco-buildings. Some Italian local Authorities are operating in such conditions. A change in citizens perception, supported by the cost reduction of eco-technologies in the market.

7.1.5 Dublin

It is too early in the process to draw any conclusions.

- We hope to incorporate our approach into a standard policy document for use by NABCo's numerous member groups comprising of cooperative and self build groups as well as for use by other similar housing associations.
- Simplicity will be important and other construction types will need to be considered.

7.1.6 Havířov

It is important to define the needs and interests of all stakeholders. The embedding agreement should help to set up clear ambitions and to define the role of each actor. The ability of partners to co-operate would be beneficial for the whole area in terms of energy savings, CO₂-reduction and improvement of the quality of life.

Agreements can be established only on a voluntary basis. In case of the Czech regulated rental sector the investments in energy efficiency measures and CO₂-reduction cannot not be paid back through increased rents. The local authorities have limited possibilities to stimulate energy saving projects. Future developments in local energy legislation are expected especially in relation to the subsidy programs like "Zelená úsporám" and in the regulated rental housing policy.

CONCLUSIONS LESSONS LEARNED

A good project manager and involvement of partners is essential for realising higher ambitions.

A clear process is essential. Make sure everybody in the process has the same focus and ambition and have interest in realising this ambition.

Financing and economical issues define what energy saving options can be seriously considered.

Pay attention to the building process to avoid mistakes in the realised buildings.

Choosing well known techniques improves the chance of realisation.

Voluntary agreements are acceptable as instrument to realise higher ambitions.

Ambitions in the participating countries are hard to compare because of different calculation models and performance indicators.

In case of renovating or building rented houses, the problem of split incentive must be solved. It has to be subject in the beginning of the process. Some projects dealt with this problem successfully.

Energy studies should be focussed on more aspects than energy alone. Aspects like economics (investments, financing, energy costs, raised value (in case of renovation)), indoor air quality, comfort and even social aspects should be made clear for the different partners in the process and for different possible solutions. They are important factors in the decision making process.

Introduce aspects on a higher scale than the building itself (local aspects) in the earliest stages of the project. It can provide other or better solutions for energy saving or CO₂-reduction. In most projects the focus has been on energy saving measures on building level. This means that this aspect needs extra attention.

Check long term effects.

Investigate possibilities for different forms of exploiting the energy system.

Take future regulation into account when planning new buildings over longer periods of time.

Low temperature heating is a measure that makes the heating system suitable for many techniques including techniques that use renewable energy (solar, ground, et cetera).