European Union Committee of the Regions

The use of renewable energy sources and measures to boost energy efficiency - significant contributions at local and regional level to combating climate change

CDR/ETU/20/2006/

December 2007
# Table of Contents

Table of Contents ........................................................................................................... i
Scope and Content of the Report ....................................................................................... iii
Executive Summary ........................................................................................................... v

1. Introduction .................................................................................................................. 1
   1.1 Background and Objectives of this Report ......................................................... 1
   1.2 Study Approach and Methodology ....................................................................... 2
   1.3 Structure of this Report ....................................................................................... 4

   2.1 Renewable Energy Sources ............................................................................... 7
       2.1.1 European Policy ....................................................................................... 7
       2.1.2 Situation of Renewable Energy in the European Union ........................... 8
       2.1.3 Progress in Various Technologies ............................................................ 12
   2.2 Energy Efficiency ............................................................................................... 17
       2.2.1 European Policy ....................................................................................... 17
       2.2.2 Energy Efficiency Situation in the European Union ............................... 18
   2.3 Contributions from Local and Regional Authorities to Combating Climate Change ........................................................................................................... 20
       2.3.1 The Role of Local and Regional Authorities ............................................. 20
       2.3.2 Good Local and Regional Examples ......................................................... 21
       2.3.3 Contribution from Local and Regional Authorities ................................. 23

   3.1 Analysis of the Energy Efficiency Projects ......................................................... 71
   3.2 Analysis of the Renewable Energy Projects ...................................................... 84

4. Conclusions and Recommendations ......................................................................... 93
   4.1 Conclusions ......................................................................................................... 93
   4.2 Recommendations for Replication ..................................................................... 95

5. References ................................................................................................................ 101

6. Annexes .................................................................................................................... 105
SCOPE AND CONTENT OF THE REPORT

This document constitutes the final report in the framework of the study “The use of renewable energy sources and measures to boost energy efficiency - significant contributions at local and regional level to combating climate change - CDR/ETU/20/2006”, carried out by BIO Intelligence Service (BIO) for the European Union Committee of the Regions in 2007.
EXECUTIVE SUMMARY

- Background and objectives of the project
Local and regional authorities (LRAs) can play a key role in the energy sector, often both as producer/supplier and consumer of energy. In their role of planners and regulators, they can set the framework to promote energy-efficient products and services and renewable energy. LRAs can also influence energy demand by informing and motivating end-users as to how they can use energy more efficiently. Some effective plans developed at local and regional level for reducing energy consumption and the emission of greenhouse gases (GHG) are successful examples that can be replicated elsewhere.

The European Union Committee of the Regions launched this study on the contribution by local and regional levels to combating climate change through the use of renewable energy sources (RES) and measures to boost energy efficiency.

The main objective of this study was to analyse successful cases of LRAs promoting renewable energy and energy efficiency in different European Member States (MS), in order to identify key factors behind their success.

- Methodology
For this purpose, 10 different case studies, 5 each for energy efficiency and renewable energy use, were selected and analysed in detail.

The case studies had
- to be concretely applied;
- to be recent (completed after 2000);
- to be led by local or regional authorities;
- to cover a variety of climatic, demographic, and economic conditions;
- not to be already included in existing compilations of case studies at European Union (EU) level;
- to include (for each group of five projects) at least one case study involving a local or regional authority in a new MS of the EU; and
- to include preferably an information dissemination or public awareness step.

Information in each case was collected by means of questionnaire and telephonic interviews with relevant contacts. After the analysis of each case study, they were compared among themselves, and with the situation at national and European level, in order to identify best practices when planning and implementing energy projects at local and regional level. Conclusions and recommendations were drawn from the analysis.
Case studies
The five case studies promoting energy efficiency include an energy management programme in public buildings in Kuopio (Finland), building refurbishment in three hospitals in the region of Skåne (Sweden), public lighting improvement in the town of Gödöllő (Hungary), the construction of a public secondary school using the French concept of “Haute Qualité Environnementale” (HQE) in the city of Mirecourt (France), and the construction of a holiday village following the concept of “passive housing” in the federal state of Schleswig-Holstein (Germany).

The five case studies promoting renewable energies include a project using solar energy at the council offices in Český Krumlov (Czech Republic), the implementation of a biomass district heating plant in Las Navas del Marqués (Spain), building refurbishment with combined heat and power and solar thermal plants in social housings in Frankfurt am Main (Germany), the implementation of ground source heat pump (GSHP) systems in farmhouse properties in Aberdeen (United Kingdom), and the pilot implementation of biodiesel mixtures in public buses in Crete (Greece).

Results
Energy Efficiency
In general, energy efficiency projects are perceived by LRAs as an opportunity to reduce energy consumption and thus the electricity bill. The specific motivations for carrying out the energy efficiency projects were different in each case study, depending on the local or regional context.

In the five case studies presented in this study, the LRAs participated in the financing, planning, and decision-making process of the project. In three of the case studies, there was a close co-operation with national, regional or local energy agencies, which highlights the important role that these organisations play in assisting LRAs when implementing this type of project.

In all the case studies analysed, preliminary analyses were conducted in order to determine the feasibility of the proposed actions. The results of these preliminary analyses helped to define better the objectives of the specific project and to minimise problems during the implementation phase.

Private companies intervened at different phases of the analysed projects. In one of the case studies, a public-private partnership (PPP) and an Energy Performance Contract (EPC) were established. EPCs are generally perceived as a complicated process, mainly due to the inexperience of LRAs in applying this innovative method for investment financing.
When carrying out energy efficiency projects, it is useful to monitor in quantitative terms the progress made in energy management. The results can allow local and regional governments to evaluate their achievements and decide on the further actions needed.

All five selected case studies were well-accepted by the main beneficiaries and the general public. Three of the case studies illustrate the importance of responding quickly and efficiently to beneficiaries’ concerns. Misconceptions about energy efficiency can make it more difficult for the targeted beneficiaries to accept the project and thus can jeopardise its success. Therefore, it is important to address them as soon as possible. Indeed, if citizens and beneficiaries react negatively to the project, this can be a major barrier to its success. Other barriers that can be encountered at local and regional level include the lack of financing, the conflicting interests of major potential partners or collaborators, and the lack of experience of the authorities when implementing this type of project.

The costs of the analysed projects vary widely depending on the type of energy measures implemented, the scale of implementation, and the lifespan of the project. In general, energy efficiency projects have short payback periods (less than 15 years). This is due to the profits associated with the energy savings that can be potentially achieved. The savings depend on several factors such as the type of measures that are applied and the cost of the heating and electricity energy in the area.

The five analysed case studies contributed to the reduction of energy consumption, which in turn resulted in a reduction of GHG emissions. The amount of avoided carbon dioxide (CO₂)¹ depends on several factors such as the original situation or baseline, the type of measures and the scale of implementation. In the five analysed case studies, the reduction of CO₂ emissions varied widely, from 57 to 3,886 tonnes per year for the holiday village built following the concept of “passive housing” in Schleswig-Holstein and the building refurbishment in public buildings in the region of Skåne respectively.

The cost for reducing CO₂ can be estimated as the cost associated with the implementation of the project (i.e. initial investment and yearly operational and maintenance costs) minus the monetary savings associated with the project (i.e. savings in fuel or electricity costs), divided by the amount of CO₂ that is avoided through the implementation of the concrete project. When the sum of the savings is worth more than the project costs (investment, maintenance, etc.) over

¹ CO₂ is the main GHG responsible for climate change.
the whole lifetime of the project, this figure is negative and represents a monetary benefit. This means that the project is profitable and that it reduces CO_2 emissions in a cost-efficient way. If the project costs are higher than the associated fuel and energy savings, this figure is positive and represents an expense. See Annex 2 for further details about the methodology used for the calculation of the cost per tonne of CO_2 avoided). In this regard, the case studies included in this study show that it is feasible to achieve a cost-efficient reduction of CO_2. The cost for reducing CO_2 emissions though the implementation of energy efficiency measures depends on the lifetime of the project, the price of the energy in the area of implementation of the project, the initial investment, and the amount of CO_2 avoided annually. The cost per tonne of CO_2 avoided for the analysed case studies varied from €-11.35 to €-102.83 (i.e. benefits). This means that all of them yielded profits for reducing CO_2 emissions. This is usually the case for energy efficiency projects, where the avoided costs associated with the reduction in fuel or electricity costs are greater than the investment costs of the measures implemented, while the lower energy use results in lower CO_2 emissions.

The LRAs involved in the five energy efficiency projects also set a good example for citizens and local businesses through their actions, i.e. reducing the energy consumption of public buildings, motivating their own employees to adopt climate-friendly behaviour, improving public lighting, etc.

**Renewable Energy Sources**

The main objectives of the analysed case studies were to reduce fuel costs and thus reduce the electricity bill, to increase the independence from conventional sources of energy, and to use locally available renewable resources effectively.

In all the case studies, the LRAs participated in the planning, funding, and decision-making process. In some case studies, the authorities were also responsible for the subsequent monitoring and maintenance of the installed technology. The main roles of the LRAs were as providers and suppliers of energy, as promoters of RES in the area, and as motivators through raising awareness about sustainable energy.

In these projects, national, regional, or local energy agencies played an important role in the implementation, mainly as advisors and managers. Also, the participation of experts and specialised consultants was very important in the decision-making process, as the lack of experience of the authorities and partners in carrying out such projects can become a limiting factor for the

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2 In this report, expenses are presented as positive amounts and benefits as negative.
In some cases, the public and beneficiaries were initially sceptical about the feasibility of this type of project in their municipality or region. Seminars and awareness campaigns helped to dispel these initial doubts.

The barriers encountered for the implementation of renewable energy projects at the local and/or regional scale also include administrative obstacles, public opposition, difficulties in grid access, lack of information, and frequent changes in funding regimes.

The investment costs depend greatly on the type of technology to be implemented and the scale of implementation. The case studies present payback periods slightly higher than those observed in the energy efficiency case studies, i.e. 18.5 years on average. This is in line with the figures available from other published sources, which suggest that payback periods for this type of project are between 15 and 20 years.

These case studies illustrate the benefits of using energy sources available in abundance locally. Such benefits are not only environmental but also socio-economic as these projects often lead to the generation of new economic activities in the vicinity. The use of renewable sources entails the substitution of conventional fuels, which have larger GHG emissions. All the renewable energy projects analysed in this study resulted in annual reduction of GHG emissions. The reduction of CO$_2$ emissions resulting from the implementation of the described projects vary greatly from 9.57 tonnes per year for the project for solar energy use in Český Krumlov to 1,126 tonnes per year for biomass district heating plant in Las Navas del Marqués. In the case of renewable energy projects as well, the cost per tonne of CO$_2$ avoided depends on different factors such as the project lifetime, the maintenance and operational costs, the price of the energy, the initial investment and the amount of CO$_2$ avoided. All the analysed case studies (except one) showed a negative cost (i.e. a benefit) per tonne of CO$_2$ avoided (varying from €-1.48 for the case study in Aberdeen to €-11.23 for the case study in Las Navas del Marqués$^3$). This means that these cases resulted in net savings, mainly due to the significant reduction in fuel costs. In the case study in Frankfurt am Main, there was an expense for reducing GHG emissions (€13.04 per ton of CO$_2$ avoided). This was due to the fact that the energy produced by the installed renewable system was more costly than traditional energy sources.

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$^3$ The cost per ton of CO$_2$ avoided has been estimated in each case for the entire lifetime of the specific project.
In some case studies, the obtained results motivated the involved authorities to further develop the project, for example by increasing the capacity of the installation and the number of beneficiaries. Indeed, some of the case studies served as demonstration projects and helped to increase general knowledge on RES.

**Conclusions**

The following conclusions can be drawn from the analysis of the case studies presented in this report:

- The main driving forces for the implementation of energy efficiency measures, renewable energy projects and other energy-related actions are the necessity to make energy production and consumption more sustainable, the willingness to increase the competitiveness of the local industry (not just limited to those operating in the energy sector), to secure the energy supply, and to reduce energy costs.
- In some cases, sustainable energy actions serve as demonstration projects that allow gaining local experience and know-how regarding the use of renewable sources and energy efficiency.
- Local and regional energy agencies are usually well placed to assist LRAs and bring together all the necessary elements for carrying out these types of projects.
- The analysed case studies illustrate how projects relating to energy efficiency and renewable energy can result, not only in clear benefits for the environment, due to the reduction of GHG emissions, but also for the local economy. They can help to develop new local markets and the creation of new jobs, thus contributing to the economic growth of the area. Furthermore, they can play an important role in setting the foundation for the future actions in the field of sustainable energy. These projects can raise awareness of the climate change issues, affect the general interest of the citizens in environmental problems, and remove misconceptions about energy savings.
- Poor acceptance of energy efficiency and renewable projects by the public and beneficiaries, lack of financing or economic resources, and limited knowledge and experience in the implementation of these types of projects can be identified as the most important barriers.
- The investment costs can vary greatly depending on the type of project, technology, scale of the implementation, and geographical location. Innovative financing methods, such as Performance Contracting (PC), can be interesting and beneficial alternatives to the traditional methods of financing.
- There is a large potential for carbon emission savings by the actions taken by LRAs. However, with the exception of a few well documented cases, there is little evidence on the impact of local or regional actions on global...
carbon emissions. This could be explained by the lack of effective or regular monitoring and evaluation rather than an actual absence of impact.

- In principle, all the projects presented in this study could be replicated elsewhere by adapting to the specific conditions of the area of implementation.

**Recommendations**

On the basis of the analysis of the different case studies, various measures that have proven to be especially efficient in planning and implementing projects related to energy efficiency and RES have been identified. These include:

*Initiation and planning phase*

- Have a clear vision of the policy objectives.
- Gather information on similar projects that have been carried out by other LRAs.
- Seek the assistance of existing networks at European and national level in the field of sustainable energy.
- Define clearly the goals, time frame and responsibilities of the partners.
- Conduct feasibility studies in the beginning of the project.

*Efficient financing*

- Evaluate the feasibility of innovative financial tools (Leasing, PC, or third party financing).
- Benefit from national feed-in tariff schemes.
- Investigate if the existing national and European funding opportunities apply to the project.

*Effective Decision-Making*

- Establish strong partnership with the local/regional energy agency.
- Seek the assistance of specialised experts and consultants.

*Implementation*

- Motivate the personnel/working units involved in the project and explore ways to reward their efforts.
- Respond to the doubts and concerns that might arise during the implementation of the project among the beneficiaries of the project or the general public.

*Useful cooperation/partnership.*

- Explore the possibility of using PPP.
- If the project involves a service contract with a private company, establish a clear procedure for the evaluation and award of the contract.
- Exchange know-how with other municipalities or regions.
- Seek the support from the local and regional politicians.
- Establish good communication with all the partners from the beginning.

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4 Feed-in tariff schemes are procurement mechanisms designed to promote the uptake of renewable energy through government regulation. Under these schemes, the government fixes an above-market price rate for ‘green’ electricity (electricity generated from renewable sources).
Adequate information/public awareness campaigns.

- Involve experts in training sessions and seminars.
- Use simple and clear messages.
- Be reactive to preoccupations of the potential beneficiaries about the project.
- Inform the public about the advantages of the project.
- Participate and organise events to share the gained experience.

Monitoring

- Monitor, in quantitative terms, the results of the concrete project (i.e. the progress made in energy management and/or the performance of the renewable energies that have been installed).
- Use simple indicators to compare performance.
1. Introduction

1.1 Background and Objectives of this Report

The European Union (EU)\(^5\) is a highly energy-dependent society, with ever increasing levels of energy consumption. This means that the European Community's economy is very dependent on third-party countries for its energy supply. Furthermore, climate change, resulting from the rise in greenhouse gases (GHG), is closely linked with the way we produce and use energy. In order to address this situation, several approaches may be followed including the promotion of a wider use of renewable energy sources (RES), the modification of the consumption habits in all social sectors, the promotion of more energy efficient technologies, and the provision of information aiming at sensitising and educating the wider public about energy savings and efficiency.

Local and regional authorities (LRAs) in Europe are playing a very important role in the production and use of renewable energies and in increasing energy efficiency. Therefore, an active involvement of local and regional governments is necessary, in order to achieve the targets of the EU’s energy policy. Indeed, many LRAs give priority to sustainable energy solutions and set targets that are sometimes even more ambitious than those at national or European level. Some of the local and regional plans for reducing energy consumption and GHG emissions are successful examples that can be repeated elsewhere.

In this context, the European Union Committee of the Regions launched this study on the contribution made at local and regional level to combat climate change through the use of RES and measures to boost energy efficiency. The overall objectives of the study are three-fold:

- To analyse ten successful case studies of LRAs promoting renewable energy and energy efficiency in order to identify key factors contributing to the success of these projects.
- Based on the analysis of these case studies, formulate concrete recommendations for the replication of the analysed projects by other LRAs.
- To compile useful information in the field of renewable energy and energy efficiency.

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\(^5\) NOTE: In the present report, abbreviations and acronyms are spelled out only the first time they are introduced, and in the explicative boxes to facilitate their reading. A list with the abbreviations and the acronyms used can be found at the end of the report (Annex 6).
1.2 Study Approach and Methodology

This study of the current contribution by LRAs was made on the basis of ten successful case studies from different Member States (MS), five each for energy efficiency and renewable energy use. Special attention was paid to case selection and data collection.

The following criteria were used for the selection of the case studies:

- Projects carried out by LRAs (either three regional and two local projects or two regional and three local projects).
- Projects carried out recently (completed not earlier than 2000).
- Projects carried out in different MS and in a variety of climatic, topographic, economic and demographic conditions.
- At least two projects involving local or regional authorities in one of the new MS (one for the case studies concerning renewable energy and one for the case studies relating to energy efficiency).
- A preference for projects having a component related to the promotion of energy efficiency and the use of renewable energy via, for instance, financial incentives or information campaigns/training programmes.

Furthermore, in order to avoid an overlap with previous studies on similar subjects, the selected case studies do not refer to the existing compilation of case studies in other programmes at the EU level (e.g. European frameworks such as Intelligent Energy Europe or ManagEnergy).

The case studies regarding renewable energy were selected in order to cover:

- Different kinds of energy sources, such as:
  - solar energy (photovoltaic -PV- & thermal),
  - wind power,
  - biomass,
  - hydraulic power,
  - geothermal energy.
- Different uses of renewable energy such as transport, heating, electricity generation.

The case studies regarding energy efficiency were selected in order to cover:

- Energy management in public buildings
- Energy efficient public lighting
- Energy efficient heating
- Public procurement.

For the elaboration of the list of case studies, BIO followed a progressive
screening process, starting from a broader search without any limitation on the number of case studies required in the final list.

The first step consisted of a wide consultation of relevant information sources in order to identify possible case studies. A preliminary list of case studies was first elaborated, which served as a basis for establishing the final list. For the identification of these cases, web research and a literature survey were performed. Furthermore, relevant persons from different regional and local energy agencies in Europe were contacted by e-mail and telephone. These actions further helped to interest potential participants in the project.

On the basis of this preliminary list of case studies, a provisional final list of case studies was drawn up. This list contained ten cases of successful projects, five in the field of energy efficiency and five in the field of RES. These case studies were selected because they were considered to be good examples of the contribution of LRAs to the implementation of energy efficiency and renewable energies projects.

The potential participants from the different projects were contacted by e-mail and by phone in order to present the study and request their collaboration for the collection of information. A final list of case studies was drawn up when an agreement to participate in the project had been received from the persons contacted.

Two questionnaires, one each for energy efficiency and renewable energy projects, were prepared in order to facilitate the collection of information from the relevant authorities. The questionnaires were translated into other languages depending on the MS to which they were going to be sent, the one on renewables in Greek and Czech, and the one on energy efficiency in Hungarian.

An active follow-up was maintained by e-mail and phone in order to get back the requested information on time. Other relevant persons besides those initially contacted (e.g. consultants, engineers, or private companies that participated in the project) were also targeted to complement the information provided by the main contact.

Once the information gathered was complete, a detailed fact sheet for each case study was prepared, which included a summary of the most relevant information. For each case study, the following aspects were analysed:

- the role and responsibilities of each body involved in the project
- the decision-making progress (origin of the project, actors, sources of information, motivation, consultation, etc.)
- the problems and obstacles in the planning and implementation process
(administrative, political barriers, etc)
- the citizens’ attitude towards the project
- the technical aspects of the project
- the project costs
- the funding of the project
- the project’s lifespan
- the key factors for the success of the project
- the socio-economic impacts/benefits
- the environmental impacts/benefits (e.g. reduction of greenhouse gas emissions, energy consumption reduction, air pollution reduction, etc.)
- the ongoing applications of the project
- the potential to replicate a similar project by other local/regional authorities

Furthermore, an estimate was made of the reduction in GHG emissions, in particular carbon dioxide (CO₂), as well as a calculation of the cost per tonne of CO₂ avoided resulting from the project. More information on the methodology for estimating the reduction of CO₂ and the cost per tonne of CO₂ avoided is presented in Annex 1 and Annex 2 respectively.

Once the fact sheets for each case study were finalised, they were sent to the relevant contacts for validation.

The case studies were compared among themselves and with the situation at national and European level (regarding the overall energy efficiency situation and the current share of overall renewable energy production) in order to better identify best practices in planning and implementing energy projects at local and regional level. Conclusions and recommendations were drawn from the analysis.

Different associations and non-governmental organisations (NGOs) contributed to the identification of some relevant information for this study, viz. Prioriterre, ICLEI Europe, and CLIMATE ALLIANCE. This collaboration was voluntary and did not involve the exchange of any confidential information.

1.3 Structure of this Report

Section 2 of this report provides an overview of the current situation regarding renewable energy and energy efficiency in Europe and the important role that energy efficiency and renewable energy play in the reduction of GHG emissions. It briefly outlines EU policy, including the legal framework as well as the incentives the EU provides to projects in these fields. Finally, it highlights the current contribution from LRAs in implementing this policy.

In section 3, the ten selected successful projects are described and analysed. For
each of them, a detailed fact sheet and a summary were drawn up. The summary presents the main characteristics of the specific project and highlights the most important results from the analysis.

Section 4 presents the conclusions and recommendations for LRAs willing to implement energy projects.

Section 5 contains a list of the references that have been used in this report.

The annexes of this report are compiled in section 6. Annex 1 and Annex 2 describe the methodologies that were used to estimate the reduction of CO\textsubscript{2} and the cost per tonne of CO\textsubscript{2} avoided respectively.

A detailed fact sheet for each case study can be found in Annex 3. Annex 4 contains useful information and links for LRAs concerning practical and technical know-how, project funding, networking, best practice cases for energy efficiency, and renewable energy projects.

The questionnaire that was used to collect information from the relevant contacts in each case is presented in Annex 5 (this Annex contains the questionnaire for renewable energy projects, a similar but adapted questionnaire was used for the energy efficiency projects, which is not included in this report).

Annex 6 contains the list of abbreviations and acronyms used in this report.
INTRODUCTION
2. Situation of Renewable Energy Sources and Energy Efficiency in the European Union

Climate change is one of the most challenging economic, environmental and social problems facing society nowadays. The rise in the emission of GHG, the main contributors to global warming, is strongly linked to the ways society currently produces and consumes energy. Renewable energy and energy efficiency have a crucial role to play in reducing GHG emissions. Consequently, they have become central elements in the European Commission’s (EC) energy policy. They are expected to contribute to:

- Security of supply,
- Competitiveness and the implementation of the objectives of the Lisbon agenda, and
- Environmental protection and the respect of the EU’s Kyoto obligations.

Under the Kyoto Protocol, the 15 Member States that had joined the EU before 1 May 2004 (EU-15) committed to cut their GHG emissions to 8% below the 1990 level by 2012. This overall target has been translated into a specific legally-binding target for each MS based on its capacity to curb emissions. Unlike the EU-15, the EU-27 does not have a collective emissions target under the Kyoto Protocol. Eight of the ten MS that acceded to the EU on 1 May 2004 have individual targets to cut their emissions to 6% or 8% below base year levels. The two other countries, Malta and Cyprus, do not have for the moment GHG emission reduction targets. Bulgaria and Romania have committed to cut their GHG emissions to 8% below the 1990 level by 2012.

2.1 Renewable Energy Sources

2.1.1 European Policy

The EU began to set targets for renewable energies in 1997 in its White Paper on RES. This document sets out a strategy to double the share of renewable energies in gross domestic energy consumption in the EU by 2010 (from 6% to 12%) including a timetable of actions to achieve this objective in the form of an Action Plan. A Directive on the promotion of the electricity produced from renewable energy sources (RES-E) in the internal electricity market was adopted on the 27th September 2001 (Directive 2001/77/EC). The overall indicative target of the Directive is to increase the share of renewable energy production to 12% of total energy use and of renewable electricity production to 21% of total electricity consumption by 2010. This Directive has indicative targets for the
share of renewable electricity production in each MS.

In January 2007, the EC proposed a comprehensive package of measures to establish a new Energy Policy for Europe to combat climate change and boost the EU's energy security and competitiveness. The package of proposals sets a series of ambitious targets on GHG emissions and renewable energy and aims to create a true internal market for energy and strengthen effective regulation. The Commission believes that when an international agreement is reached on the post-Kyoto framework\(^6\), this should lead to a 30% cut in emissions from developed countries by 2020. To further underline its commitment, the Commission proposes that the EU commits now to cutting GHG emissions by at least 20% by 2020, in particular through energy measures.

As a part of its Energy Policy for Europe, in January 2007, the EC put forward a proposal for a long-term Renewable Energy Roadmap. This proposal includes an overall binding 20% renewable energy target and a binding minimum target of 10% for transport biofuels for the EU by 2020. This also includes a pathway to bring renewable energies in the fields of electricity, heating, and cooling and transport to the economic and political mainstream.

During a meeting in Brussels on 8-9 March 2007, all MS agreed on a binding target of a 20% share of renewable energies in overall EU energy consumption by 2020. It would then be up to each MS to decide on national targets for specific sectors – electricity, heating and cooling, etc. Furthermore, a 10% minimum target on biofuels was also agreed, although the EU leaders stressed that the binding nature of this objective was subject to "production being sustainable", and to "second-generation biofuels becoming commercially available".

2.1.2 Situation of Renewable Energy in the European Union

- **Share of RES in primary energy consumption**

Figure 1 illustrates the situation of the renewable energies share of primary energy consumption in EU countries (EU-25, information at the EU-27 level is not yet available) in 2005. This share is estimated at 6.38% (against an objective of 12% established by the 1997 White Paper on RES) [EurObserv’ER, 2006]. It seems that the current share of renewable energies in primary energy consumption will not make it possible to reach the objective that is set for the EU (12% by 2010). The EC has also made this same observation and is expecting a 9% share in 2010.

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\(^6\) With the first commitment period of the Kyoto Protocol closing in 2012, the EU has launched discussions on its future long-term strategy to fight global warming after 2012.
Figure 1 also shows the major differences across MS (EU-25): from 40.03% for Latvia to 0.31% for Malta. MS, as a function of their natural resources (wind, forests, hydraulic, solar and geothermal deposits) and of the economic fabric having developed around each sector, have contrasted implications. It should be noted that the six leading MS in terms of their share of primary energy of renewable origin have in common the fact that they are all large countries with forests (thus biomass availability) and with sizeable hydraulic energy potentials.

**Figure 1– Share of renewable energies in primary energy consumption of EU-25 countries in 2005 (in %)**

Source: Adapted from [EurObserv’ER, 2006]

■ **Share of RES in gross electricity consumption**

As mentioned before, the second European objective pertains to the renewable energy share in gross electricity consumption (21% share of electricity produced from renewable energy sources in 2010). As shown in Figure 2, the share for the EU is estimated to be 13.97% for 2005. This marks a 0.31 point decline with respect to 2004. The very low level of rainfall in 2005 (the worst year in this context for the last ten years) is the principal cause of this drop. If hydroelectric
production could have been maintained at the level of 2004, which was an average year, the share of renewable electricity would have reached 14.60% in 2005, i.e. + 0.32 points with respect to 2004 [EurObserv’ER, 2006]. The increase was thus the result of development in the other renewable sectors, in particular wind power and biomass.

**Figure 2 - Share of renewable energies in gross electrical consumption in EU-25 countries in 2005 (in %)**

![Diagram showing the share of renewable energies in gross electrical consumption in EU-25 countries in 2005.](image)

Source: Adapted from [EurObserv’ER, 2006]

According to the EC communication in 2007 on the progress in renewable electricity since 1990, recently implemented RES have produced 148 Terawatt-hours (TWh), which is the equivalent of the total electricity consumption of Ireland, Austria and Portugal [EC, 2007 a].

The EU-15 MS had to transpose Directive 2001/77/EC by October 2003. The ten MS that acceded to the EU on 1 May 2004 and the two that acceded on 1 January 2007 (Bulgaria and Romania) had to transpose it by their date of
accession [EC, 2007 a].

Nine MS have joined the club of those countries “performing well” with some of them even reaching their targets early. Of these nine MS, Denmark, Germany and Hungary are on track for meeting the 2010 target, while Finland, Ireland, Luxembourg, Spain, Sweden and the Netherlands are well placed to reach the 2010 target if current developments continue.

The Czech Republic, Lithuania, Poland, Slovenia and the United Kingdom are likely to reach the targets with additional efforts. However, eleven MS seem to be failing to meet their national commitment. Strong additional efforts would be required in the case of Belgium, Portugal, and Greece. Finally, Austria, Cyprus, Estonia, France, Italy, Latvia, Malta and the Slovak Republic are far from reaching their targets [EC, 2007 a].

Regarding the situation in Austria, which is the country with the most ambitious national target for 2010, the production of renewable energy is dominated by large-scale hydropower (60% of total electricity consumption). Over recent years, there has been considerable growth in capacity in the wind and biomass sectors due to favourable feed-in tariffs. However, there are currently poor investment conditions due to a revised support scheme, leading to a stagnating RES development.

Romania and Bulgaria have set up a target by 2010, maintaining the objective for the enlarged Union at 21%. Romania has set up a target for passing from 28% to 33% by 2010 and Bulgaria from 6% to 11% by 2010 [EC, 2007 a]. In Romania, the share of renewable energies in gross electrical consumption has shrunken from 31.3% in 1997 to 29.87% in 2004. Nevertheless, in general terms, this country is considered to be well placed to reach its target for 2010. In the case of Bulgaria, the share of renewables in gross electricity consumption increased from 7.2% in 1997 to 9.28% in 2004 [EC, 2007 c].

By the end of 2003, EU-25 GHG emissions stood 5.5% below 1990 levels, while average EU-15 emissions over the five years to 2003 were 2.9% lower than in 1990 [EC, 2005 a].


\(^7\) Press Release from the European Environment Agency “EU greenhouse gas emissions drop in 2005” (07/05/2007)
decreased by 0.8% between 2004 and 2005, and by 1.5% compared to 1990. EU-25 emissions of GHGs decreased by 8% compared to 1990 levels. In absolute terms, the main sectors contributing to emissions reductions between 2004 and 2005 in the EU-15 were public electricity and heat production, households and services.

Due to Bulgaria's and Romania's recent accession to the EU, the emissions that have been notified to the European Commission for 2005 have not been independently verified by an external party and therefore they are not considered in the latest EU greenhouse gas inventory.

2.1.3 Progress in Various Technologies

- **Current status of different renewable energies**
  As shown in Figure 3, biomass is the major source of renewable primary energy in Europe followed by hydraulic power. All other sources have smaller market shares. Regarding renewable electricity generation, the most important source is hydraulic power followed by wind power (see Figure 4).

  The contribution of renewable energies to electricity production has constantly increased during the past decades, especially in the past five years as a result of the energy policies that have established more ambitious targets and promoted the implementation of RES (see Figure 5).

  The information presented hereafter regarding the current status of different renewable energies is mainly based on information provided in the Communication from the Commission to the Council and the European Parliament (COM (2006) 849 final) entitled “Green Paper follow-up action Report on progress in renewable electricity” [EC, 2007 a], as well as on the 6th report EurObserv’ER about the state of renewable energies in Europe [EurObserv’ER, 2006]. This information covers only EU-25 MS, information at the EU-27 level is not yet available.
Figure 3- Share of each resource in the renewable primary energy production (in %)

<table>
<thead>
<tr>
<th>Resource</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic power</td>
<td>24.7%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Geothermal power</td>
<td>5.6%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Biomass</td>
<td>64.1%</td>
<td>66.1%</td>
</tr>
<tr>
<td>Wind power</td>
<td>4.9%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Solar</td>
<td>0.6%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Figure 4- Share of each resource in the renewable electricity generation (%)

<table>
<thead>
<tr>
<th>Resource</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic power</td>
<td>70.9%</td>
<td>66.4%</td>
</tr>
<tr>
<td>Geothermal power</td>
<td>1.2%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Biomass</td>
<td>13.8%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Wind power</td>
<td>13.9%</td>
<td>16.3%</td>
</tr>
<tr>
<td>Solar</td>
<td>0.2%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

Source: Adapted from [EurObserv’ER, 2006]
■ Wind power

The EU remains the global leader in wind power with a 60% share of the world market. In 2002, 80% of world capacity was installed in Germany and Spain. In 2005, this share was 56%. The slowdown in the impressive growth in Germany was counterbalanced by the rise in other European markets such as those of the United Kingdom, Portugal, and Italy. Since 2000, wind power capacity has increased by more than 150% in the EU. The amount expected in the White Paper on renewable energies of 40,000 Megawatts (MW) was reached five years ahead of schedule [EC, 2007 a]. The total installed wind capacity of 40,517.8 MW produced 69.1 TWh in 2005 [EurObserv’ER, 2006].

The excellent performance of the wind sector has enabled the industry to upgrade its target to 75,000 MW in 2010. New wind power represents 33% of the new electricity generating capacity in the EU. The remaining 67% is mainly conventional thermal power stations. RES-E from wind constitutes 2.6% of total EU electricity consumption, the equivalent of the electricity consumption of Denmark and Portugal together. Average annual growth of electricity produced from wind has been 26% over the past five years [EC, 2007 a].

■ Biomass

Three fuel types contribute to the total biomass electricity generation: solid biomass, biogas, and the biodegradable fraction of municipal solid waste. Biomass electricity constitutes 2% of the total EU electricity consumption. Total electricity from biomass grew by 18% in 2002, 13% in 2003, 19% in 2004 and 23% in 2005. If the growth rate of 2004 could be extrapolated to 2010, total biomass contribution would reach about 167 TWh, which corresponds to the generation needed from biomass to fulfil the 21% target of electricity from
renewable energy.

As with the progress of total biomass, the development of solid biomass accelerated significantly in 2004 and 2005. Annual growth rates in recent years at the EU-25 level were 20% in 2002, 13% in 2003 and 25% in 2004 (information at the EU-27 level is not yet available). Between 2002 and 2004 about 10 TWh of additional energy from biomass was generated. The largest contributors to total solid biomass RES-E generation are Finland and Sweden followed by Germany, Spain, United Kingdom, Denmark, Austria, and the Netherlands [EC, 2007 a]. Primary energy production from solid biomass accounted for 58,783 million tonnes of oil equivalent (Mtoe\(^8\)) in 2005 [EurObserv’ER, 2006].

Regarding biogas, approximately two thirds is used for electricity production and one third for heat production A constant increase in biogas electricity generation has been observed over the last decade in the EU, with annual growth rates that of 24% in 2002, 13% in 2003, 22% in 2004, and 15% in 2005 [EC, 2007 a]. In 2005, nearly 5 Mtoe were produced for energy uses in the different countries of the EU. The total resource is estimated at more than 20 Mtoe at current waste production levels [EurObserv’ER, 2006; EC, 2007].

The EC estimates that the measures in the Biomass Action Plan\(^9\), could lead to an increase in the use of biomass (solid biomass, biogas, biofuels, renewable municipal wastes, etc.) that could reach approximately 150 Mtoe in 2010 or soon after [EC, 2005 c]. However, in the EurObserER 2006 report on the state of renewable energies in Europe, the primary biomass energy consumption was forecasted to be 103.7 Mtoe by 2010, i.e. 46.3 Mtoe less than the scenario foreseen by the motioned Plan [EurObserv’ER, 2006].

---

**Photovoltaic (PV) solar energy**

Total installed PV capacity in the EU has been growing at an unprecedented average annual growth rate of 70% over the last five years, from 127 Megawatt peak (MWp) in 2000 to 1,791.7 MWp at the end of 2005 [EurObserv’ER, 2006]. The impressive growth of the total installed capacity in Europe is driven by Germany: 86% of currently installed PV capacity of the EU is in Germany. The Netherlands and Spain have an installed capacity of over 50 and 58 MWp respectively. The “peak power per capita” ratio of the EU 25 MS, is also rising significantly. It rose from 2.5 Watt peak (Wp) per capita in 2004 to 3.9 Wp per

---

\(^8\) The tonne of oil equivalent (toe) is a unit of energy that represents the amount of energy released by burning one tonne of crude oil, approximately 41.868 GJ or 11.630 MWh. [APS, 2007]

\(^9\) The Biomass Action Plan was adopted in 2005 and sets out actions aimed in particular at increasing the demand for biomass, improving supply, overcoming technical barriers and developing research. For more information see Annex 4.
inhabitant in 2005. In comparison, Japan (128 million inhabitants) has an installed capacity of 8.9 Wp/inhabitant, while the USA (291 million inhabitants) has an installed capacity of 1.3 Wp/inhabitant [EC, 2007 a].

**Small-scale hydro**
The term "small-scale hydro" normally refers to hydro power plants with a capacity of up to ten MW. The current European trend in terms of the progression of small plant capacity is not very dynamic, mainly due to administrative and environmental barriers. Nevertheless, the sector has a real potential which can generate steady and buoyant economic activity.

This renewable energy source is characterised by considerably differing potentials and electricity generation costs throughout Europe. In the EU-25, small-scale hydro capacity has grown annually by 3.8% on average during the last four years. The main reason for the slow development is, in particular, the high administrative barriers (e.g. environmental permits).

**Geothermal energy**
Worldwide, the geothermal sector is currently the fourth largest electrical power production sector using RES, ranked behind hydraulic power, biomass, and wind power. Europe has about 9% of the worldwide geothermal capacity. However, main geothermal use in Europe is not in the electricity generation but in heating with a large majority being exploited in the building sector through geothermal heat pumps.

In the EU, electricity production from geothermal sources is currently mainly used in Italy, Portugal (Azores) and France [EC, 2007 a]. The White Paper objectives (5,000 Megawatts thermal –MW$_{th}$\textsuperscript{10}–, including 2,500 MW$_{th}$ of geothermal heat pumps) have been largely exceeded. At the end of 2005, the number of the so called ground source heat pump (GSHP) systems was estimated at 455,435 units in Europe, representing an installed capacity of 5,379 MW$_{th}$ [Eurobserv’ER, 2006].

Table 1 summarises the installed capacities for different renewable energies, as well as the target for 2010 and the capacity per capita.

\textsuperscript{10} Watt thermal refers to thermal power produced.


<table>
<thead>
<tr>
<th>RES technology</th>
<th>Capacity 2005</th>
<th>White paper objectives</th>
<th>Energy Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind power</td>
<td>40,517.8 MW</td>
<td>40,000 MW</td>
<td>69.1 TWh</td>
</tr>
<tr>
<td>Installed PV</td>
<td>1,791.7 MWP</td>
<td>3,000 MWP</td>
<td></td>
</tr>
<tr>
<td>Solar thermal collectors</td>
<td>17,267,538 m²</td>
<td>12,087.3 MWth</td>
<td>100,000,000 m²</td>
</tr>
<tr>
<td>Small hydraulic</td>
<td>11,601 MW</td>
<td>14,000 MW</td>
<td>41 925 TWh</td>
</tr>
<tr>
<td>Biogas</td>
<td>4.7 Mtoe¹¹</td>
<td>15 Mtoe³</td>
<td></td>
</tr>
<tr>
<td>Biomass solid</td>
<td>58,783¹² Mtoe</td>
<td></td>
<td>44,104 TWh¹³</td>
</tr>
<tr>
<td>Biofuels</td>
<td>3,184 000 tonnes</td>
<td>3.3 Mtoe¹⁴</td>
<td>18 Mtoe</td>
</tr>
<tr>
<td>GSHP</td>
<td>455,435 pumps</td>
<td>5,379 MWth</td>
<td>2,500 MWth from geothermal heat pumps</td>
</tr>
</tbody>
</table>

Source: Adapted from [EurObserv’ER, 2006]

### 2.2 Energy Efficiency

#### 2.2.1 European Policy

The EC published the Green Paper on Energy Efficiency in June 2005. It suggests that the EU could save at least 20% of its current energy use, equivalent to €60 billion per year, or the present combined energy consumption of Germany and Finland, in a cost effective manner if all the different players and stakeholders at regional and local levels were involved in the production and use of renewable technologies as well as in increasing energy efficiency [EC, 2005].

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¹¹ Biogas production
¹² Primary energy production from solid biomass.
¹³ Gross electricity production from solid biomass
¹⁴ Biofuel production
2005 b]. An Action Plan for Energy Efficiency was published in October 2006. The Plan contains a package of priority measures covering a wide range of cost-effective energy efficiency initiatives. These include actions to make energy appliances, buildings, transport, and energy generation more efficient. Stringent new energy efficiency standards, promotion of energy services, and specific financing mechanisms to support more energy efficient products are proposed. The Commission will furthermore create a Covenant of Mayors of the 20-30 most pioneering cities in Europe and will propose an international agreement on energy efficiency. Altogether, over 75 measures have been put forward [EC, 2006 c].

In order to support better integration of energy efficiency measures into national legislation, the EC has proposed several directives which have been adopted and are now in force. These concern broad areas where there is significant potential for energy savings, including End-use Efficiency & Energy Services, Energy Efficiency in Buildings, Eco-design of Energy-Using Products, Energy Labelling of Domestic Appliances and Combined Heat and Power (CHP). More information in this regard is summarised in Annex 4.

The EC’s efforts also concentrate on developing sustainable and clean technologies and on removing barriers to a well functioning market. This is done with the help of Community technology research and demonstration programmes, such as the Framework Research and Technology Development Programmes, and with pro-active support programmes, such as the Intelligent Energy - Europe Programme and its preceding programmes, an overview of which is provided in the present section. More information in this regard is summarised in Annex 4.

2.2.2 Energy Efficiency Situation in the European Union

The consumption of energy in Europe is substantial, while the growth in demand for transport and electricity represent the most worrying trends. If nothing is done to reverse this trend, energy consumption could still increase by almost 10% over the next 15 years.

Mobility, particularly by road, has increased substantially over the last 30 years. Transport alone represents almost 20% of total EU primary energy consumption. It is responsible for 26% of CO₂ emissions.

The demand for electricity also experienced considerable growth in recent years. In fact, two thirds of the primary energy needed to generate electricity is lost in production, transmission, and distribution.
Buildings alone use 40% of the energy consumed in the EU. Too much energy continues to be wasted in buildings because of inefficient heating and cooling systems and lighting.

Table 2 represents the potential savings that can be achieved by applying the Action Plan for Energy Efficiency, which aims to save a substantial part of the 20% of EU annual primary energy consumption by 2020. Partly because of its large share of total consumption, the largest cost-effective savings potential lies in the residential (households) and commercial buildings sector (tertiary sector), where the full potential is now estimated to be around 27% and 30% of energy use, respectively. In residential buildings, retrofitted wall and roof insulation offer the greatest opportunities, while in commercial buildings, improved energy management systems are very important. Improved appliances and other energy-using equipment still offer enormous energy saving opportunities.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Households (residential)</td>
<td>280</td>
<td>338</td>
<td>91</td>
<td>27%</td>
</tr>
<tr>
<td>Commercial buildings (tertiary)</td>
<td>157</td>
<td>211</td>
<td>63</td>
<td>30%</td>
</tr>
<tr>
<td>Transport</td>
<td>332</td>
<td>405</td>
<td>105</td>
<td>26%</td>
</tr>
<tr>
<td>Manufacturing Industry</td>
<td>297</td>
<td>382</td>
<td>95</td>
<td>25%</td>
</tr>
</tbody>
</table>

Source: [EC, 2006 b]

Monetary savings estimated for the EU economy would be around €50 billion annually by 2012; this would increase substantially - to more than €100 billion - by 2020. This savings estimate reaches €150 billion per year if oil prices of 70$/barrel were considered for the estimation. These savings would have to be reinvested for a large part into options and technologies that generate higher energy efficiency. If the full 20% savings are realised, the carbon emissions savings are estimated to be around 780 million tonnes of CO₂ [EC, 2006 b].
2.3 Contributions from Local and Regional Authorities to Combating Climate Change

2.3.1 The Role of Local and Regional Authorities

Climate change can have a direct impact on local and regional areas through extreme weather conditions, floods, soil damage and erosion, structural damage, etc. This is particularly true in certain areas that are more vulnerable to suffering these consequences or with less capacity for adaptation. Therefore, actions at local and regional levels are important in both mitigation (slowing down the effects of climate change) and adaptation (protecting populations against the effects of climate change) and thus placing local and regional governments in the forefront of climate protection policies. Many actions aimed at combating climate change relate to the improvement of energy efficiency and the use of renewable energies.

LRAs are in a privileged position to interact with citizens and influence their everyday behaviour. Therefore, the realisation of EU policy greatly depends on the success of a local government's ability to communicate ideas and involve its citizens.

LRAs have a significant influence on final energy consumption through the decisions they make. Indeed, the local and regional governments work with all aspects of energy policies. They can influence energy demand directly through the management of their own energy use, but also indirectly by informing and motivating end-users as to how they can use energy more efficiently [CEMR et al., 2006].

In general, the roles that LRAs can play in local and regional energy management include the following:

- As energy consumers in public buildings and properties.
- As producers and suppliers of heat and electricity for the citizens and local or regional businesses.
- As planners, developers and regulators by enforcing efficiency standards and building regulations.
- As advisors and motivators by raising awareness, engaging, persuading and motivating populations and communities, and promoting sustainable energy for citizens and local businesses.

Most LRAs manage a large stock of public buildings and facilities, such as schools, public offices, swimming pools, municipal car fleets, street lighting, etc. In schools, offices and other public buildings, huge energy savings can be made by setting up programs for efficient use of electrical appliances, lighting
(relighting and retrofitting), heating systems, insulation, glazing (from single to double/triple), and so forth. In this regard, LRAs can also integrate environmental criteria into all stages of their procurement process to encourage the introduction of green electricity\(^\text{15}\), efficient appliances, products certified with environmental labels and low emission vehicles.

LRAs take important decisions that have an impact on the energy supply. However, due to the recent privatisation of the energy market, they are rapidly losing their role as energy suppliers and are becoming increasingly dependent on the private sector. Several European cities and regions are now introducing city or district heating systems using biomass, landfill gas, and co-generation in order to face this dependency problem. Local energy production can also boost the local economy by creating new jobs [CEMR et al, 2006].

Transport alone represents almost 20% of total EU primary energy consumption [EC, 2006 c.]. In particular, car usage has significant impacts on climate change, with about 12% of the overall EU emissions of CO\(_2\) coming from the fuel consumed by passenger cars. Even though there have been significant improvements in vehicle technology this has not been enough to neutralise the effect of increased traffic and car size [EC, 2007 b]. In this regard, regional and local authorities can play a major role in developing sustainable forms of transport. The main challenge is to find alternative forms of transport, in order to slow down the growth of road and air transport. The greatest barriers to sustainable transport in European regions are people’s preference for the private car as well as the lack of good and affordable public transport. Sustainable mobility requires a shift from private car to public transport; a better integration of different modes of transport through intermodality (the use of more than one form of transport for a journey); a shift to “environmentally friendly” forms of transport and cleaner fuels; the introduction of transport charging based on pollution levels and infrastructure damage and the promotion of car sharing and bicycle use.

2.3.2 Good Local and Regional Examples

In Europe, there are a large number of LRAs that have demonstrated their commitment to combating climate change. Many cities across Europe have implemented sustainable energy policies and strategies, which have yielded very positive results in terms of energy savings, and reductions in GHG emissions and local pollution.

\(^15\) Green electricity is produced from sources which are more environmentally friendly (e.g. lower GHG emissions) than traditional sources using fossil fuels. It usually comes from RES.
For example, due to the implementation of the Climate Protection Programme (KLiP) in the city of Vienna (Austria), between 1990 and 2002 annual CO\(_2\) emissions were reduced by 3%. The programme resulted in the avoidance of a total of 2 million tons of CO\(_2\) emissions annually [Hauer, 2007].

Another example is the city of Berlin (Germany), where between 1990 and 2000, per-capita GHG emissions were reduced by more than 18% due to the implementation of successful proactive energy policies, including public-private energy conservation partnerships, the establishment of a municipal energy management system and a network to promote energy-saving and solar energy measures [Climate Alliance, 2000].

In 1996, the Swedish Municipality of Växjö (Sweden) unanimously adopted the Fossil Fuel Free Växjö programme with the objective to stop using fossil fuels. Between 1993 and 2005 the emissions of CO\(_2\) from fossil fuels were reduced by 24% per inhabitant and the share of renewable energy is now over 50%, which is largely above the current average share of renewable energies in total primary energy consumption in Europe (6.38%) [Växjö, 2007].

In some cases, LRAs establish more ambitious targets that the ones set at national and European level. For example, the Autonomous Community of Andalusia in Spain has the objective of reaching a share of 15% renewable energies in the primary energy demand by the year 2010, as stated in the Andalusian Energy Plan (Plan Energético de Andalucía PLEAN) 2003-2006. This target is slightly higher than the one established both at national and European levels (12%) [Junta de Andalucia, 2003].

Some cities in Europe have proven to be pioneers in the implementation of sustainable energy policies. The city of Barcelona (Spain), for example, already has a unique regulation in the area of solar energy: the "Solar Ordinance". This standard, which came into force in August 2000, decrees that all new buildings undergoing major refurbishment should use thermal solar energy for 60% of their sanitary hot water supplies. The volume of processed projects is equivalent to a saving of 5,640 tonnes of CO\(_2\) per year. Many other municipalities adopted the same regulation in Catalonia and subsequently in cities of other regions. Finally through the Spanish Building Technical Code (CTE - Código Técnico de la Edificación), similar obligations are now imposed though the country. This norm requires all new or renovated buildings to cover 30%-70% of the domestic hot water demand with solar thermal energy. This provides strong evidence that local initiatives can be transformed into a legislative framework [BEA, 2007; CTE, 2006].

Furthermore, there are a number of committed local and regional government
networks and associations working in the field of energy, transport and climate protection policies. These networks and associations work towards promoting good practice and facilitate the exchange of experience at European level (for more information in this regard, see Annex 4. For example, Climate Alliance is a network of European cities and municipalities that aims to preserve the global climate. The members of the Climate Alliance (1,300 members in 14 European countries) commit themselves to a continual reduction of GHG emissions. The target is to reduce CO2 emissions by 10% every five years. The important milestone of halving per capita emissions (reference year 1990) should be achieved by 2030 at the latest. In the long term, Climate Alliance cities and municipalities aim to reduce their GHG emissions to a sustainable level of 2.5 tonnes CO2 equivalent per inhabitant and per year by implementing energy-saving and energy-efficiency measures and by using renewable energies [Climate Alliance, 2007].

2.3.3 Contribution from Local and Regional Authorities

It is difficult to estimate the number of renewable energy and energy efficiency projects that have been carried out by LRAs in Europe to date that contribute to combating climate change. Many LRAs are implementing projects, but do not communicate on them. Or they implement them with or through local partners, so they are initiators, but do not really execute them. The degree of involvement of LRAs also varies immensely.

Also, there is little evidence of the impact of local or regional action on carbon emissions. This can be expected to be mainly due to the lack of effective or regular monitoring and evaluation rather than to an actual lack of impact. The available information is incomplete and does not allow aggregation at national or European level. Furthermore, there is little academic research in this field. The development of local inventories could help LRAs to be informed about the important emission sources and priorities for emission reduction, track improvement and design effective policies for further emission reductions.

Some well documented case studies, like the ones referred to in the section 2.3.2, provide some indications of the impacts that could be achieved through ‘best practice’.

Regarding the most common type of project carried out by LRAs, this varies greatly across Europe. There are priorities in each city or municipality and region, some specialised in renewable energy projects, but without any activity in energy saving, or, like Frankfurt am Main, the "champion" in co-generation, but which has almost no projects in the field of renewables.

It has been previously observed that certain project types that aim to reduce the
energy demand are more attractive from the economic point of view than others (i.e. considerable gains with short payback periods), so they have become more frequent among LRAs. These are typically [ADEME, 2006]:

- Energy efficient refurbishment of municipal buildings or social housing.
- Energy efficient modernisation of street lighting systems.
- Modernisation of outdated district heating networks.

In this section, ten different case studies of energy efficiency and renewable energy projects promoted by local or regional authorities are presented and discussed. The cases studies are:

**Energy Efficiency**
- Kuopio energy management programme (Finland)
- Building refurbishment in Skåne (Sweden)
- Public lighting in the town of Gödöllő (Hungary)
- Environmentally friendly school building in Mirecourt (France)
- Energy efficient holiday village in Schleswig-Holstein (Germany)

**Renewable Energy**
- Project for solar energy use at Český Krumlov council offices (Czech Republic)
- Biomass district heating plant in Las Navas del Marqués, Ávila (Spain)
- Building refurbishment with CHP and solar thermal in Frankfurt am Main (Germany)
- Aberdeen farmhouse heat pumps (United Kingdom)
- Implementation of biodiesel mixtures in public transport buses in Crete (Greece)

Summaries of these case studies are presented in this section, while the detailed description and analysis of each of them can be found in the dedicated fact sheets included in Annex 3.
ENERGY EFFICIENCY PROJECTS

The detailed description and analysis of each case study can be found in the dedicated fact sheets that are included in Annex 3.
Kuopio Energy Management Programme

Type of project: Energy Efficiency - Public buildings / User behaviour and education
Location: Kuopio, Finland
Scope: Local
Date of completion: December 2005

BACKGROUND
• The city of Kuopio is engaged in continuous work to achieve energy savings.
• Many technical energy efficiency and savings options have already been implemented.
• Further improvements are mainly to be achieved through changes in user attitudes and behaviour.

OBJECTIVES
• Reduce the electricity consumption in the buildings and work units of the city of Kuopio through changes in user behaviour regarding lighting and office appliances.
• Develop a training model in order to enable the replication of the project in other organisations.

DESCRIPTION
• Staff training, aimed at the entire city staff, was carried out during the city’s “Energy Saving Week”. One person from each work unit of the city (roughly 330 in total) was invited. The participants were asked to hold a short information session at their work unit in order to disseminate the information to the whole staff.
• Monitoring of results was started immediately after the training
• The intermediary and final results were communicated to the whole staff.

FINANCIAL RESOURCES
• The total project budget was €88,500, of which:
  – 55%, i.e. €48,500 came from the local authority (the different operational units of the City of Kuopio).
  – 45%, i.e. €40,000 came from the state-owned company Motiva Oy, which is an energy sector expert.
• A payback period of approximately 1 year was expected for the local funding part.
MANAGEMENT

- The project was led and carried out by the City of Kuopio Environmental Centre. A full-time project manager was allocated to the project.
- The project's executive group, which played a role especially in the planning and decision-making phases, included three persons from the Environmental Centre and one person from each of the four parties involved indicated below.

OBSTACLES

- No specific problems were encountered in the planning phase of the project. Implementation ran smoothly in general.
- Certain motivational barriers were encountered among the target audience of the project (e.g. lack of interest in environmental issues, wrong ideas about energy savings in general, etc.).

RESULTS

- The general objectives of the project were achieved: the electricity consumption was reduced through changes in user behaviour.
- In the best work units, electricity consumption fell by around 10% over the project period (20 months).
- Total annual energy savings resulting from the project were estimated at 450,000 kWh, which results in 175 tonnes of CO₂ avoided per year. In monetary terms, the project resulted in a €25,000 reduction in the total electricity invoice over one year.
- The cost per tonne of CO₂ avoided was estimated at €28.49\(^{16}\) (assuming that the benefits of the project accrue over 5 years). This means that the project reduced GHG in a cost-effective way.
- In Kuopio and surrounding municipalities, the local organisations had already achieved 4%-6% energy savings (5.5% for the City of Kuopio), which count towards the 9% target of the Directive 2006/32/EC on energy end-use efficiency and energy service. The energy efficiency situation in Kuopio can be considered above the national average. In Finland, since 1995 the energy efficiency index\(^{17}\) shows that the overall energy efficiency has improved by 7% from 1995 to 2004, more than the EU average index, that improved by 5%.

\(^{16}\) The cost per tonne of CO₂ avoided can be positive (an expense) or negative (a benefit). In this report, expenses are presented as positive amounts and benefits as negative.

\(^{17}\) An energy efficiency index has been developed under the EU-funded Odyssee project. It provides an overall perspective of energy efficiency trends by sector and combines the trends of indicators by end-use or sub-sector. A decrease means an energy efficiency improvement [ODYSSEE, 2006-07]
KEYS TO SUCCESS
• Project launched with support from the municipal management
• Training sessions were short, but sufficiently informative (1 hour)
• Project concentrated on delivering only 3 key messages
• Participants in the training sessions were given a summary of guidelines (one A4 sheet)
• Active follow-up, frequent reminders and communication of results.
• Reward to the work units with the best improvements.

CITIZEN’S ATTITUDE TO THE PROJECT
• The feedback from the municipal staff (the project's target audience) was mostly very positive: people found the content of the training good and the project in general well organised.
• The implementation and results of the project raised the interest of many local organisations and stakeholders Finland-wide.
• Some negative feedback was received from a small group of participants.

POTENTIAL FOR REPLIICATION
• The project can be easily replicated by other local/regional authorities. Planning and organisation of the training are straightforward.
• The factual content, i.e. the key messages of the project, are simple and clear. The challenge is to come up with effective communication tools and methods to convey the message and motivate people. They can easily be adapted to the local culture and social context.

PROJECT LEADER
City of Kuopio Environmental Centre

PARTIES INVOLVED
• Motiva Oy (governmental energy expert organisation)
• City of Kuopio Facility Management
• Kuopio Energy (municipal energy corporation)
• Jätekukko Oy (municipal waste corporation)

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Building refurbishment in Skåne

Type of project: Energy Efficiency – Building refurbishment
Location: Skåne, Sweden
Scope: Regional
Date of completion: On-going (end scheduled June 2014). Starting date was 2004.

BACKGROUND
- RegionFastigheter Skåne is mainly responsible for health care, but also for public transportation and regional growth and development.
- The region had experienced an increased need to refurbish and upgrade its premises. Substantial potential savings in energy and operational costs were identified in public buildings.

OBJECTIVES
- Massive reduction of energy consumption (>25%) in 1/3 of the buildings, with unaffected or improved indoor climate.
- Profitable investments (pay-off in <7½ years)
- Positive environmental effects
- Use of established technology.

DESCRIPTION
- The project was carried out in three old hospitals in the region.
- An Energy Performance Contract (EPC) was established with a private company, who guaranteed a certain amount of energy savings for a certain remuneration. The private energy service company (ESCO) with whom a public-private partnership (PPP)\(^\text{18}\) was established is now in charge of the energy analysis, technology/know-how, implementation of solutions, and provision of the guaranteed results (e.g. firm guarantees of energy savings). The concrete measures to be implemented by the ESCO include extensive rebuilds of the Heating, Ventilation and Air Conditioning (HVAC) systems and implementation of numerous energy conservation measures in all three hospitals including building insulation, variable speed drives on fans and pumps or day lighting and natural ventilation strategies.

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\(^{18}\) In general, the term public-private partnership (PPP) refers to forms of cooperation between public authorities and the private sector which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service [EC, 2004]
FINANCIAL RESOURCES
- The total cost of the project was €11,800,000.
- Only the financing resources of the RegionFastigheter Skåne were used. These can be separated into two types: investments for normal maintenance, and firm guarantees of savings of slightly more than €1 million per year.

MANAGEMENT
- RegionFastigheter Skåne, owner of the buildings, issued a call for tenders and established the framework for the PPP.
- The private ESCO which won the call for tenders is T.A.C Energy Solutions.

OBSTACLES
- The lack of knowledge and interpretation capacity among the public branch organisations regarding financial, accounting and contractual aspects of PPP, third party financing (TPF) and EPC in Sweden.
- The attitude of employees who often think they already know what to do. The preventive solution put in place by RegionFastigheter Skåne lies in three words: information, participation, and explanation.

RESULTS
- Currently, the objectives of the project have been achieved up to 85% and this is still improving. RegionFastigheter Skåne hopes to reach 100% in 2007 and the objectives will probably be exceeded in 2008, but only marginally.
- The total energy savings in RegionFastigheter Skåne over the last two years were approximately 23,000 MWh in district heating.
- Approximately 3,889 tonnes of CO₂ are avoided annually. The cost per tonne of CO₂ avoided is €102.83 (i.e. benefits), which means that the project reduced GHG in a cost-effective way.
- The success of this project helped to focus both public attention and the region’s policy priorities on energy management.
- In 2004, when the project was launched, energy consumption was 288 kWh/m² in public buildings owned by RegionFastigheter Skåne. In 2005, RegionFastigheter Skåne established targets for reducing energy consumption each year. The targets were achieved in 2005, but not in 2006. More detailed information about the current energy efficiency situation in the region of Skåne could not be identified. In the period 1990-2004, the energy efficiency index for the whole economy in Sweden decreased by 11 %, (the same evolution was reported for EU-25) [ODYSSEE, 2006-07].
KEYS TO SUCCESS

- The internal preparation with clear communication, involving all stakeholders, was crucial in order to avoid internal opposition and to maximise the value of the future project.
- The rising energy price.
- The dawning environmental awareness.
- The good understanding and use of the Swedish code of Public Procurement by the team responsible for this project in the RegionFastigheter Skåne

CITIZENS' ATTITUDE TO THE PROJECT

- The customers/tenants of the three hospitals started their own internal campaigns to reduce the use of electricity. This is important since tenant behaviour affects the use of electricity more than technical modifications to the building.
- The operational and maintenance staff of the three hospitals where the project was implemented reacted positively because care was taken from the beginning to gain their adherence to the project.
- On a more general level, citizens were neither affected nor informed of the project. It was a deliberate choice to only involve the hospitals' personnel and tenants to ensure that the project would be reasonably feasible, easy to explain, and quick to produce results.

POTENTIAL FOR REPLICATION

- Organising the material and contacts with potential energy service providers is time consuming. It is usually necessary to set up a small team with complementary skills to carry out the tendering and contractual work.
- It is recommendable to analyse the feasibility of innovative financing methods taking into consideration the local and regional context.
- This is a profitable project despite the massive investments as long as the pay-off is set at < 8-10 years (calculated with present interest rates).

PROJECT LEADER
RegionFastigheter Skåne (regional authority)

PARTIES INVOLVED
- RegionFastigheter Skåne
- T.A.C Energy Solutions (private company)

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Public Lighting in the Town of Gödöllő

BACKGROUND
- Gödöllő is a town of around 30,000 inhabitants, North-East of Budapest. The energy expenditure of the town increased significantly in the 1990s due to rising electricity costs.
- The renewal of the outdated public lighting system was identified as one of the ways to bring energy and cost savings to the municipality.

OBJECTIVES
- The project aimed at bringing energy and related cost savings to the municipal administration through modernisation of the public street lighting by means of:
  - Changing over from old, inefficient mercury lamps in public street and park lighting to more efficient sodium and compact fluorescent lamps
  - Improving lighting quality in streets and parks.

DESCRIPTION
- 269 mercury lamps were changed into 3,241 sodium and compact fluorescent lamps.
- Part of the lamp posts were also renewed, as switching from old mercury vapour lamps to new energy efficient products often means replacing not just the lamps but also the equipment trays or the total fittings.

FINANCIAL RESOURCES
- The total budget of the project was approximately €327,650 (84 million Forints), of which 51% came from the town of Gödöllő, 37% came from a commercial credit and 12% came from the EU through the PHARE Fund.
- The payback period was estimated at 3-3.5 years.
MANAGEMENT
- The Head advisor to the municipality worked as project manager during the planning and implementation of the project.
- Budapest Electric Works (private electric company) carried out all the technical work.

OBSTACLES
- The implementation of the project was originally delayed due to the lack of financing and the opposing interests of Budapest Electric Works.
- External funding solved the first issue and it also enabled the involvement of Budapest Electric Works as co-beneficiary.

RESULTS
- The new lamps and the improved lighting system reduced the energy consumption by 55%, resulting in savings of 1,376,000 kWh per year. This translated to €41,280 at the time of the project, but prices have increased significantly since then. At today’s prices, the annual cost savings could be estimated at €92,192.
- 787 tonnes of CO₂ are avoided per year due to the introduction of this more efficient lighting system. The cost per tonne of CO₂ avoided was estimated at €43.21, assuming that the benefits of the project accrue over 20 years. This means that the project reduces GHG in a cost effective way.
- The current overall energy efficiency situation in Gödöllő is poor. The majority of the buildings are old and major renovation is needed to improve their energy efficiency. However, for the moment, lack of financing prevents the municipality from implementing such projects. Even so, Gödöllő has just completed energy audits in 17 of its public buildings. These will form the basis of the energy-conscious renewal of the buildings when funds become available. With its energy audits, Gödöllő is a frontrunner in Hungary. More detailed information about the current energy efficiency situation in Gödöllő could not be identified. In Hungary, between 1998 and 2004 the energy efficiency index improved by 10 %, against 5% for the EU-25.

KEYS TO SUCCESS
- The ability to create a win-win situation between the local authority and the electric company. External funding (commercial credit and EU fund) played an important role in this.
- The project on public lighting is part of a continuum of energy (efficiency) actions carried out by the City of Gödöllő. The commitment of Gödöllő’s ex-deputy mayor to energy issues motivated the whole municipal council.
- The city’s close relationship with the local university, where work on energy issues is carried out.
CITIZENS’ ATTITUDE TO THE PROJECT
- Citizens were satisfied with the outcome of the project. New lamp posts installed during the project are considered to be more aesthetic, broken lamps/lamp posts were replaced.
- Some additional streets were also equipped with lighting, which was welcomed by the citizens.

POTENTIAL FOR REPLICATION
- Technically, the project can easily be replicated elsewhere. However, at least in Gödöllő, the external funding was an important enabling factor, which may not always be available to the local/regional authorities.
- The change over from mercury vapour lamps to more efficient alternatives is relevant throughout the EU, not only in new MS. Approximately one third of Europe's roads and motorways are still being lit using energy-inefficient mercury lamps.

PROJECT LEADER
Town of Gödöllő (municipality)

PARTIES INVOLVED
- Budapest Electric Works
- Town’s Delegates’ Body
- External Consultant

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# Environmentally friendly school building in Mirecourt, France

**Type of project:** Energy Efficiency - Efficient building  
**Location:** Mirecourt, Vosges, France  
**Scope:** Regional  
**Date of completion:** June 2004

## Background
- The considered area is rich in forestry resources, and a plan for using wood resources for building and heating purposes has been developed since 1996.
- The project leader is the local authority responsible for building and maintenance of secondary school buildings in its area. The new building which the project refers to fell into the scope of this effort to use wood.

## Objectives
- Build a school that is environmentally friendly throughout its life cycle.
- Energy efficiency thanks to the structure of the building.
- Good acoustic and thermal properties and in general good indoor conditions for the users of the building.
- Use of the forestry resources of the area.

## Description
- A secondary school for 800 pupils was built based on the French “Haute qualité environnementale” (HQE) concept, which seeks the integration of the principles of sustainable development in buildings.
- The building is largely made out of wood and the heating system uses local forestry resources.
- A main feature of eco-efficiency is due to the building structure, with a large overall structure including workplace “islands”. The external structure acts as a thermal regulator and creates a pleasant indoor space.
- The project lasted from 1997 to 2004. The building was completed on time and within the scheduled budget.
FINANCIAL RESOURCES
- The cost of the project was €14,000,000.
- The construction of the school was entirely funded by the Conseil Général des Vosges (regional council in the area).
- The additional cost compared to a building not built according to the HQE approach and without using wood as its material and heating power supply is estimated to be about 3.5% (about €473,000).

MANAGEMENT
- The Conseil Général launched the call for tenders to select an architect, selected the architect to design the building, and funded the whole project.
- A private company (Architecture Studio) was in charge of the design and construction of the building.

OBSTACLES
- The choice of wood as the construction material for the school caused some concerns to pupils’ parents, about the safety of the building.
- This problem was overcome thanks to a simple and efficient communication strategy based on a meeting between firemen and pupils’ parents.

RESULTS
- Estimated energy savings compared to a corresponding standard building: 940 MWh per year, which would equal annual savings of 226 tonnes of CO₂.
- Use of renewable energy (wood) reduced CO₂ emissions by about 197 tons per year.
- Furthermore, about 1,350 tons of CO₂ are captured in the wood material of the building.
- Estimated savings thanks to renewable energy use: €21,000 per year.
- For a period of 30 years of operation, the cost per tonne of CO₂ avoided was €-19.96 (taking into account both the energy efficient building and the renewable energy heating system) or €-11.35 (taking into account only the energy efficient building), which means that the project reduced CO₂ in a cost-efficient way.
- In the area where the project took place, only 2.7% of energy production come from renewable sources compared to almost 13% across France (1999 data). Such a project is a solution to increase the renewable energy production in the area. Regarding energy efficiency, detailed information about the current energy efficiency situation in the département des Vosges could not be identified. In France, the energy efficiency of final consumers improved by 13% (or 1%/year) in France between 1990 and 2004. This is better than the EU average (11% improvement) [ODYSSEE, 2006-07].
KEYS TO SUCCESS
- The project is included in a larger sustainable building strategy based on a major natural resource of the area: wood.
- In terms of acceptance of the building, a careful follow-up of citizens' reactions and a quick answer to their questions via an explanatory public meeting led to good acceptance by the population.

CITIZENS' ATTITUDE TO THE PROJECT
- No formal enquiry was made to collect citizens' opinions, but attention was paid to the questions that citizens spontaneously expressed.
- Once detected, the negative opinion of pupils’ parents was taken seriously and dealt with.
- Apart from this early problem, the building was well accepted in the area.

POTENTIAL FOR REPLICATION
- Such a project could be replicated in areas with large and exploitable wood resources.
- In some cases, the application of low-energy standards to buildings has to be certified by a competent authority.
- Usually, the construction of a building according to the HQE approach can increase the total costs by 5-10%.

PROJECT LEADER
Conseil Général des Vosges (regional council in the area), department of wood and environmental quality

PARTIES INVOLVED
- Architects: Architecture Studio (contractor)
- Subcontractors

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Energy efficient holiday village in Schleswig-Holstein

BACKGROUND
- The project in Augustenhof Beach Village, located in Schleswig-Holstein, aims to prove that the tourist industry and conservation can get along while being profitable.
- The promoters of the project wanted to build a modern and eco-designed holiday village in harmony with ecological, economic and social considerations.

OBJECTIVES
- Build an eco-designed holiday village, with low energy consumption and low impact on the environment.
- Be at the cutting edge of innovative environmental technology whenever and wherever possible.
- Build houses and use the surrounding areas as aesthetically as possible.

DESCRIPTION
- The community building of the tourist village is one of the first commercially used "passive houses" (buildings in which a comfortable interior climate can be maintained without active heating and cooling systems, the buildings have to comply with specific standards for energy use) in this area. It needs less than 15 kWh/m² of yearly energy input.
- The 15 guest houses are wind-proof, perfectly insulated and have triple-glazed windows.
- A pellet burner, 19 solar collectors, a gas burning system as well as a PV system on the roof of the community building are used to provide energy.
- The materials and technologies that were used were chosen for their low impact on the environment.
FINANCIAL RESOURCES
• The project was partially founded by the Schleswig-Holstein Energy Foundation (Energiestiftung Schleswig-Holstein) and the Ministry for Agriculture, Environment and Rural Areas of Schleswig-Holstein.
• The cost associated with the low energy consumption measures (i.e. insulation) and the renewable energy systems is €142,000.

MANAGEMENT
• The Schleswig-Holstein Energy Foundation was the leading regional organisation in this project.
• This foundation was assisted by the Investitionsbank of Schleswig-Holstein (regional development bank), and the Ministry for Agriculture, Environment and Rural Areas of Schleswig-Holstein.

OBSTACLES
• The location of the beach village was controversial and the district planning authorities were initially against it. For this reason, it took seven years to get the licence for the building of the village.
• Conservationists were also opposed to the project, due to the valuable characteristics of the surrounding area.
• The initial opposition to the construction of the beach village was overcome. The promoters of the project defended it by pointing out that they only used 3 hectares out of 15 for the beach village, the 12 remaining hectares remaining wild.

RESULTS
• 56.9 tonnes of CO₂ were saved thanks to the implementation of low energy standards and 16.2 tonnes of CO₂ to the use of renewable energy sources.
• Solar energy from the Photovoltaic (PV) system and the solar thermal plants as well as the wood pellets provide most of the energy that is used for heating.
• Estimated savings thanks to renewable energy use amounted to €13,000 per year. Taking into account the 20-year life span of the installations and considering the energy savings associated to the implementation of the low energy standards, the cost per tonne of CO₂ avoided is estimated to be €-39.07, which means that the project reduces GHG in a cost-effective way.
• The share of renewables in Schleswig-Holstein electricity consumption was 33% in 2006, which is considerably higher than the national figure (4.83% in 2005). Detailed information about the overall energy efficiency situation in Schleswig-Holstein could not be identified. In Germany, in the period 1991-2004, the energy efficiency index for the whole economy decreased by 15 %, compared to 11 % for the EU.
KEYS TO SUCCESS
- The project received contributions from the regional authorities. It notably received major funding and help from the Energistiftung Schleswig-Holstein and the Regional Ministry for the Environment.
- Another key factor in the success of this project was the promoter’s capacity to sell this innovative concept to stakeholders and to motivate funding institutions.

CITIZENS' ATTITUDE TO THE PROJECT
- Some of the guests come because of their interest in eco-friendly holidays. Others, who arrive without being aware of the beach village’s characteristics, are often positively impressed by the eco-buildings and pick up some ideas to replicate at home.
- The local press and TV-station made documentaries about the beach village, which is now well-known as a pioneer of sustainable tourism in the region.

POTENTIAL FOR REPLICAATION
- This experience shows that it is possible to build successful passive houses for commercial purposes and to use eco-friendly buildings as tourist accommodation.
- Similar projects could be developed provided that tourist promoters agree to take into consideration the environment, and realise that higher investments related to energy efficient buildings can pay off.
- It is important to take into consideration that some locations would be more appropriate than others for the implementation of this type of project.

PROJECT LEADER
Schleswig-Holstein Energy Foundation
(Energiestiftung Schleswig-Holstein, funded by the German Federal State of Schleswig-Holstein and the energy industry)

PARTIES INVOLVED
- Ministerium für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein
  (Ministry for Agriculture, Environment and Rural Areas of Schleswig-Holstein)
- Investitionsbank of Schleswig-Holstein (regional development bank)

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RENEWABLE ENERGY PROJECTS

The detailed description and analysis of each case study can be found in the dedicated fact sheets that are included in Annex 3.
ANALYSIS OF 10 SUCCESSFUL ENERGY EFFICIENCY AND RENEWABLE ENERGY PROJECTS
Project for solar energy use at Český Krumlov council offices

**BACKGROUND**
- The city of Český Krumlov wanted to reduce the use of natural gas and obtain lower running costs for hot water and domestic heating.
- Other reasons to carry out this project included the willingness of the city to cut environmentally harmful emissions and to set a good example for other institutions and for citizens in the use of renewable energy sources.

**OBJECTIVES**
- Install solar collectors and PV panels at the council offices in Český Krumlov
- Increase the awareness and skills of local authority officials, company employees and the general public regarding the use of RES.
- Increase the share of renewable energies in total energy production by using the experience of the Upper Austrian partners in this area.
- Cross-border exchange of know-how in energy savings, renewable energy sources and modern technologies between Upper Austria and South Bohemia Region.

**DESCRIPTION**
- Installation of 85 m² of solar collectors and a PV system with an installed output of 1 kWp at Český Krumlov Council offices.
- The solar photothermal system is used for hot water and heating.
- Two seminars on solar energy were organised for city mayors and the general public and more than 5,000 copies of the project’s brochure were disseminated.
- A training programme called "Energy consulting courses for multipliers" was also carried out. It consisted in 6 seminars and 6 site-trips on the themes of RES, energy efficiency and energy policy.
FINANCIAL RESOURCES
• The total project budget was €62,815. From this amount, €42,947 were designated to the installation of solar equipment.
• 75% of the funding was provided by an EU grant (Phare CBC 2003). The other 25% of the total cost was financed by the local authority (69%), Energy Centre České Budějovice (regional energy agency in the region of South Bohemia) (27%) and the Regional energy agency in Upper Austria (4%).

MANAGEMENT
• The city of Český Krumlov was mainly in charge of the decision-making and financing.
• The Energy Centre České Budějovice (ECCB) and O. Ö. Energiesparverband (regional energy agency in Upper Austria) took over the technical aspect, planning and organisation of the promotional activities, and also contributed to the financing.

OBSTACLES
• A detailed technical inspection and examination of the building structural load led to the supporting steel structures being strengthened during the project, which involved building work and required the project to be extended and the contract price to be raised.
• The contract specification could not directly stipulate the product type (parameters of the equipment). This prolonged the tender procedure and selection of supplier.

RESULTS
• The total annual yield of heat energy from the photothermal system is estimated at 41,300 kWh/year. The annual yield of the PV system is estimated at 900 to 1,200 kWh.
• The photothermal system avoids the burning of 5,425 m³ of natural gas, thus avoiding 8.4 t of CO₂. The PV system can provide savings of 1.17t of CO₂.
• It was estimated that the saving from the photothermal system if used to the full could amount to €3,000 per year with €143 for the PV system. Considering 20 years of operation, the cost per tonne of CO₂ avoided was €-7.28, which means that the project achieved GHG emissions reductions in a cost-effective way.
• Very limited information exists regarding the current contribution from LRAs to the implementation of renewable energy systems in the Czech Republic. The total surface area of solar collectors installed in the country in 2005 was 18,780 m², against 2,073,391 m² in Europe.
KEYS TO SUCCESS

• Support from all the different stakeholders, and particularly the involvement of the city council.
• The promotional part as well as the campaign awareness (i.e. the “solar energy” seminars) contributed to the acceptance of the project but also to increased awareness and understanding of the problem of climate change and renewable energy technologies.
• Cross border exchanges of know-how in renewable energy technologies between experts from Austria, and the Czech Republic helped to establish new and professional contacts that may be extremely useful in the future for the implementation of similar projects.

CITIZENS' ATTITUDE TO THE PROJECT

• Only positive public reactions were observed upon implementation of the project.
• The public information campaign that was carried out during the project contributed to the good acceptance of the project by the general public.

POTENTIAL FOR REPLICATION

• The project can serve as a demonstration project for other such buildings. Such a project could easily be replicated by other local/regional authorities, as it is not complicated from the technical point of view (i.e. installation of the solar collectors and PV panels).
• Planning and organisation of the training is straightforward. Nevertheless, the involvement of specialised consultants could be extremely useful.

PROJECT LEADER
City of Český Krumlov

PARTIES INVOLVED
• Energy Centre České Budějovice(ECCB, regional energy center)
• O. Ö. Energiesparverband (Regional energy agency in Upper Austria).
• OÖ für Umwelt und Natur (environmental department of the Upper Austrian government).
• Energieinstitut (Austrian Energy Institute)
• Klimabündnis Österreich (the Austrian Climate Alliance)

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Biomass district heating plant in Las Navas del Marqués, Ávila

Type of project: RES – Solid biomass  
Location: Las Navas del Marqués, Avila, Castilla y Leon, Spain  
Scope: Regional  
Date of completion: December 2006

BACKGROUND

- The project was intended to promote the utilisation of forestry residues for energy generation, thus allowing for the creation of new and durable jobs in this rural area, contributing to the energetic independence of the municipality and promoting the utilisation of renewable energy sources.
- The project was carried out in the framework of the Biorreg-Floresta project 19.

OBJECTIVES

- Support the establishment of a fuel supply from forestry residues.
- Install a medium-size biomass heating plant for the production of energy for heating purposes that could be used in public buildings of the municipality of Navas del Marqués.

DESCRIPTION

- A biomass district heating plant with a heat output of 1,000 kW was installed in the municipality of Las Navas del Marqués.
- The biomass is obtained from woodland undergrowth clearance in local forests. The boiler supplies energy for heating and hot water to different public buildings in the area.
- Seminars were organised for representatives of the local government, the general public, companies, and specialised professionals.
- Promotional material, including a brochure of the project and press releases, were produced and disseminated.

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19 The Biorreg-Floresta project (http://www.biorreg-floresta.org/index.php) fits in the programme on transnational cooperation Interreg III (B) Atlantic Area. Its main objectives are the promotion of exchanges of environmentally-friendly agricultural and forestry practices, the promotion of renewable energies inside the Atlantic Area, the development of environmental technologies, and the valuation and use of forest residues.
FINANCIAL RESOURCES
- The total cost of the Biorreg-Floresta project was €2,048,178.58.
- The total investment in the implementation of the biomass district heating plant was €515,000.
- The European Regional Development Fund (ERDF) grant contributed with 57% of the total programme cost, while the different partners (see table below "parties involved") financed the remaining 43%.

MANAGEMENT
- The leading partner of this project was the County Council of Ávila, through the Energy Agency of the province of Ávila (APEA), which is a specialised unit of the Ávila County Council.
- The city council of Las Navas del Marqués, where the project was carried out, contributed to the funding of the project and the decision-making process. European forestry associations (e.g. Forestry Association of Galicia) and energy agencies from other MS also participated.

OBSTACLES
- One of the main obstacles encountered at the beginning of the project was that the general public, in particular the population in the area of implementation, was sceptical about the feasibility of carrying out this type of project in the area.
- Another obstacle was the inexperience of the authorities and partners in carrying out renewable energy projects.

RESULTS
- The biomass plant produces 4,165,000 kWh/year.
- It replaces 70% of the traditional fuel for district heating (natural gas), which in turn contributes to the reduction of GHG. It was estimated that the plant avoids the emission of approximately 1,126 tonnes of CO2 per year.
- Over 20 years of operation, the cost per tonne of CO2 avoided is estimated to be €-11.23, which means that the project resulted in a cost-efficient reduction of GHG.
- The seminars and awareness campaigns that were carried out within this project contributed to increased awareness about climate change issues and the know-how in the municipality regarding renewable energies.
- In the autonomous community of Castilla y Leon, where the province of Ávila is located, the share of renewable energies is 11.4% of the total energy consumption, and 15.7% in the case of total electricity, thus above the national average (the share of renewable energies in primary energy consumption in Spain in 2005 was 6.03%).
KEYS TO SUCCESS
• The close collaboration between the different project partners and the local authorities.
• The contribution from the technicians and specialised consultants who advised and assisted the authorities in the decision-making process was essential for the success of the project.
• A good public awareness campaign contributed to the acceptance of the project.

CITIZENS' ATTITUDE TO THE PROJECT
• The seminars and awareness campaigns that were carried out within this project helped to dissipate the initial doubts among the general public about the feasibility of the project.
• Nowadays the support for and acceptance of the biomass plant is unanimous.

POTENTIAL FOR REPLICATION
• Similar projects can be replicated in other municipalities with forestry resources.
• The use of waste biomass to fuel a district heating network does not require such a large supply of biomass as other projects, such as electricity generation.
• Before considering solid biomass for heating or electricity production, it is important to evaluate the availability of biomass in the area of implementation, the quality of the material that will be necessary and the associated costs.

PROJECT LEADER
County Council of Ávila

PARTIES INVOLVED
• Energy Agency of the province of Ávila (APEA)
• City council of Las Navas del Marqués Monte Industria (Association of forestry industries) and SFORGAL (Forestry Association of Galicia (Spain)
• Energy Agency of the Mayo County Council (Ireland)
• Associacio de productores florestais de Setubal, Centro de Biomassa para a Energia, Villa de Ponte de Lima, Ponte de Barca (Portugal)
• Severn Wye Energy Agency (UK).

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ANALYSIS OF 10 SUCCESSFUL ENERGY EFFICIENCY AND RENEWABLE ENERGY PROJECTS
Building refurbishment in Frankfurt am Main using CHP and solar thermal

Type of project: RES - Solar energy
Location: Frankfurt am Main, Germany
Scope: Local
Date of completion: 2004

BACKGROUND
- The Wohnheim GmbH - a social housing company - has gradually modernised its real estate property by following a standard scheme of renovations, which included the installation of solar thermal plants.
- A total of 200 dwellings, housing approximately 280 inhabitants were targeted with this project.

OBJECTIVES
- Improve the residential environment and the sanitation of low-cost housing, and creating dwellings that will be profitable in the long term by:
  - Installing a solar thermal plant for hot water in summer on every building
  - Refurbishing the buildings to low energy standards
  - Reducing CO₂ emissions

DESCRIPTION
- Five decentralised solar thermal plants of 51 m² each were installed for domestic hot water.
- A Combined heat and power (CHP) unit with a capacity of 30 kW (electrical) and 60 kW (thermal) was installed together with a boiler for peak demand with a capacity of 390 kW to provide heat to the tenants.
- The buildings were also refurbished to low energy standards (60 kWh/m²a).

FINANCIAL RESOURCES
- The main source of funding for this project was the KfW Bankengruppe (KfW-banking group), owned by the German federal government and the federal states - "Länder") through the CO₂ Building Rehabilitation Programme.
- The cost of the solar thermal plants was €180,000 (€670 - 740 /m²), €55,000 for the district heating line and €170,000 for the central heating station.
MANAGEMENT
• The Wohnheim GmbH is a public housing company that was founded in 1951 by the city of Frankfurt and the Land of Hessen. In this project, it promoted the installation of decentralised solar thermal plants and a district heating system with a cogeneration unit.
• Advice was provided by the Energiereferat Stadt Frankfurt am Main (department of the city of Frankfurt am Main that sets up and implements the energy and climate protection plan for the City of Frankfurt am Main).

OBSTACLES
• In the first place, the promoters of this project wanted to sell the electricity produced by the CHP unit to the tenants. This would have increased the project's profits. But this was not possible for legal reasons and therefore, the profits of the project were reduced.

RESULTS
• The total energy produced by the implemented renewable energy source amounted to 70,000 kWh (during the warmer months).
• 40% of the electricity used in the area could be provided by the CHP unit (though in the present case all the electricity goes to the grid).
• The annual reduction of CO₂ emissions amounted to 734 tonnes (installation of solar thermal plants, thermal insulation and CHP-unit), of which 23 tonnes are avoided by the solar plants.
• The solar plants can potentially generate 116,025 kWh annually (considering a thermal efficiency of 455 kWh/m²), which would be equal to 38 tonnes of CO₂ avoided.
• If only considering the potential annual energy production for water heating (116,025 kWh/year) and 20 years of operation, the cost per tonne of CO₂ avoided by the solar thermal plants would be €13.04 (i.e. an expense).
• In Frankfurt, 240 GWh of electricity are produced locally from renewable energy sources, which represents 5% of the local electricity consumption. This figure is below the national share (10.37% in 2005). The city’s goal, as a founder member of the “Climate Alliance”, is to reduce its CO₂ emissions by 50% by 2010.

KEYS TO SUCCESS
• Strong support from the stakeholders, and especially from the Director of the housing company, who wanted this organisation to be competitive and eco-friendly in the future.
• Good financing conditions from the KfW- banking group “CO₂ Building Rehabilitation Programme”.
• Contribution from the energy department of the city of Frankfurt am Main.
CITIZENS' ATTITUDE TO THE PROJECT

- People were supportive of the project, as they saw that the housing company cared about the environment, and also because they were informed that it would help reduce their energy bills.
- The project has helped to improve the image of the neighbourhood among dwellers who now perceive their housing as more environmentally-friendly.

POTENTIAL FOR REPLICATION

- Before replicating this project, it is important to evaluate the different concepts for the refurbishment of buildings and also to take into consideration the existing feed-in systems in order to maximise benefits.
- This project shows that even in Central Europe, where there are fewer hours of sunlight, the installation of solar thermal plants represents an interesting opportunity to replace fossil fuels and fight climate change.

PROJECT LEADER
Wohnheim GmbH (social housing company)

PARTIES INVOLVED
- Energiereferat Stadt Frankfurt am Main Frankfurt (energy department of the city of Frankfurt)
- KfW Bankengruppe (KfW-banking group, owned by the German federal government and the federal states - "Länder")

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Aberdeen Farmhouse Heat Pumps

**Type of project:** RES – Geothermal  
**Location:** Aberdeen, North East Scotland, United Kingdom  
**Scope:** Local  
**Date of completion:** July 2006

**BACKGROUND**
- More than 20 farmhouse properties, situated on the outskirts of Aberdeen, are owned by the Aberdeen City Council. Most of the properties are detached, solid wall, and are exposed to the elements. They have had little or no insulation added since they were built pre 1900 and are heated by a mix of solid fuel, electric storage or stand-alone electric heaters.  
- All properties are off the main gas network, and therefore they can be considered as “hard to heat”.

**OBJECTIVES**
- Determine whether Ground source heat pump (GSHP) systems are a means to achieve “affordable warmth” in “hard to heat” farm houses properties off the gas network in Aberdeen.

**DESCRIPTION**
- GSHP were installed in six farmhouses chosen because of their very poor insulation (NHER score (National Home Energy Rating)< 3)\(^1\).  
- Electricity consumption was monitored in the farmhouses during 12 months, in order to calculate energy costs and compare them with hypothetical annual running costs for traditional electric or oil heating systems.

**FINANCIAL RESOURCES**
- The total estimated capital cost of the project was €109,800.  
- The project was mainly financed by the Aberdeen City Council, the Scottish Community and Householder Renewable Initiative and Scottish Power.

\(^{20}\) Affordable Warmth is defined in the Aberdeen City Council Fuel Poverty Strategy as “No more than 10% of a household’s disposable income needs to be spent on fuel in order to cover the cost of heating up to 16 hours per day, along with light and power”  
\(^{21}\) NHER gives a building a score of 0 up to 10, with 0 representing the worst energy efficiency and 10 the best.
MANAGEMENT

• The project was managed by the Scottish Community and Householder Renewable Initiative (SCHRI), which offers grants, advice and project support to assist the development of new community and household renewable schemes in Scotland and is managed jointly by the Energy Saving Trust and Highlands and Islands Enterprise (HIE).
• The final decision to launch the project was taken by the person responsible for energy in the Aberdeen City Council.
• A private company called Save Cash and Reduce Fuel (SCARF) carried out the monitoring of the performance of the installed GSHP systems.

OBSTACLES

• Manufacturer instructions for controlling the system were complicated and not easy to understand, so SCARF published their own simplified pictorial instructions on how to control heating and hot water and carried out the monitoring of the GSHP systems.
• Tenants were wary and unsure of this new technology, so SCARF visited tenants at home at the very beginning of the project to explain GSHP, and left them a fact sheet and a case study. They also gave a contact number for a local advice centre for impartial advice.
• Tenants were worried about costs. Indeed, as there was no similar installation to compare against to allay fears, it was a step into the unknown. This was one of the reasons why SCARF asked the heat pump companies to give their predicted running costs as part of their tender return.

RESULTS

• Affordable warmth was achieved in the four farmhouses where it was actually possible to monitor consumption. After installation of the heat pumps, all the farmhouses had a respectable average NHER score of 6.75 Annual fuel cost savings ranged from 41% to 60%.
• In general, tenants were satisfied with the new heating system.
• It was observed that GSHP systems enabled approximately 75% annual CO₂ emissions savings, compared to the standard electricity mix. Approximately 112 tonnes of CO₂ are avoided annually.
• The cost per tonne of CO₂ avoided was estimated to be €1.48.
• The current share of renewable energy in overall energy production in the Aberdeen area is assumed to be less than 1%, according to SCARF, which is below the national share of 1.61% in 2005. Generally speaking, there were 550 GSHP systems representing a total power of 10.2 MWth in the United Kingdom in 2006. The total number of installed GSHP in the EU in 2006 was 455,435 units, for a total capacity of 5,379 MWth.
**KEYS TO SUCCESS**

- The visits to the tenants in their homes by an experienced energy advisor (SCARF) to explain the heating system and work involved was probably a major factor in achieving 100% agreement from the first six tenants chosen.
- In general, the granting of funding and the support from the local authority and SCHRI Development Office were key factors in driving the project forward.

**CITIZENS' ATTITUDE TO THE PROJECT**

- The six tenants involved in the project were all very sceptical about the Heat Pump Technology on the first visit but they finally agreed, with the thought that it could not be worse than what they had.
- All agreed to go forward to the tendering stage with one tenant waiting to find out more about the technical and logistical aspects of installation before fully committing.
- After the tender was complete, all participants were visited again and it was confirmed at this stage that all were willing to participate.

**POTENTIAL FOR REPLICATION**

- When assessing whether a GSHP system is a suitable replacement heating system for installation in “hard to heat” properties, the household net income should be taken into consideration in order to ensure that the occupants can afford to heat the house by using 10% or less of their net income. Technical assessments should also be carried out prior to installation.
- The estimated running costs should be supplied to the occupants prior to installation to enable them to make an informed decision on the type of heating system to be installed in their home.

**PROJECT LEADER**

Aberdeen City Council

**PARTIES INVOLVED**

- Energy Saving Trust (organisation that promotes the sustainable use of energy and the reduction of CO2 emissions in the United Kingdom).
- Scottish Community and Householder Renewable Initiative (SCHRI)
- Company “Save Cash and Reduce Fuel” (SCARF), (energy efficiency services)

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Implementation of Biodiesel Mixtures in Public Transport Buses in Crete

Type of project: RES – Biofuels - Sustainable Mobility
Location: Crete, Greece
Scope: Regional
Date of completion: February 2006

BACKGROUND
- Crete produces a very large quantity of used vegetable oils (fried oils), especially in summer.
- The public bus company of Eastern Crete had already expressed its interest in alternative fuels, especially in biodiesels, and its willingness to implement an innovative project in this field.

OBJECTIVES
- The integration of biodiesel in public transport in Crete.
- The familiarisation of transport providers with biodiesel.
- Increasing the experience and know-how of biodiesel technology among transport organisations and relevant authorities.
- Obtaining valuable results by the scientific monitoring of buses using biodiesel mixtures.
- Raising awareness amongst the relevant stakeholders and the general public thanks to information and dissemination campaigns.

DESCRIPTION
- A level of 20% of biodiesel was used in 2 public buses in Heraklion.
- A seven-month special monitoring and control procedure was implemented to check the technical and environmental performance of the 2 buses.
- A market analysis was conducted to assess the potential supply of used oils in Crete and the potential demand for biodiesel if this pilot project was to be implemented on a larger scale.
- An information campaign was initiated to convince sceptical drivers and the general public of the environmental benefits and technical performance of buses using biodiesel.
FINANCIAL RESOURCES
• The total budget for the project was €89,203.
• It was financed by national and regional funding (€45,154) and the European Community (€44,048).

MANAGEMENT
• The project was led by the Regional Energy Agency of Crete (REAC).
• The REAC organised meetings and workshops and ensured the cooperation of important regional and national actors: public authorities, transport organisations and institutions (Heraklion government offices).
• It was responsible for the planning, development, implementation, evaluation and information dissemination of the project.

OBSTACLES
• In 2004, the legal framework for the promotion and use of biodiesel had not been finalised in Greece and the REAC had to overcome various administrative problems. Nevertheless, it obtained the commitment of the regional and national politicians and continued as planned.
• The REAC had no know-how or experience in biodiesel use (biodiesel mixtures etc.) and therefore Greek experts had to participate in training courses in Austria.
• The drivers and the public were very suspicious of the use of biodiesel but REAC organised workshops, events and very successful information campaigns and they achieved the acceptance of biodiesel.

RESULTS
• The results show a reduction of up to 50% in smoke density (opacity), a reduction in hydrocarbon emissions by 40% – 55% (low – high speed), and a reduction in carbon monoxide (CO) and fossil CO₂ emissions.
• The project proved the technical feasibility of using biofuels in public transport buses in Crete, thus if implemented on a large scale in the future this could help increase the security of the island's energy supply and create a local business.
• The current share of renewable energies in overall energy production in Crete is 12% – 13%. In 2005, 3,000 tons of biodiesel were produced, as compared with 3,184,000 tons in the EU for the same period.
KEYS TO SUCCESS
- Obtain the active and full cooperation of all stakeholders (public authorities, politicians, private companies, institutions, etc.)
- Obtain political commitment in order to avoid administrative problems.

CITIZENS' ATTITUDE TO THE PROJECT
- As a result of the information campaign, which included the dissemination of informative leaflets and other promotional material and the broadcasting of news about the project in the regional TV and radio, the citizens who were sceptical in the beginning were finally very enthusiastic about the project.
- Public transport providers were interested in using biodiesel in their vehicles.
- REAC observed an increasing interest in investing in fried oil collection companies and installing biodiesel production plants.

POTENTIAL FOR REPLICACTION
- The use of biodiesel mixtures made from used fried oil, as in the best practice example in Greece, can be replicated in other areas where this type of waste is available in large quantities.
- This project required the implementation of a system for the collection of the used fried oil from the main producers such as private households, hotels and restaurants.
- Transport companies can easily follow this example as no modification of the bus engine is required.

PROJECT LEADER
Regional Energy Agency of Crete (REAC)

PARTIES INVOLVED
- Public Bus Company of Eastern Crete
- Heraklion Technical Vehicle Control Centre
- National Technical University of Athens
- Directorate of Transport of Heraklion Prefecture

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3.1 Analysis of the Energy Efficiency Projects

The projects carried out in Kuopio (Finland), the region of Skåne (Sweden), the town of Gödöllő (Hungary), in the city of Mirecourt (France) and in Schleswig-Holstein (Germany) presented in this study are good examples of the successful application of energy efficiency measures. Hereafter, the 5 projects are discussed and compared. For more detailed information about the projects, please consult the detailed fact sheets drawn up for each project that can be found in Annex 3.

- The roles and responsibilities of the different bodies involved in the projects

In the five energy efficiency case studies presented in this study, the LRAs participated in the financing, planning and decision-making process of the concrete projects. In most cases, someone from the energy or environmental department of the municipality or region was in charge of preparing and supervising the call for tenders for a service contract, the management of the implementation, and the coordination with the different partners of the project. For the case studies in Kuopio and Mirecourt, the LRAs also participated in the planning and development of training sessions and awareness campaigns. In all the five case studies, the main roles of the LRAs were as motivators for the reduction of energy consumption in public buildings and premises, and as consumers of energy.

Co-operation with national, regional or local energy agencies was observed for the projects in Kuopio, Skåne, and Schleswig-Holstein. This highlights the important role that these organisations play in assisting LRAs when implementing this type of project.

Private companies intervened at different phases of the projects. In some cases, they participated at the start by carrying out feasibility or preparatory studies, in others they were contracted for the actual implementation of the technical aspects of the project, such as in the project in Skåne where a PPP was established.

PPP refers to forms of cooperation between public authorities and the private sector which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service [EC, 2004]. For more detailed information on PPP, see Box 1.
Box 1 - Public-private partnership

The term PPP is used to describe a wide variety of working arrangements from loose, informal and strategic partnerships to service contracts and formal joint venture companies. A typical PPP example would be a hospital building financed and constructed by a private developer and then leased to the hospital authority. The private developer then acts as landlord, providing housekeeping and other non medical services while the hospital itself provides medical services.

PPP can be of different types [Energie-Cités, 2004]:

- The public authority and a private organisation form a private/mixed company. Both participate in that company. The new company carries out the public services.
- The public authority signs a contract for a planned duration with a private organisation that carries out the public tasks. This is known as performance contracting (PC). In the case the service contract involves energy savings, it is an Energy Performance Contract (EPC).
- The private organisation is granted a concession to provide a service and is allowed to charge a fee to the citizens using that service. This is a concession contract.

From all these categories of PPP, the most relevant for sustainable energy projects is PC. It can used for monitoring buildings, for managing technical equipment (i.e. boilers, cogeneration equipment, ventilation, lights), and for making energy savings.

The decision-making process

The motivations for carrying out the energy efficiency projects were different in each case. While the project in Mirecourt was implemented in the context of the regional strategy to exploit forestry resources available in the area for the construction of buildings and with heating purposes, the project in the city of Kuopio was the next step in the continuous work carried out by the city for energy savings and improved efficiency. In the case of Skåne, the project responded to the increased need to refurbish and upgrade old public buildings that had high energy and operation costs. For the project in Gödöllő, the renewal of the outdated public lighting system was identified as the best way to reduce the ever-increasing energy expenditure. The project in Schleswig-Holstein was intended to prove that the tourist industry and environmental conservation can work together and at the same time be profitable. In any case, it can be generalised that energy efficiency projects are perceived as an opportunity to reduce energy consumption and thus the electricity bill.

The assistance of specialised consultants and experts from public or private organisations and companies is important for the adequate implementation of the project as their experience and knowledge can facilitate the decision-making process and help authorities to take sound decisions.
An important aspect highlighted in the case study of Skåne was that it is important to keep all the participants of the project informed of the progress of the different phases and the decisions that are taken. Ideally, all of them should be present when decisions are taken. In Skåne, certain aspects of the project were modified in the beginning of the implementation and it was thanks to the good communication with the different partners that it was not difficult to introduce such changes.

**The citizens’ and beneficiaries’ attitude**

In general, the five projects analysed in this study were well-accepted by the main beneficiaries and the general public. The case studies of Kuopio, Skåne and Mirecourt show that it is important to be reactive to beneficiaries’ preoccupations. For example, in the case of the school built in Mirecourt, the managers of the project did have to “dismantle” certain “common incorrect facts” about buildings made from wood. Public information sessions were held in order to inform the public about the qualities of wooden structure buildings compared with metal structure buildings in case of fire. This type of misconception can make acceptance among beneficiaries more difficult and jeopardise the success of the project. It is therefore important to address them as soon as possible.

In the case study of Kuopio, difficulties over acceptance of the project were linked to lack of knowledge and ignorance about the importance of energy saving measures. A negative attitude to environmental issues was also observed among some stakeholders. One specific point that was obtained as negative feedback was that the cost savings did not directly benefit the work units involved in the project, but were allocated to the city in general. A similar reaction was observed in the project in Skåne.

None of the projects included a public consultation. The available data suggests that this practice is not widely used in the implementation of this type of project.

An element that can be decisive in the attitude of the population and the beneficiaries towards the concrete projects is their existing awareness of climate change.

**Cost and funding**

The cost of the analysed projects varies greatly from €88,500 for the energy programme in Kuopio up to €11,800,000 for the project in Skåne (depending on the type of energy measures implemented, the scale of implementation and the lifespan of the project). In general, it is observed that energy efficiency projects have short payback periods (less than 15 years). This is due to the major cost
savings associated with the energy savings that can potentially be achieved. For example, the payback period for the project in Kuopio was estimated at 1 year, while the payback period for the project in Skåne is expected to be 7.5 years.

Only in 2 of the case studies (in Skåne and Mirecourt), the projects were entirely funded by the concrete LRAs. In the other 3, the projects received also European (in Gödöllö) and national (in Schleswig-Holstein and Kuopio) funding. This highlights that in some cases, local or regional financial resources are not enough and external funding is required.

In this regard, only the case study of Skåne presented a more innovative financing mechanism, though the establishment of an EPC. For more detailed information on financing methods, see Box 2.
Box 2: Financing Methods

There are different types of financing for sustainable energy projects. It is possible to distinguish between classic and innovative methods.

The so-called ‘classic’ methods generally include equity (or self-) financing, where project investors, in this case the local or regional authorities (LRAs), invest their own resources without using any external fund, or ‘debt financing’ where investors borrow the money they invest, either in the form of loans or by issuing shares. These methods are broadly applied but in some cases they might cause difficulties for municipalities and regional authorities, who are required to provide guarantees or have a limited borrowing capacity [ADEME, 2006].

This is the reason why other methods for financing are gaining momentum today, as they offer more flexibility and reduce the barriers that can be encountered with traditional methods. Three interesting innovative methods include [ADEME, 2006]:

- **Leasing**, when the loan is given in the form of a piece of equipment of which the lessor remains the owner. This can be an expensive form of financing and it is generally limited to a relatively common and clearly defined object, which limits its usability in the case of more complex projects.

- **Energy Performance Contracting** consists of a shared savings contract, where a private company, the so-called Energy Service Company (ESCO), guarantees a certain amount of energy savings to its customer (LRA) for a certain remuneration of its services (i.e. implementation of energy efficiency improvement measures in public premises). The investment can be financed either by the ESCO or the customer, or by a third party, a bank or another financial institution. An Energy Performance Contract (EPC) is a type of public-private partnership (PPP) (see Box 1). For an EPC it is important to agree on the results to be delivered by the ESCO based on the findings of an initial feasibility study, and to define the monitoring, education activities and the guarantee that will be applied. According to the available literature, the contract period is usually for between 7 and 15 years [Energie-Cités, 2004]. Nevertheless, it is important to take into consideration that a contract engagement with an ESCO that is too long could be harmful, leaving the municipality with an outdated facility by the end of the contract. One of the main advantages of an EPC for the LRAs involved is that the ESCO assumes responsibility for any unforeseeable events in the areas of the technology involved and finance.

[For more information: http://www.eurocontract.net (EUROCONTRACT is a platform and a network, supported by Intelligent Energy Europe, to exchange on current issues around Energy Performance Contracting. )].

- **Third party financing** (TPF) involves, as its name says, a third party sponsor, generally a financial institution, which makes the investment based on the financial performance of the project and often guarantees the operation.
Implementation and project life span

Planning and implementation

The planning and implementation period varied from 1 year for the projects in Kuopio and Gödöllő up to almost 10 years for the project in Skåne.

In all the analysed case studies, preliminary studies were carried out in order to determine the feasibility of the proposed actions. The results of these studies helped to better define the objectives of the specific project and to minimise problems in the implementation phase. It is important when setting the objectives at the start of the project not to be too ambitious, and to take into consideration the possible limitations. This is even more important if there is no previous experience in implementing this type of project.

In this regard, the planning and implementation of the energy management programme in Kuopio was easy as the city already had experience in similar projects. In fact, this project was considered as the natural next step to continue the city’s efforts to increase energy savings and improve energy efficiency.

Contracting

A contract can be established between a public agency/LRA and a private company in order to install a certain technology, to refurbish or operate existing installations, or to advice during the implementation of a project. Different models of contracting can be consequently identified depending on the service, the financing and the nature of the relationship established between the various parties involved. Traditionally, private sector participation has been limited to separate planning, design or construction contracts on a fee for service basis (based on the public agency’s/ LRA's specifications) This was the case for the project in Mirecourt: a contract was established with a private company for the design and construction of a school building based on the French concept of “Haute Qualité Environnementale" (High Environmental Quality). Expanding the private sector role, through the implementation of PPP models, allows the public sector to use “innovative methods to contract with the private sector, who bring their capital and their ability to deliver projects on time and to budget, while the public sector retains the responsibility to provide these services to the public in a way that benefits the public and delivers economic development and an improvement in the quality of life” [UNECE, 2007]. There are different forms of long-term contracts that can be established between legal entities and public authorities. In the case study in Skåne, the public authority established an EPC with a private company, which is a type of PPP (see Box 2). The EPC with the service provider comprised a detailed energy analysis, the full project implementation, financial solutions and was backed by firm guarantees of savings.
Both the projects in Skåne and in Mirecourt, for which calls for tenders were launched, show that it is important to define clearly the criteria for awarding contracts (such as service specifications, energy efficiency requirements, etc).

As illustrated by the case study in Skåne, PPP and EPC are generally perceived as a complicated process by LRAs. Indeed, many public bodies haven’t discovered this possibility yet, and others are still inexperienced and therefore often reluctant to use these services [Swärd, 2005]. In an EPC, the ESCO normally charges its customers, according to a pre-agreed payment plan, based on the delivered savings and increased value created for the customer. It is therefore important to define clear objectives and to inform all the parties involved about them. In Skåne, in spite of the lack of experience of the authorities involved in dealing with an EPC, the realisation and launch of the PPP were finally not as complicated as expected thanks, to a large extent, to the preparatory process followed by the relevant personnel involved.

**Monitoring**

When carrying out energy efficiency projects, it is useful to monitor in quantitative terms the progress made in energy management (examples of quantitative indicators are the total electricity consumption (kWh) per m²/year or the energy consumption (kWh) per m²/type of building). The results can allow local and regional governments to evaluate their achievements and decide on the further actions needed. This is illustrated in the case study in Skåne, where monitoring was required in order to guarantee that the ESCO was achieving the expected savings.

In the project in Kuopio, monitoring allowed the results to be used to inform the people who participated in the training sessions of the results of the project, which in turn served as motivation to pursue the changed behaviour.

**Promotional activities and training sessions**

The promotion of energy efficiency via information campaigns and training programmes was carried out in the projects implemented in Kuopio, Skåne and Mirecourt. In these three projects, the informative sessions and training programmes were adapted to the specific target audience (e.g. work units of the city, maintenance staff of public buildings, parents of the pupils in a state school, etc). Furthermore, the training and information sessions were given by experts (e.g. specialised consultants). In the project in Kuopio, the first sessions were used to redefine and concretise the approach. One of the main lessons learned from this project is that it might be preferable to use short and clear messages in the training sessions and information campaigns.
Another aspect observed in the case studies in Kuopio and Skåne is that it is important to reward somehow the efforts carried out by the people who have contributed to the energy savings through the implementation of the planned measures. For example, in the Kuopio case study, a certificate to recognise their achievement was given to the units having the largest energy savings.

- The problems and obstacles
It was observed during the implementation of these projects that a negative attitude towards the specific project from citizens and beneficiaries can be a very important barrier for the success of the project. For example, in the case of the project in Schleswig-Holstein, district planning authorities and conservationists were initially against the project, so the period for obtaining the building licence took longer than initially planned.

General lack of interest in environmental issues and wrong ideas about energy savings can be changed through training programmes and awareness campaigns as described above.

As indicated earlier, another problem that can be encountered in energy management projects relating to the acceptance of the project is that people might complain because the profits resulting from the energy savings do not directly benefit the working unit or department that has carried out the efforts. This was observed in the projects in Kuopio and Skåne. In order to solve this problem, it is important to return the savings somehow to the units or departments that have realised them.

In the project that was carried out in Gödöllö for the improvement of public lighting, the main obstacles were lack of financing and the opposing interest of the most important potential partner (the electric company). The external funding helped to solve these problems and to create a win-win situation for the local authority and the electric company.

- Socio-economic impacts
The annual cost savings vary from €25,000 for the project carried out in Kuopio up to €1.3 million for the public buildings refurbishment in the region of Skåne. The savings depend on several factors including the type of measures that are applied and the cost of the heating and electricity energy in the area.

These projects demonstrated that by establishing energy criteria when awarding service contracts, introducing energy management programmes in buildings or applying high-energy requirements for buildings, the local government can improve their energy performance in the long run and also reduce public expenditure.
Lighting accounts for a large proportion of local and regional government energy consumption and costs. The project in Gödöllő shows that the possibilities for maintenance cost savings are significant. Indeed, although energy-efficient alternatives appear to have a higher initial cost than high consumption- or non energy-efficient lighting, they offer the cheapest alternative in the long term. Energy-efficient lamps can last up to 15 times longer than their less energy-efficient equivalents and the payback time in most cases is less than six years [CEMR et al, 2006], 3-3.5 years in the case study of Gödöllő.

The impact of the analysed projects on employment also varies from 1 new job created for the project in Kuopio to 5 new jobs for the project in Schleswig-Holstein.

Last but not least, the LRAs involved in the five projects fulfil an important model function by reducing the energy consumption of public premises, and motivating their own employees in a climate-friendly behaviour.

Environmental impacts

The five energy efficiency projects presented in this study contributed to the reduction of energy consumption, which in turn resulted in a reduction of CO₂ emissions.

The built environment accounts for 40% of the energy requirements in the EU. The building sector provides a huge potential for energy saving by applying energy efficiency standards to both new public and private buildings and when refurbishing old premises. Indeed, those projects involving the application of energy standards to new buildings and refurbishment of old buildings (projects in Mirecourt and Skåne) resulted in significant energy savings and reduction of CO₂ emissions. Also the project in Gödöllő for the improvement of public lighting generated major energy savings. In any case, it is not possible to conclude what type of energy efficiency project is more efficient for the reduction of GHGs as the total amount of energy saved through the implementation of the specific project will depend on several factors including the original situation or baseline, the type of measures and the scale of implementation. Indeed, the reduction of CO₂ emissions resulting from the described projects varied greatly from 57 tonnes per year for the holiday village in the context of “passive housing” in the state of Schleswig-Holstein up to 3,886 tonnes per year from the building refurbishment in public buildings in the region of Skåne.

Cost-benefit analysis of the environmental impacts

The cost for reducing CO₂ can be estimated as the cost associated with the
implementation of the project (i.e. initial investment and yearly operational and maintenance costs) minus the monetary savings associated with the project (i.e. savings in fuel or electricity costs), divided by the amount of CO₂ that is avoided through the implementation of the concrete project. The cost per tonne of CO₂ avoided (here after also referred as cost of saved carbon = CSC) can be positive (a benefit) or negative (an expense)²². When the sum of the savings is worth more than the project costs (investment, maintenance, etc.) over the whole lifetime of the project, this figure is negative, which represents a monetary benefit. This means that the project is profitable and that it reduces CO₂ emissions in a cost-efficient way. If the project costs are higher than the associated fuel and energy savings, this figure is positive, which represents an expense. See Annex 2 for further details of the methodology used for the calculation of the CSC).

The case studies included in this study show that a cost-efficient reduction of CO₂ emissions is possible. For all of them, it was determined that the overall benefits of the project outweighed the costs. If a project is profitable, the cost per tonne of CO₂ is reduced every year as the savings pay off the initial investment. Therefore, after the payback period, there is no cost associated with the reduction of GHG, but only profits. For the case studies analysed such cost varies from €-11.35 to €-102.83. This means that all of them yielded benefits (negative CSC) for reducing CO₂ emissions. This is usually the case for energy efficiency projects, where the avoided costs associated with the reduction in fuel costs and energy consumption are greater than the investment costs of the measures implemented; thus resulting in a negative CSC. When a project has a negative CSC, this results in a win-win situation as carbon emissions are reduced and money saved.

The CSC depends on the lifetime of the project, the price of the energy in the area of implementation of the project, the initial investment and amount of CO₂ avoided annually. Of the five projects analysed, the one in Skåne is the most cost-efficient in reducing CO₂ emissions (€-102.83 per year).

Each option has additional benefits besides saving energy, reducing energy costs and decreasing carbon emissions, particularly reductions in air pollutants. Electric generation from fossil fuelled power plants produces a number of emissions to the atmosphere that are directly or indirectly harmful to human health. These include particulate matter, sulphur dioxide, and nitrogen oxide. Reductions in electricity required from the power grid reduce fossil fuel use in

²² Expenses are represented as positive amounts and benefits as negative.
electricity production and translate as reductions in such air emissions. These co-benefits are not included in the CSC that has been estimated for each case study.

Key factors for the success of the project
One of the factors for success pointed out by the managers of some of the projects analysed in this study was the importance of the initial preparatory phase. For example, in the case of the project in Skåne, the initial internal preparation was crucial in order to avoid internal opposition and to maximise the future potential benefits of the project. The call for tenders was issued under the laws of Public Procurement and therefore, a good understanding of the code was also required. Feasibility studies are important to determine the most appropriate solutions in each case study.

Another important element for the success of a project mentioned in the case studies in Kuopio and Gödöllö was the commitment and support from the regional or municipal politicians.

It is also important to involve all the different stakeholders and participants in the different phases of the project and establish good communication channels. As in the case study of Gödöllö, creating a win-win situation for all the partners and stakeholders can help avoid internal opposition.

Ongoing applications of the project
The ongoing applications of the projects that were analysed vary greatly. In some cases, as in Kuopio, new projects were launched on energy and climate issues as a follow-up of the implemented project and based on the results obtained.

All the projects have continued to provide energy and cost savings since their implementation dates. In the case of the project in Skåne, improvement in the current energy efficiency results is still expected.

The overall energy efficiency situation on the territory of the authority responsible for the concrete project and comparison with the national situation
In the case of Kuopio, the energy efficiency situation in the municipality is above the national level, which was also observed for the project in Gödöllö.

Nevertheless, a similar comparison with the national level was not possible in the other three cases. The in-depth research that was carried out (i.e. literature review and communication with relevant persons in the municipality/region) showed that information concerning the concrete local or regional energy
efficiency situation does not exist. In general, it is observed that there is little information on the energy efficiency situation at local and regional level. In many cities and regions, energy efficiency has only recently started to interest politicians and the general public. This situation is expected to change in the near future due to adoption of the energy efficiency measures specified in the different European directives in the field, and also due to ever-increasing energy prices and the need to modernise and refurbish existing premises.

■ The potential to replicate
In general, all the energy efficiency projects presented in this study could be replicated elsewhere, adapting the model to the specific conditions of the area of implementation. To achieve full potential, this type of project requires energy experts and a definite source of funding. Local and regional energy agencies are usually well placed to bring all the necessary elements for carrying out energy efficiency projects.

Both the projects in Skåne and Kuopio have served as an example for other regions and municipalities in Sweden and Finland respectively, some of which have expressed their intention to replicate the specific projects using the established model.
Box 3: Best practice for energy efficiency projects

**Energy Management**
- Appoint an energy officer or establish an energy department within the local or regional administration (depending on the size of the municipality or region).
- Carry out information campaigns and training sessions highlighting the importance of energy savings.
- Communicate the results of the energy saving measures that have been implemented on a regular basis to the personnel that has been involved.
- Find ways of rewarding the staff and working units that have contributed to the energy savings.
- Carry out an active follow-up and issue regular reminders of the key messages explained during the information campaigns and training sessions via, for example, e-mail reminders, posters, dissemination of information via the intranet, etc.
- Make sure that the people involved in the energy management programme are aware of the energy management measures.
- Monitor and evaluate energy consumption in buildings where the measures have been implemented.

**Energy Performance of Buildings**
- Evaluate the feasibility and use of innovative financing methods, such as Energy Performance Contracting.
- Subject municipal public buildings to systematic reviews of potential energy savings.
- Promote the use of renewable energies and cogeneration in public and private buildings.
- Set sustainable building standards for new and renovated public buildings and use low energy standards in new buildings.
- Aim at targets which are above existing standards set by national and European regulations.

**Public Lighting**
- Develop improvements in outdoor street lighting.
- Use low-consumption lamps, such as sodium and compact fluorescent lamps.
3.2 Analysis of the Renewable Energy Projects

The project for the introduction of a biomass district heating plant in Las Navas del Marqués (Spain), the project for solar energy use at the council offices in Český Krumlov (Czech Republic), the installation of solar thermal plants in social housing in Frankfurt am Main (Germany), the utilisation of a GSHP system in farmhouses in Aberdeen (United Kingdom), and the use of biodiesel for public buses from waste oil in Crete (Greece) are good examples of the successful application of renewable energy systems. Hereafter, the 5 projects are discussed and compared. For more detailed, consult the detailed fact sheets drawn up for each project and that can be found in Annex 3.

- The roles and responsibilities of the different bodies involved in the projects

In all the five renewable energy case studies analysed in this study, the LRAs participated in the planning, funding and decision-making process. In some projects, the authorities were also in charge of the subsequent monitoring and maintenance, as in Las Navas del Marqués, Aberdeen and Český Krumlov. In all of them, the main roles of the LRAs were as provider and supplier of energy and as promoter of RES among citizens and local business.

Co-operation with national, regional or local energy agencies took place in all the projects. They participated mainly as advisors in the planning phase and in some case studies they were also in charge of the promotional activities and organisation of the awareness campaigns and training sessions (in the projects in Las Navas del Marqués, Crete and Český Krumlov).

Private companies participated in different phases of the project, for the realisation of feasibility studies or for the actual implementation of the specific renewable energy system. For the projects in Las Navas del Marqués and Český Krumlov, a call for tenders was launched for the selection of the private company to carry out the implementation.

- The decision-making process

Although the specific motivations for carrying out the projects vary in each case study, in general the main objectives pursued by the implementation of these projects were to reduce the costs of fuels and thus to reduce the electricity bill, to increase the independency from external sources of energy, and to use local resources.

The participation of experts and specialised consultants was very important in the decision-making process. Given the fact that the persons in charge of taking
the final decisions usually have limited technical knowledge and experience of
the implementation of renewable energy systems, advice and contribution from
experts helped the LRAs involved to take sound decisions. In this regard, expert
working committees were created for the project in Las Navas del Marqués in
order to support and guide the decision-making process.

■ The citizens’ and beneficiaries’ attitude
The five projects were well accepted by the general public and the beneficiaries.
In the project in Las Navas del Marqués, Crete and Aberdeen, the public and
beneficiaries were initially sceptical about the possibility of carrying out this
type of project in their municipalities. In the case study of Las Navas de
Marqués, the seminars and awareness campaigns helped to dissipate these initial
doubts. In the project in Aberdeen, informative sessions with the tenants
participating in the project also helped to solve this initial problem. In Crete, an
information campaign was also initiated to convince sceptical drivers and the
general public of the environmental benefits and the feasibility of using
biodiesel in public busses.

■ Implementation and project life span
Planning and implementation
On average, the planning and implementation period lasted 2 years for the
projects analysed in this study. Nevertheless, it is not possible to extrapolate this
figure to renewable energy projects in general as this period might vary
considerably.

In all the case studies, preliminary studies were carried out in order to determine
the feasibility of the proposed actions. For example, in the project in Las Navas
del Marqués, the feasibility studies helped to establish if the available forestry
resources in the area of implementation were enough to satisfy the energy
demand of the buildings that were going to be supplied, to analyse the different
technical options and also to determine the cost-efficiency of using the available
resources.

Contracting
A contract was established with a private company in three out of the five
analysed case studies for the supply and installation of the concrete technologies
(i.e. a biomass district heating plant in Las Navas del Marqués, solar collectors
and PV panels in Český Krumlov and GSHP systems in Aberdeen). To this end,
a tendering procedure was carried out in each case. Once all the necessary
documents for the tender process were prepared (e.g. contract, baseline data,
evaluation criteria, etc.), calls for tenders were launched in order to seek the
better bid.

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As illustrated by the case study in Český Krumlov, it is advisable in some cases to pay special attention to the tender’s procedure and specifications in order to avoid prolonged procedures and non suitable equipment.

**Monitoring**
A monitoring programme is advisable in order to determine the achievement of the expected results and the evolution of the installed technology in terms of energy production and environmental performance. Monitoring is particularly crucial in the case of pilot projects. This is illustrated by the case study in Aberdeen, for which a thorough monitoring programme was carried out. Based on the information gathered, it was possible to conclude that the GSHP systems could achieve affordable warmth for the tenants. Now the Aberdeen City Council intends to install GSHP systems in all the remaining farm properties that are off the gas supply network.

**Promotional activities and training sessions**
Information campaigns for the general public to increase awareness about climate change and renewables were organised for the projects in Las Navas del Marqués, Český Krumlov and Crete. They were usually carried out at the end of the project once the technical part was finalised and results could be used to illustrate the success of the project. In some cases (e.g. Las Navas del Marqués, and Crete), there were also information campaigns before and during the implementation of the project in order to overcome citizens' negative attitudes (see "problems and obstacles"). These case studies illustrate the role that LRAs can play as motivators by raising awareness and engaging citizens and local businesses.

Furthermore, training sessions were held for the projects in Las Navas del Marqués, Český Krumlov, and Aberdeen. The training programme in Český Krumlov included site-visits, which were very appreciated by the targeted audience as they were able to see for themselves and put to test what they had learnt at the seminars.

**Cost and funding**
The cost of the analysed projects varies substantially from €42,947 for the project in Český Krumlov up to €515,000 for the project in Las Navas del Marqués. The investment costs depend greatly on the type of technology implemented and the scale of implementation.

Three of the analysed projects (projects in Las Navas del Marqués, Crete and Český Krumlov) were co-funded by the EU through different programmes. National funding was granted for two of the projects. In the project in Aberdeen, local and regional funding schemes were the only sources. This suggests that
financing is usually forthcoming from several sources, as it is not possible to cover the total costs of the projects with the local or regional budgets. It is important to consider that multi-source financing may require more time as it has to undergo the approval and validation from different organisms or partners.

The renewable energy projects analysed in this study present payback periods slightly higher than those observed in the energy efficiency projects with 18.5 years on average (taking into consideration the grants). This is in line with the figures available from other case studies, which suggest that payback periods for this type of project are between 15 and 20 years [EC, 2002; EC, 2003; EC, 2006 a].

The problems and obstacles

The inexperience of the authorities and partners in carrying out this type of projects can become a limiting factor for their success. It is necessary in such cases to search for the advice of experienced professionals that are going to provide the required information to make sound decisions. Training courses in order to update professionals' knowledge and increase the know-how of the authorities could also be recommended.

The initial reluctance of the general public and some of the beneficiaries was observed in some projects. This could have serious consequences for the success of the project. A targeted and effective information campaign can contribute to avoiding or minimising this problem.

Finally, certain regulatory and administrative barriers can make the implementation of renewable energy projects difficult, as illustrated in the project carried out in Crete. In this case study, the legal framework for biodiesel was not finalised in Greece by the time of the implementation, which in turn resulted in several administrative problems.

These observations are in line with some of the results of the EU-funded project “RES-E Regions”, which started on 1 January 2005 and aims at boosting electricity production from RES and the use of green electricity in eleven European regions by defining concrete regional RES-E targets and developing and implementing regional RES-E strategies. Throughout this project, different barriers were identified that are encountered on a local and regional scale when implementing this type of project. This includes administrative obstacles, public opposition, grid access, lack of information, and frequent changes in funding regimes. In particular, it was highlighted by some of the participants that, for the development of renewable electricity, one of the main barriers is the insufficient grid capacity available for RE electricity evacuation on the part of the transport electrical net [ESV, 2007].
**Socio-economic impacts**

All the projects analysed in this study resulted in cost savings as the electricity produced by the specific renewable sources is less expensive than the energy generated by traditional sources. For example, in the case of the GSHP systems in Aberdeen, the annual fuel cost savings were estimated at approximately 50%. The cost savings will depend on the price of the energy in the area produced from traditional sources, the lifetime of the installations, the amount of energy produced by the renewable energy system and the initial investment costs.

These projects also illustrate the advantages of using indigenous RES, not only from an environmental but also from a social perspective as new economic activities in the vicinity are generated (in the case study of the biomass district heating plant in Las Navas de Marqués with the collection system for forestry residues and in the project for use of waste oil in Crete for the production of biofuels with the installation of fried oil collection companies).

Also in the case of renewable energy projects, the LRAs involved carried out an important function by serving as a positive example for the citizens and other institutions and private companies.

**Environmental impacts**

The use of renewable sources entails the substitution of conventional fuels, which have larger GHG emissions. All the renewable energy projects analysed in this report led to an annual reduction in CO₂. The reduction of CO₂ emissions resulting from the implementation of the described projects varies greatly from 9.57 tonnes per year for the project in Český Krumlov up to 1,126 tonnes per year for the project in Las Navas del Marqués. The avoided CO₂ emissions depend largely on the type of technology, the scale of the implementation and the type of traditional energy source use in the area.

*Cost-benefit analysis of the environmental impacts*

In the case of renewable energy projects, the cost per tonne of CO₂ avoided depends on different factors such as the project lifetime, the maintenance and operational costs, the price of the energy, the initial investment and the amount of CO₂ avoided. All the case studies that were analysed except for one resulted in a negative cost (i.e. a benefit) per tonne of CO₂ avoided (varying from €-1,48 for the case study in Aberdeen to €-11,23 for the case study in Las Navas del Marqués23). This means that these cases resulted in net savings, mainly due to the significant reduction in fuel costs. In these cases, as the projects are profitable, the cost per tonne of CO₂ avoided is reduced every year as the

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23 The cost per ton of CO₂ avoided has been estimated in each case for the entire lifetime of the specific project.
savings pay off the initial investment. This means that, for these projects, after the payback period there were no costs associated with the reduction in GHG, only profits. In the case study in Frankfurt am Main, there was an expense for reducing GHG emissions (€13.04 per ton of CO₂ avoided). This was due to the fact that the energy produced by the installed renewable system was more costly than traditional energy sources.²⁴ See Annex 2.2 for further details of the methodology used for the calculation of the CSC.

■ Key factors for the success of the project
One element cited by the project managers as key to the success of the projects was the support from and collaboration with the different stakeholders involved. In this regard, it seems recommendable to clearly define right from the beginning the nature of the collaboration and the role of each participant, as illustrated by the case studies in Las Navas del Marqués and Český Krumlov. Also, one of the key factors for the success of the case study in Frankfurt am Main was the close collaboration between the various partners, including tenants, LRAs, and the social housing company, all of which worked together to bring about a significant change in behaviour. For this reason this project can offer a good example for similar situations (i.e. refurbishing social housing), in which a collaborative approach is crucial for the positive results of the project.

Also, the promotional activities and awareness campaigns contributed to the good acceptance of the project.

The limited knowledge of how to implement this type of project can represent an important barrier in some cases. In this regard, the exchange of know-how between different regions and municipalities and cross-border cooperation, as in the project in Český Krumlov, can be an important element contributing to the adequate development of this type of project.

■ Ongoing applications of the project
Some of the projects, in particular those involving solar equipment, are almost self sufficient and the associated maintenance costs are minimal, such as in the projects in Český Krumlov and Frankfurt am Main.

In some cases, such as in Las Navas del Marqués, the results obtained motivated the interest of the authorities involved to further develop the project by

²⁴ Co-benefits are not included in the calculation of CSC in this study. In some cases, especially when the cost of the renewable energy source implemented is relatively close to that of the fossil alternative, including externalities (environmental effects of production and consumption that affect consumer utility and enterprise cost outside the market mechanism), generally fairly higher for the fossil-fuel based sources, can tip the balance and make a small expense into a benefit in the case of the renewable energy.
increasing, for example, the capacity of the installation and the number of beneficiaries. Indeed, today some of the projects serve as demonstration projects and help to increase general knowledge of the implementation of this type of project in the region or municipality.

In general terms, there was a general increase in awareness of energy matters and climate change among the general public and the main beneficiaries in the area where the projects were implemented.

- **Overall renewable energy situation on the territory of the authority responsible for the concrete project and comparison with the national situation**

It was observed that in two of the projects (Frankfurt am Main and Aberdeen), the overall renewable energy production in the area of implementation of the project is below the national level, while in another two case studies (Las Navas del Marqués and Crete) the local or regional share of RES is above the national figures. For the case study in Český Krumlov, information is not available on the overall local renewable energy production.

- **The potential to replicate**

Regarding the potential to implement these projects, there are many institutions and public bodies with central heating systems where solar systems and biomass plants could be integrated.

The use of waste biomass in thermal applications is particularly feasible in areas where there are forestry management and agriculture. Using waste biomass in this way makes a contribution in terms of waste disposal and offers a service using a less polluting fuel. Furthermore, the low investment and the reduced operation and maintenance costs result in a low heating price and therefore the potential for similar small district heating plants is considered to be large.

In the case of the project for the use of waste oil for the production of biofuels in Crete, waste vegetable oils are produced by homes, restaurants and food companies across Europe. However, the project in Crete shows that to convert this raw material into sustainable biofuel requires the participation of several partners, including a waste collection company, and a local biodiesel manufacturer.

In the case study in Aberdeen, the monitoring clearly shows that the GSHP systems can be used to achieve affordable warmth. Nevertheless, the application of this type of project is greatly determined by the type of buildings the pumps are going to supply energy to and the specific ground conditions.
The success of many of these projects was determined by the ability of a central organisation, often an energy agency, to ensure that all partners collaborate smoothly together.

**Box 4 - Best practice for renewable energy projects**

**Renewable Energy Sources (RES) in buildings**
- Define priority areas (e.g. schools, sports facilities, households, etc) for renewable energy sources and Combined Heat and Power (CHP).
- Remove or minimise administrative barriers towards the use of renewable energy sources.
- Develop pilot projects to determine the feasibility of renewable energy systems, before a large scale implementation.
- Monitor the performance of the installed equipment.
- Use the results of the projects implemented in public buildings, for example to promote the use of renewables in private buildings. This can be done by disseminating information about the specific project and its results through publications in the local newspapers and online.
- Promote the use of renewables
- Provide information and training about renewables for planners, architects and other relevant professionals.

**RES in public transport**
- Promote and use clean fuels in the public transportation.
- Assess the creation of a biodiesel market at the local and regional level.
- Identify best suitable materials for biodiesel production and logistics (i.e. fuel sources that can be easily obtained in the area, such as used fried oils).
- Support measures in public tendering to promote the introduction of biodiesel vehicles.
ANALYSIS OF 10 SUCCESSFUL ENERGY EFFICIENCY AND RENEWABLE ENERGY PROJECTS
4. Conclusions and Recommendations

4.1 Conclusions

The different projects presented in this report were carried out under a variety of climatic, topographic, economic and demographic conditions. Nevertheless, some general conclusions can be drawn from their analysis. These include the following:

- The main drivers for the implementation of energy efficiency measures, renewable energy projects and other energy-related actions are the necessity to make energy production and consumption more sustainable and the willingness to increase the competitiveness of the local industry, to secure the energy supply and to reduce energy costs. In the case of renewable energy projects, the LRAs that promote or participate in this type of project consider them as an opportunity to increase the energy security of the municipality or region, by the exploitation of local resources.

- Most of the cases studied served as demonstration projects that allowed the development of local experience and know-how on the use of renewable sources and energy efficiency. Furthermore, the experience gained at local and regional level served as reference point in some cases for the large scale deployment of the used technologies and approaches in energy efficiency and renewable resources.

- Some of the projects presented in this study helped in the development of new local markets and the creation of new jobs, which in turn contributed to the economic development of the area.

- For all the case studies analysed, benefits for the environment were observed, including the reduction of GHG. Indeed, renewable sources and energy efficiency measures entail the substitution or reduction of the use of conventional fuels that have larger GHG emissions. Furthermore, energy generation from fossil fuelled power plants produces a number of emissions to the atmosphere that are directly or indirectly harmful to human health, including sulphur dioxide, nitrogen oxides and particulate matter emissions.

- The analysed projects played an important role in raising awareness on the climate change issue and setting the foundation for actions on the territory of the authorities responsible for their implementation.

- Projects in public buildings have a key role to play in demonstrating the technical possibilities and creating market incentives for innovations that can then be applied in the private sector. Retrofitting public buildings provides great opportunities for energy saving.

- Poor acceptance of the projects by the public and/or the beneficiaries, lack
of financing or economic resources, and limited knowledge and experience in the implementation can be the most important barriers encountered by this type of project. Sometimes, such as in the case of renewable electricity, certain administrative and regulatory barriers may also have to be faced.

• The investment costs vary greatly depending on the type of project, the technology, the scale of the implementation, and the geographical location of the project. All the projects analysed yielded annual cost savings and had relatively short payback periods. Furthermore, they all demonstrated that a cost-efficient reduction of CO₂ emissions is possible.

• Local and regional energy agencies are usually well placed to assist LRAs and bring together all the necessary elements for carrying out this type of project.

• Local authorities considering sustainable energy management as strategic for local development and integrating it in their sector-based policies can gain a significant advantage over those neglecting this domain.

• In general, all the projects presented in this study could be replicated elsewhere by adapting the model to the specific conditions of the potential area of implementation.
4.2 Recommendations for Replication

Taking into account the analysis of the case studies, this section summarises specific measures taken by LRAs which have proved to be efficient in planning and implementing projects related to renewable energy and energy efficiency.

■ Initiation and planning phase
The following strategies have proven to be effective when implementing renewable energy and energy efficiency projects:

• Have a clear vision of the (policy) objectives (e.g. reduction of GHG, reduction of air pollution, transport policy, job creation, etc.) existing at local and regional level in particular but also at national and European level.
• Define clearly the measures and/or type of technology to be implemented.
• Develop an action plan for the project on sustainable energy to be implemented, indicating the targets, time frame, and responsibilities.
• Establish from the beginning a strong partnership with the local or regional energy agency, energy centre or relevant organisation. They are in a good position to provide advice and help in the definition of the possible energy-related measures to be implemented. It might also be useful to consult other experts and professionals in the field that can provide practical information for the implementation of the project. For more information in this regard see Annex 4.
• Consult different sources of information that might be relevant to the project. For example, it might be useful to get information on similar projects that were carried out by other LRAs. The exchange of know-how can save time and resources and allow for a better and more adequate design of the measures/technology. This will help avoid problems and barriers discussed above. The different compilations of case studies existing at national and European level might be a good starting point (see Annex 4).
• Carry out preparatory studies in order to determine the feasibility and the cost-effectiveness of the suggested measures. These studies can also provide useful information regarding the local market conditions, which can determine to a large extent how the project is implemented.
• Carry out a public consultation in order to identify potential acceptance problems and to inform the public about the project.

■ Efficient financing
The following strategies are recommended regarding financing for sustainable energy projects:

• Develop in-house knowledge, carry out internal preparation and ensure
CONCLUSIONS AND RECOMMENDATIONS

good communication with all the departments involved when considering and planning innovative financing methods, in order to avoid problems and achieve good results.
• Take into account that the success of certain financing schemes results from the successful combination of different methods causing a leverage effect. For example, certain investments would not necessarily pay off if they do not benefit from a national feed-in tariffs scheme. Furthermore, national frameworks can provide funding opportunities for local and regional sustainable energy actions.
• Be informed about the existing national and European funding mechanisms. In addition to national funding, local and regional governments can apply to European funding schemes. Funding from the EU, through different programmes such as JASPERS or the EU Structural Funds (SF), is in some cases essential for these projects to be carried out. Annex 4 contains more detailed information on existing European funding programmes.
• Carefully evaluate the potential extra costs resulting from using external service providers, such as ESCOs. Outsourcing the service adds additional administrative and transaction costs to the project's contract management budget.

■ Effective decision-making
• Gain knowledge about sustainable energy. As observed in some of the analysed case studies, the assistance of experts and professionals in the field can help the LRAs to take sound decisions. Furthermore, if possible, the creation of expert working groups can be very useful to support and guide the decision-making process.
• Inform all project participants of the progress of the project. Ideally, all partners should be present when key decisions are taken.

■ Implementation
• Motivate the people/personnel/working units involved in the project or who are targeted by the project. This is important, in particular, for energy management projects aiming at reducing the electricity consumption through behavioural changes.
• Find ways to reward the personnel that has helped to obtain satisfactory results by, for example, returning the cost savings to the working units

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25 Feed-in tariff schemes are procurement mechanisms designed to promote the uptake of renewable energy through government regulation. They introduce guaranteed prices or premiums for electricity produced from renewable sources. Besides Germany, where a system for Renewable electricity feed-in, purchase and payment was already introduced in 1991, also Estonia (1998), Finland, France (2001), Greece, Latvia, Lithuania, Luxemburg, the Netherlands (2003), Austria (2003), Portugal (1988), Slovenia (2002), Spain (1994), the Czech Republic (2002), Hungary (2003) and Cyprus (2004) use feed-in tariffs to date. [EUROSOLAR, 2006]
that have achieved them or by awarding certificates to recognise their efforts. Motivation will be increased if the participants are informed of the positive results obtained.

- Respond to the doubts and concerns that might arise during the implementation of the project. This can be done through awareness raising and information campaigns.

**Useful cooperation**

- Cooperate and exchange experience and know-how with other municipalities or regions, either from the same country or from others, willing to participate in the project.
- Establish good communication with all the different partners from the beginning. They can provide the project with different experiences and skills. A key element for good cooperation is communication. It would be helpful to appoint a contact person or organisation in charge of the organisation and co-ordination between the different partners. In particular, if the project has a long implementation period, to organise periodic meetings will help maximise cooperation between the different participants and stakeholders.
- Determine clearly the responsibilities of each participant in the project. The involvement of potential beneficiaries of the project right from the beginning can also contribute to its success.
- Seek for the commitment and support from local and regional politicians. This helps facilitate the implementation of the project and makes it easier to solve the problems that might arise.
- Explore the possibility of using a PPP (see Box 1). When choosing one or another modality of PPP, it is important to take into consideration the type of project. For example, the use of an EPC has proven to be very efficient for the implementation of energy efficiency measures.
- Establish a procedure for awarding the contracts (e.g. in the framework of a PPP), as well as the service specifications and requirements. The larger the project, the greater the amount of time that should be invested in the preparation of the tender documents.

**Information/public awareness campaigns**

Some projects cover promotion and public awareness campaigns.

**Promotional activities** are necessary to increase awareness about climate change issues. They also provide information about the actions that were carried out (so that others can learn from the experience), or that are going to be implemented (to inform the general public or the project’s beneficiaries). In this regard, the following general recommendations can be made for an efficient campaign:
• Use a website for the promotion, as it will reach more people.
• Generate promotional materials that can be easily distributed in conferences and other events as well as to the citizens and other interested parties. They should be very eye-catching and contain pictures and figures to illustrate the expected results.
• Prepare press releases that can be disseminated through the local and regional press.
• Participate in or organise specialised symposiums and events to present the results and the experience gained through the implementation of the concrete project.

In some projects, such as in the case of energy management projects, information campaigns are organised and training provided to change peoples’ behaviour. They can also be orientated to respond to the doubts and concerns that might arise during the implementation of the project among the beneficiaries of the project or the general public. Measures and actions that have proven to be efficient include the following:

• In the case of training for the staff/people participating in/working on the project, organise initial pilot sessions in order to be able to better adapt the content to the real needs of the target audience and identify weaknesses that can be minimised.
• Involve experts, such as specialised consultants, in the seminars and/or training sessions.
• Identify wrong ideas and misconceptions and address them during the training sessions and seminars.
• Use simple and clear messages.
• Use visual material in the explanations, and, if possible and applicable, organise field trips to illustrate the main lessons.
• Use reminders (e-mails, posters, stickers, etc.) with the key messages of the training sessions.
• Inform about the (expected) benefits/advantages of the concrete project to be implemented.

**Monitoring**

• Monitor - in quantitative terms - the progress made in energy management and also the performance of the renewable energies that have been installed. Using a small set of indicators (see Box 5) can allow LRAs to evaluate their achievements and decide on further actions needed.
• Use simple indicators to compare performance in the monitoring programme. In the most up-to-date systems, energy use is monitored continuously by special meters and the information is transmitted to a central point. However, these systems are usually expensive.
• The results obtained during the monitoring can be used for the promotion
of the project.

**Box 5 - Indicators can be used in the monitoring programmes [CEMR et al, 2006]**

<table>
<thead>
<tr>
<th>Energy Management</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Energy consumption of municipal buildings (Average performance index, Kilowatt-hour (kWh)/m² per building category)</td>
<td></td>
</tr>
<tr>
<td>• Total electricity consumption (kWh/m²/year)</td>
<td></td>
</tr>
<tr>
<td>• Share of electricity consumption in public buildings covered by certified Green Electricity (%)</td>
<td></td>
</tr>
<tr>
<td>• Budget of municipal energy management (€/inhabitant/year)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Local energy production and renewables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Share of renewable energies in the energy production of municipal utilities (%)</td>
<td></td>
</tr>
<tr>
<td>• Share of Combined Heat and Power (CHP) electricity in total electricity consumption (%)</td>
<td></td>
</tr>
<tr>
<td>• Installed area of solar collectors (m²/1000 inhabitants)</td>
<td></td>
</tr>
<tr>
<td>• Energy from biomass; capacity installed (kW/1000 inhabitants).</td>
<td></td>
</tr>
</tbody>
</table>
5. References


REFERENCES


REFERENCES

Available at:  


[ESV, 2007] Website of the project RES-E Regions. Project coordinator is O.Ö. Energiesparverband (ESV) - Energy Agency of Upper Austria. Available at:  
http://www.res-regions.info/

http://www.energies-renouvelables.org/

[EUROSOLAR, 2006] EUROSOLAR Info Paper, June 2006. EUROSOLAR website. Available at:  

REFERENCES


[ODYSSEE, 2006-07] Website of the project ODYSSEE, a project between the ADEME, the EIE programme of the European Commission DG TREN and energy efficiency agencies, or their representative, in the 27 countries in Europe plus Norway and Croatia. Available at: http://www.odyssee-indicators.org/


The bibliography that was used for the analysis of each case study is presented at the end of each extended fact sheet (Annex 3).
6. Annexes

The implementation of renewable energy and energy efficiency projects avoids the generation of a certain amount of energy from traditional sources (e.g. electricity from oil in a power plant, heating from natural gas in a boiler, etc.) which are associated with determined GHG emissions.

In most cases, the amount of GHG avoided thanks to the implementation of the renewable energy and energy efficiency projects was provided by the relevant contacts. However, in cases where this data was not available, the avoided emissions of CO₂ were estimated using the life cycle assessment approach.

Using the inventories of emissions from the whole life cycle of the different energy generation processes, the emissions of CO₂ that were avoided were calculated. These emission factors take into account the whole life cycle of the energy generation process, e.g. the extraction of energy sources. For each case study, the share of traditional sources of energy that were substituted or avoided was determined. In some cases, this information was provided by the relevant contact, in others, the share was established taking into account the national energy production share estimated by the International Energy Agency.²⁶ For each case study this information is provided in table 1.1.

---
²⁶ http://www.iea.org
### Table 1.1 - National Share of Energy Production and Consumption for Selected Countries and European Energy Consumption estimated by the International Energy Agency

#### Electricity/Heat in Hungary in 2004

<table>
<thead>
<tr>
<th>Production from:</th>
<th>Electricity</th>
<th>Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: GWh</td>
<td>%</td>
</tr>
<tr>
<td>coal</td>
<td>8339</td>
<td>25%</td>
</tr>
<tr>
<td>oil</td>
<td>773</td>
<td>2%</td>
</tr>
<tr>
<td>gas</td>
<td>11719</td>
<td>35%</td>
</tr>
<tr>
<td>biomass</td>
<td>699</td>
<td>2%</td>
</tr>
<tr>
<td>waste</td>
<td>52</td>
<td>0%</td>
</tr>
<tr>
<td>nuclear</td>
<td>11813</td>
<td>35%</td>
</tr>
<tr>
<td>hydro</td>
<td>205</td>
<td>1%</td>
</tr>
<tr>
<td>geothermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar PV</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar thermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>other sources</td>
<td>6</td>
<td>0%</td>
</tr>
</tbody>
</table>

#### Electricity/Heat in Spain in 2004

<table>
<thead>
<tr>
<th>Production from:</th>
<th>Electricity</th>
<th>Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: GWh</td>
<td>%</td>
</tr>
<tr>
<td>coal</td>
<td>80322</td>
<td>29%</td>
</tr>
<tr>
<td>oil</td>
<td>45560</td>
<td>16%</td>
</tr>
<tr>
<td>gas</td>
<td>5833</td>
<td>2%</td>
</tr>
<tr>
<td>biomass</td>
<td>52</td>
<td>0%</td>
</tr>
<tr>
<td>waste</td>
<td>22686</td>
<td>8%</td>
</tr>
<tr>
<td>nuclear</td>
<td>63605</td>
<td>23%</td>
</tr>
<tr>
<td>hydro</td>
<td>34439</td>
<td>12%</td>
</tr>
<tr>
<td>geothermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar PV</td>
<td>54</td>
<td>0%</td>
</tr>
<tr>
<td>solar thermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>other sources</td>
<td>15601</td>
<td>6%</td>
</tr>
</tbody>
</table>

#### Electricity/Heat in France in 2004

<table>
<thead>
<tr>
<th>Production from:</th>
<th>Electricity</th>
<th>Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: GWh</td>
<td>%</td>
</tr>
<tr>
<td>coal</td>
<td>28607</td>
<td>5%</td>
</tr>
<tr>
<td>oil</td>
<td>10140</td>
<td>2%</td>
</tr>
<tr>
<td>gas</td>
<td>18353 inventor</td>
<td>3%</td>
</tr>
<tr>
<td>biomass</td>
<td>1841</td>
<td>1%</td>
</tr>
<tr>
<td>waste</td>
<td>448241</td>
<td>78%</td>
</tr>
<tr>
<td>nuclear</td>
<td>64903 inventor</td>
<td>11%</td>
</tr>
<tr>
<td>hydro</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>geothermal</td>
<td>10</td>
<td>0%</td>
</tr>
<tr>
<td>solar PV</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar thermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>other sources</td>
<td>1091</td>
<td>0%</td>
</tr>
</tbody>
</table>

#### Electricity/Heat in Germany in 2004

<table>
<thead>
<tr>
<th>Production from:</th>
<th>Electricity</th>
<th>Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: GWh</td>
<td>%</td>
</tr>
<tr>
<td>coal</td>
<td>308132</td>
<td>50%</td>
</tr>
<tr>
<td>oil</td>
<td>10140 inventor</td>
<td>2%</td>
</tr>
<tr>
<td>gas</td>
<td>61475 inventore</td>
<td>10%</td>
</tr>
<tr>
<td>biomass</td>
<td>7631</td>
<td>1%</td>
</tr>
<tr>
<td>waste</td>
<td>8792</td>
<td>1%</td>
</tr>
<tr>
<td>nuclear</td>
<td>167065</td>
<td>27%</td>
</tr>
<tr>
<td>hydro</td>
<td>27874 inventore</td>
<td>5%</td>
</tr>
<tr>
<td>geothermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar PV</td>
<td>557</td>
<td>0%</td>
</tr>
<tr>
<td>solar thermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>other sources</td>
<td>25509 inventore</td>
<td>4%</td>
</tr>
</tbody>
</table>

#### Electricity/Heat in Czech Republic in 2004

<table>
<thead>
<tr>
<th>Production from:</th>
<th>Electricity</th>
<th>Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: GWh</td>
<td>%</td>
</tr>
<tr>
<td>coal</td>
<td>50521 inventore</td>
<td>60%</td>
</tr>
<tr>
<td>oil</td>
<td>346</td>
<td>6%</td>
</tr>
<tr>
<td>gas</td>
<td>26232 inventore</td>
<td>5%</td>
</tr>
<tr>
<td>biomass</td>
<td>721</td>
<td>1%</td>
</tr>
<tr>
<td>waste</td>
<td>18</td>
<td>0%</td>
</tr>
<tr>
<td>nuclear</td>
<td>26325 inventore</td>
<td>31%</td>
</tr>
<tr>
<td>hydro</td>
<td>2562</td>
<td>3%</td>
</tr>
<tr>
<td>geothermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar PV</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar thermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>other sources</td>
<td>11</td>
<td>0%</td>
</tr>
</tbody>
</table>

#### Electricity/Heat in Finland in 2004

<table>
<thead>
<tr>
<th>Production from:</th>
<th>Electricity</th>
<th>Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: GWh</td>
<td>%</td>
</tr>
<tr>
<td>coal</td>
<td>23565 inventore</td>
<td>27%</td>
</tr>
<tr>
<td>oil</td>
<td>613</td>
<td>1%</td>
</tr>
<tr>
<td>gas</td>
<td>12749 inventore</td>
<td>15%</td>
</tr>
<tr>
<td>biomass</td>
<td>10205 inventore</td>
<td>12%</td>
</tr>
<tr>
<td>waste</td>
<td>518</td>
<td>1%</td>
</tr>
<tr>
<td>nuclear</td>
<td>23716 inventore</td>
<td>29%</td>
</tr>
<tr>
<td>hydro</td>
<td>15070 inventore</td>
<td>18%</td>
</tr>
<tr>
<td>geothermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>solar PV</td>
<td>2</td>
<td>0%</td>
</tr>
<tr>
<td>solar thermal</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>other sources</td>
<td>379</td>
<td>0%</td>
</tr>
</tbody>
</table>
The emission factors obtained this way for the different traditional energy generation processes were then multiplied by the amount of energy that is no longer consumed due to the implementation of the specific project.

The inventories of emissions that have been used are enumerated hereafter.

**Table 1.2 - Inventories of emissions that were used.**

<table>
<thead>
<tr>
<th>Source of the inventory of life cycle</th>
<th>Name of the module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity production from hard coal in Germany</td>
<td>EcoInvent v1.2 'Hard coal, burned in power plant/DE S'</td>
</tr>
<tr>
<td>Electricity production from hard coal in Spain</td>
<td>Hard coal, burned in power plant/ES S'</td>
</tr>
<tr>
<td>Electricity production from hard coal in France</td>
<td>Hard coal, burned in power plant/FR S'</td>
</tr>
<tr>
<td>Electricity production from hard coal in Czech Republic</td>
<td>Hard coal, burned in power plant/CZ S'</td>
</tr>
<tr>
<td>Electricity production from natural gas in Spain</td>
<td>Electricity, natural gas, at power plant/ES S'</td>
</tr>
<tr>
<td>Electricity production from natural gas in France</td>
<td>'Electricity, natural gas, at power plant/FR S'</td>
</tr>
<tr>
<td>Electricity production from natural gas in Germany</td>
<td>'Electricity, natural gas, at power plant/DE S'</td>
</tr>
<tr>
<td>Electricity production from natural gas in</td>
<td>Electricity, natural gas, at power plant/NORDEL S'</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Electricity production from natural gas in United Kingdom</td>
<td>'Electricity, natural gas, at power plant/GB S'</td>
</tr>
<tr>
<td>Electricity production from natural gas in Czech Republic</td>
<td>Electricity, natural gas, at power plant/CENTREL S'</td>
</tr>
<tr>
<td>Electricity production from natural gas in Hungary</td>
<td>Electricity, natural gas, at power plant/CENTREL S'</td>
</tr>
<tr>
<td>Electricity production from Nuclear in France</td>
<td>Electricity, nuclear, at power plant/UCTE S'</td>
</tr>
<tr>
<td>Electricity production from peat in Finland</td>
<td>Electricity, peat, at power plant/NORDEL S'</td>
</tr>
<tr>
<td>Electricity production from oil in Czech Republic</td>
<td>'Electricity, oil, at power plant/CZ S'</td>
</tr>
<tr>
<td>Electricity production from oil in Germany</td>
<td>Electricity, oil, at power plant/DE S'</td>
</tr>
<tr>
<td>Electricity production from oil in Spain</td>
<td>Electricity, oil, at power plant/ES S'</td>
</tr>
<tr>
<td>Electricity production from oil in France</td>
<td>'Electricity, oil, at power plant/FR S'</td>
</tr>
<tr>
<td>Electricity production from oil in United Kingdom</td>
<td>Electricity, oil, at power plant/GB S'</td>
</tr>
<tr>
<td>Electricity production from oil in Hungary</td>
<td>'Electricity, oil, at power plant/HU S'</td>
</tr>
<tr>
<td>Electricity production from oil in Sweden</td>
<td>'Electricity, oil, at power plant/SE S'</td>
</tr>
<tr>
<td>Electricity production from a share of sources (e.g. Natural gas, industrial gas and nuclear power plants) in Hungary</td>
<td>'Electricity mix/HU S'</td>
</tr>
<tr>
<td>Energy consumed by a bus in Greece</td>
<td>Transport, passenger bus/CH S'</td>
</tr>
<tr>
<td>Heat produced from Natural Gas in Europe*</td>
<td>'Heat, natural gas, at boiler modulating &gt;100kW/RER S'</td>
</tr>
<tr>
<td>Heat produced from Oil in Europe</td>
<td>'Heat, light fuel oil, at boiler 100kW condensing, non-modulating/CH S'</td>
</tr>
</tbody>
</table>
*Extrapolation from Switzerland to Europe

The table presented hereafter presents some relevant statistics for EU-25 for the year 2004.

<table>
<thead>
<tr>
<th>Population (million)</th>
<th>460.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross domestic product (GDP) (billion 2,000 US$)</td>
<td>8,920.58</td>
</tr>
<tr>
<td>GDP at purchasing power parity (GDP(PuPP)) (billion 2,000 US$)</td>
<td>11,048.29</td>
</tr>
<tr>
<td>Energy Production (Mtoe)</td>
<td>895.06</td>
</tr>
<tr>
<td>Net Imports (Mtoe)</td>
<td>913.89</td>
</tr>
<tr>
<td>Total primary energy supply (TPES) (Mtoe)</td>
<td>1,757.25</td>
</tr>
<tr>
<td>Electricity Consumption* (TWh)</td>
<td>2,978.66</td>
</tr>
<tr>
<td>CO₂ Emissions **(Mt of CO₂)</td>
<td>3,891.42</td>
</tr>
<tr>
<td>TPES/Population (toe/capita)</td>
<td>3.82</td>
</tr>
<tr>
<td>TPES/GDP (toe/thousand – 2,000 US$)</td>
<td>0.20</td>
</tr>
<tr>
<td>TPES/GDP(PuPP) (toe/thousand – 2,000 US$ PuPP)</td>
<td>0.16</td>
</tr>
<tr>
<td>Electricity Consumption / Population (kWh/capita)</td>
<td>6474</td>
</tr>
<tr>
<td>CO₂/TPES (t CO₂/toe)</td>
<td>2.21</td>
</tr>
<tr>
<td>CO₂/Population (t CO₂/capita)</td>
<td>8.46</td>
</tr>
<tr>
<td>CO₂/GDP (kg CO₂/2,000 US$)</td>
<td>0.44</td>
</tr>
<tr>
<td>CO₂/ GDP(PuPP) (kg CO₂/2000 US$ PuPP)</td>
<td>0.35</td>
</tr>
</tbody>
</table>

*Gross production + imports - exports - transmission/distribution losses
**CO₂ Emissions from fuel combustion only. Emissions are calculated using IEA’s energy balances and the Revised 1996 IPCC Guidelines.

Source: [IEA, 2004]
Annex 2: Estimation of the Cost per Tonne of CO₂ Avoided

The purpose of this appendix is to explain how the cost per tonne of CO₂ avoided (also referred as cost of saved carbon = CSC) is calculated in this study for each of the case studies analysed (in Euros per ton of CO₂ avoided). CSC measures the cost-effectiveness of an option for reducing GHG emissions.

In general terms, the cost for reducing CO₂ can be estimated as the cost associated with the implementation of the project (i.e. initial investment and yearly operational and maintenance costs) minus the monetary savings associated with the project (i.e. savings in fuel or electricity costs), divided by the amount of CO₂ that is avoided through the implementation of the concrete project. The cost per tonne of CO₂ avoided can be positive (a benefit) or negative (an expense). When the sum of the savings is worth more than the project costs (investment, maintenance, etc.) over the whole lifetime of the project, this figure is negative, and represents a monetary benefit. This means that the project is profitable and that it reduces CO₂ emissions in a cost-efficient way. If the project costs are higher than the associated fuel and energy savings, this figure is positive, and represents an expense.

CSC takes into consideration the following cost items:
1. The investment costs (€)\(^{27}\)
2. The annual maintenance and operational costs (€).
3. The energy savings (kWh converted into €).

The calculation of the CSC is also based on several key parameters:
1. The lifetime of the project (in years)
2. The interest rate (%) (see table 2.1)
3. The price of local energy from conventional sources (electricity or fuel) (in €/kWh) (see table 2.2)
4. The amount of CO₂ that is avoided (tonnes).

In the present study, CSC is calculated in the following steps:

---

\(^{27}\) Energy saving projects usually require an initial investment for new equipment. One of the main aims of the initial capital investment will be to reduce energy consumption. Monetary savings will be achieved either by installing a new technology or new equipment that reduces energy consumption and/or by fuel switching in order to benefit from another type of fuel that is cheaper (in this case with the introduction of renewable energy systems).
1. Estimation of the investment costs, which are those incurred in getting the installed scheme running (e.g. cost of the technology, installations costs, etc.) ($A_m$). Investment costs usually occur only in year 0
2. Estimation of the total yearly operating costs by totalling the maintenance and operating costs as well as the salaries ($B_m$) for each year $m$ of the project’s lifetime.
3. Estimation of the yearly savings associated with the project over its whole lifetime (e.g. the energy savings in monetary terms) ($C_m$)
4. Estimation of the net cost of the project for every year of its duration, which is the cost associated with the implementation of such an option minus the savings ($D_m$):
   \[ D_m = (A_m + B_m) - C_m \]
5. Estimation of the net present value on an annualised basis ($F_m$). In the analysis, it is important to take into consideration that an amount of money today is worth more than the same amount of money in the future because it can be invested today to earn interest and produce a greater sum in the future. The Net Present value (NPV) method calculates the present value of all yearly capital costs and net savings throughout the life of a project. It is possible to calculate what future savings are worth today by discounting them by the rate of return anticipated on investment (debt financing rate). This is a common financial appraisal technique. The discount factor for a single year is calculated from:
   \[ f_m = \frac{1}{(1 + R)^m} \]
   Where:
   $f_m$ = discount factor for estimating the NPV of the net cost $D_m$ of the year $m$.
   $R$ = debt financing rate ($< 1$). The debt financing rate is obtained from the table 2.1, which shows the interest rates for EU-25 as published by Eurostat and the European Central Bank (ECB).
   $m$ = year considered.

   The net present value ($F_m$) for a year $m$ is then calculated as follows:
   \[ F_m = D_m \times f_m \]
   Remark: The costs can be expressed as negative amounts (expenses) or positive (benefits).
6. Sum of all the present values estimated for each year of the project is called the NPV of the project ($G$). A cost-effective investment is one where the NPV is negative, i.e. the savings are worth more than the initial investment
\[ G = \sum F_m \]

7. Estimation of the annual reduction of CO₂ (Hₘ).
8. Sum of the amounts of CO₂ that are avoided each year in order to calculate the carbon reductions over the whole life time of the project (I).

\[ I = \sum H_m \]

9. CSC is the NPV of the project divided by the sum of the carbon reductions over the whole life time of the project.

\[ \text{CSC} = \frac{G}{I} \]

As indicated above, in some cases there are net present savings (negative CSC) rather than net present costs (positive CSC) for reducing GHG emissions. A simple example of net savings is a cost-effective efficient appliance, where the savings in fuel or electricity costs exceed the extra purchase cost of the more efficient appliance (compared to a standard appliance), while the lower energy use results in lower CO₂ emissions.

**Table 2.1 – Debt financing rates used for the calculations (unless otherwise specified)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Interest rate (%)</th>
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<tr>
<td>Czech Republic (CZ)</td>
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<tr>
<td>Finland (FI)</td>
<td>3.4(a)</td>
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<tr>
<td>France (FR)</td>
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<tr>
<td>Spain (ES)</td>
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</tr>
<tr>
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<tr>
<td>EU-15 Average</td>
<td>3.42(a)</td>
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<tr>
<td>EU-25 Average</td>
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(a) ECB long-term interest rates; 10-year government bond yields, secondary market. Annual average (%), 2005

(b) Assumed for the purpose of this study
### Table 2.2 – Prices of energy from conventional sources

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<tr>
<th>Country</th>
<th>Energy price (€/kWh)</th>
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<td>0.0714 (heating)</td>
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<tr>
<td></td>
<td>0.1428 (electricity)</td>
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<td>Finland (FI)</td>
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<td>0.033 (b)</td>
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<tr>
<td>United Kingdom (UK)</td>
<td>0.05 (a)</td>
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</table>

(a) Information provided by the relevant contacts for each project  
n.a. Not applicable

An example of the detailed calculation is provided hereafter for the project carried out in the Czech Republic.

The main hypotheses are:
- Interest rate: 3.4%  
- Heating price: 0.0714 €/kWh  
- Electricity price: 0.1428 €/kWh

As shown in the bottom right of the table, the cost of saved carbon (CSC) obtained is €-7.28 per tonne of CO₂ avoided.
## ANNEXES

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<tr>
<th>Year</th>
<th>Investment</th>
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<th>Heating Savings</th>
<th>Heating savings</th>
<th>Electricity Savings</th>
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<th>Sum cost</th>
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<th>Cost per tonne CO₂ avoided</th>
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Annex 3: Detailed Fact Sheets of the 10 Successful Projects on Energy Efficiency and Renewable Energy Sources
ANNEXES
EN ENERGY EFFICIENCY PROJECTS
Kuopio Energy Management Programme

The energy management programme of Kuopio (Kuopion kaupungin energianhallinta-ohjelma) aimed to reduce electricity consumption in the buildings of the City of Kuopio through changes in user habits regarding lighting and office appliances. Significant savings were achieved in many work units; in the best, the electricity consumption declined by around 10% over the project period. The project resulted in total annual energy savings of 450,000 kWh.

1. Project background

Kuopio, with its approximately 90,000 inhabitants, is the 8th largest city in Finland and the economic centre of Eastern Finland. It is situated about 400 km north-east of Helsinki.

Lakes and forests characterise Kuopio and its region. The total area of the municipality of Kuopio is close to 1,200 km² of which one third is covered by waterways (lakes and watercourses) and half by forests. The biggest lake surrounding the city is called Lake Kallavesi, which is depicted in the picture below. Its shoreline is 1,600 km in length. Apart from lakes, rich flora and varied terrain with many hills are the essential characteristics of the region.
Kuopio, like the whole of Finland, belongs to the temperate coniferous-mixed forest zone with cold, wet/snowy winters, and moderate rainfall in all seasons. Finland is situated in the Eurasian continent's coastal zone and its climate shows characteristics of both a maritime and a continental climate, depending on the wind direction. Thanks to the influence of the Baltic Sea, inland waters and the Atlantic Ocean with the Gulf Stream, the mean temperature in Finland is several degrees (as much as 10°C in winter) higher than that of other areas in these latitudes, e.g. Siberia and south Greenland. In Kuopio, the average summer and winter temperatures are around +15°C and -8°C, respectively. The four seasons are clearly distinguishable.

Kuopio is a major university city. The economic focus is increasingly on modern businesses, especially information and welfare technologies. The wood and food industries are the most important traditional industries. Additionally, tourism has an important role for the economy of the city. Most employees in Kuopio work for service industries.

### Municipalities in Finland

Kuopio is one of the 114 Finnish cities\(^\text{28}\), which are in essence large

\(^{28}\) In Finnish both “city” and “town” translate into “kaupunki”. Thus “city” in the Finnish context does not refer to an especially big town.
municipalities\textsuperscript{29}. As of 2007, there are in total 416 municipalities in Finland. The municipalities, corresponding to the level 5 of the NUTS classification\textsuperscript{30}, represent the local level of administration in Finland and act as the fundamental administrative units of the country. A municipality is governed by an elected council (kunnanvaltuusto). Municipal managers (kaupunginjohtaja for cities, kunnanjohtaja for other municipalities) are civil servants named by the council.

Municipalities provide two thirds of public services in Finland, including:
- Educational services (comprehensive and upper secondary schools, vocational institutions and polytechnics)
- Adult education, art classes, cultural and recreational services and libraries
- Child day-care, welfare for the aged and the disabled, and a wide range of other social services
- Preventive and primary care, specialist medical care and dental care.

In addition, they:
- Promote a healthy living environment
- Supervise land use and construction in their area
- Are responsible for water and energy supply, waste management, street and road maintenance and environmental protection
- Seek to promote commerce and employment in their area (Kuntaliitto, www.kunnat.net).

Finnish local and joint authorities employ nearly 430,000 people, approximately one-fifth of Finland’s workforce. About four-fifths of municipal employees work in health care, education and social services. [Kuntaliitto]

2. Scope of the project and objectives
Due to the key role that Finnish local authorities play in providing a multitude of services, cities and municipalities own and maintain many buildings whose energy consumption could be significantly reduced by energy efficiency improvements.

The Kuopio energy management programme (hereafter also called the “project”) aimed at reducing the electricity consumption in the buildings and work units of the city of Kuopio through changes in user behaviour regarding lighting and

\textsuperscript{29} Currently only ‘municipality’ is recognized by law and any municipality is allowed to call itself a city if it wishes to do so.
\textsuperscript{30} NUTS = EU Nomenclature of Territorial Units for Statistics
office appliances. The project also aimed to promote energy efficient and environmentally-friendly ways of operation among staff and key decision-makers (e.g. procurement managers and IT centres).

Specific objectives were to:

- Reduce the electricity consumption of office equipment and lighting through behavioural changes.
- Reduce fuel consumption by training users to drive more economically.
- Reduce the consumption of paper through behavioural changes.
- Start the monitoring of the issues mentioned above and give feedback at staff level.
- Develop a training model in order to enable the replication of the project in other organisations.

The project targeted all the work units of the city and its 6,500 employees and decision makers. The city maintains 656 work units/buildings. Their total surface area is 623,932 m² (2005), 85% of which is owned by the city, the rest being rented. In addition to the offices of the city administration, Kuopio is in charge of, among others, 38 kindergartens, 32 comprehensive schools, 6 upper secondary schools, 2 hospitals, and 4 health centres. The project was implemented in these buildings as well.

3. The role and responsibilities of the organisations that participated in the project

The project was led and carried out by the City of Kuopio Environmental Centre, which is part of the public administration of the city. A full-time project manager was allocated to the project.

However, the initiative came from Motiva Oy, a government owned energy efficiency and renewable energy expert organisation. It participated in the planning of the project and provided a significant share of the funding (see section 9). Motiva also played an important role in providing the energy efficiency expertise in the planning and implementation phase.

Other partners were the City of Kuopio Facility Management, and municipal energy and waste corporations: Kuopio Energy and Jätekukko Oy. They all participated in the financing and planning, and co-operated in the realisation of the project.

The executive group of the project included three persons from the Environmental Centre and one person from each of the four partner organisations mentioned above. The executive group played a role especially in the planning and decision making phases and its members facilitated the
implementation of the project in the partner organisations.

4. Decision-making process
The city of Kuopio is engaged in continuous work for energy savings and improved efficiency. Significant steps have already been taken to improve the energy efficiency of the public buildings. According to the statistics of the Association of Finnish LRAs (Kuntalitto), the consumption of heat, electricity and water in the public buildings in Kuopio is among the lowest in Finland: the city is among the best three for all three parameters. In Kuopio, many technical energy efficiency and savings options have already been implemented and further improvements are mainly to be achieved through changes in user attitudes and behaviour. Intervention for changing user behaviour was seen as the logical next step to the technical measures that were carried out in the past. All the five organisations presented above in section 3 were involved from the start in the decision-making process. The negotiations were short and no real persuasion was needed to engage the partners in the project. An initial meeting was held in February 2004 between the partners, after which a concrete project plan was drafted and agreed on, enabling the project to start in May 2004.

The project was launched when the City of Kuopio and Motiva Oy made an official agreement, which had been authorised by the city council and signed by the mayor. At the same time, the local partners committed to financing the project and agreed to participate in its activities.

No public consultation took place in the context of this project.

5. Technical aspects of the project
The project consisted of promoting energy efficiency in public buildings through an information campaign. The training given to the city staff was the main activity within the project. The training was carried out as follows:

1. First, pilot training sessions were held in two working units. The 1-hour training covered the electricity and paper consumption in the offices and waste issues. Based on the feedback from the participants, the content of the training was slightly modified in order to better adapt the content to the real needs of the target audience and clarify the key messages.

The main training sessions were held over two days during the annual “Energy Savings Week” at the main city library. An open invitation for one person, signed by the mayor, was sent beforehand to all the city's work units; the units could name the representative themselves. In total, 8 similar training sessions were held.
Around 330 invitations were sent; 187 persons participated in the main training sessions. Thus 57% of the work units of the city were represented.

The aim of the training was to convey three key messages:

- Turn off the lights at the work place, when leaving it for more than 10 minutes.
- Turn of the computer monitor when leaving the work desk (e.g. for lunch, meetings, etc. and at the end of the working day). Turn off the computer and other office equipment at the end of the day, unless there is a specific reason for not doing so.
- Use two-sided photocopying and printing.

The participants in the main training were asked to hold a short information session with their colleagues in their own work unit. For this purpose, a short summary (one A4 sheet) of the training was given to the participants, which also contained some tips on how to organise the information session. A short report on the meeting was to be sent to the Environmental Centre. The purpose of this report was to monitor to what extent information dissemination within the work units was carried out and how many people participated at this level.

Additional material about energy efficiency and energy saving opportunities in offices from Motiva Oy was available in the training.

After the main training sessions were held, the important units that had not participated were approached again and a training session in the unit itself (open to all staff of the unit) was proposed to them. As a result, a few additional units were covered by the training.

A poster with the key messages of the project was prepared together with an advertising agency. It was distributed to all the city’s work units.

An article about the energy efficiency issue was prepared for the magazines of the different administrative units.

An energy efficiency web page was added to the city’s intranet, which provided further information and links on this issue. A link to this page was found on the municipality’s intranet home page.

After the training, e-mails were sent to the entire staff approximately once a month to remind them about the project and the key messages. Intermediary results were also communicated once they were available.
The electricity consumption monitoring started immediately after the training\textsuperscript{31}. Consumption was monitored monthly and per work unit; the results were collected as a percentage change compared to the same month in the previous year. In order to exclude the impact of user-independent factors in the electricity consumption changes (i.e. periodic inactivity due to renovation work), the possible technical/operational changes in the work units were discussed with the city’s Facility Management.

6. The citizens' attitude to the project

The feedback from the municipal staff (target of the project) was mostly very positive: people found the content of the training good and the project in general well organised. The issues addressed in the project were perceived as important/relevant. The participants had many wrong ideas about energy saving, and the project helped to correct them (see section 8). The credibility of training at the work units was good, as it was run by an expert from outside the work unit (either from the Environmental Centre or Motiva Oy).

The implementation and results of the project have raised the interest of many local organisations and stakeholders Finland-wide. The project coordinator was invited to present the project on television on the regional news and the national morning news.

The project was generally well accepted by stakeholders as energy savings are regarded as beneficial. The training and distribution of information were carried out systematically and in a clear manner, which contributed to the acceptance. In general, climate change is increasingly being addressed in the media and people are starting to be more aware of the problem and to understand the ways to reduce GHG. Increasing awareness of these issues is likely to increase citizens’ support for the project.

Negative feedback could not be totally avoided. In general, difficulties concerning the acceptance of the project were linked to lack of knowledge and ignorance about the importance of energy saving measures. Negative attitudes to environmental issues in general were also observed among some stakeholders. In such cases, it was very hard to convince people of the benefits of this kind of project. Specific points that were given as negative feedback include:

- The cost savings did not directly benefit the work units, but were accrued by the city in general
- The meaningfulness of the energy efficiency measures in general was

\textsuperscript{31} It should be noted that in Kuopio the electricity consumption had been measured and recorded per work unit already before this project was carried out. Therefore the baseline consumption was known.
challenged
• The significance of the contribution that an individual could make as part of a big organisation was doubted
• The project and its aims were seen to be insignificant compared to some other energy consuming activities of the city. For example, people noted that:
  – Sports fields’ lighting often stays on all day long even if the fields are not used, which seemed to offer greater potential for energy savings than turning off office lights during lunch. The Environmental Centre is aware of this particular issue (and other conflicting issues) and it is an example of a case without easy solutions. The operational units (e.g. the sports facilities management unit) are quite independent within the city administration and the lack of motivation of one key person in these units can hamper any improvements.
  – A highway passing by Kuopio is lit at night on both sides of the city for a total distance of 160 km. Many people consider this a waste of energy as the traffic levels are rather low in the middle of the night. Highway and its lighting are administered by Finnish Road Administration, i.e. by national authorities. Thus local administration is not the relevant decision maker. Furthermore, energy savings by turning off the lights are likely to compromise road safety.

7. Implementation and project life span

The project was implemented in May 2004 and lasted until December 2005 (20 months). The project phases and timing are presented in Table 1 Please note that the last three phases were carried out partially in parallel.
Table 1 – Project phases and timing

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start date</th>
<th>End date</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>01/05/04</td>
<td>31/07/04</td>
<td>3</td>
</tr>
<tr>
<td>Pilot phase</td>
<td>01/08/04</td>
<td>31/08/04</td>
<td>1</td>
</tr>
<tr>
<td>Staff training</td>
<td>01/10/04</td>
<td>31/12/04</td>
<td>3</td>
</tr>
<tr>
<td>Monitoring of results</td>
<td>01/11/04</td>
<td>31/12/05</td>
<td>14</td>
</tr>
<tr>
<td>Training elements targeted to specific part of staff</td>
<td>01/01/05</td>
<td>31/12/05</td>
<td>12</td>
</tr>
<tr>
<td>Analysis of results and final reporting</td>
<td>01/10/05</td>
<td>31/12/05</td>
<td>3</td>
</tr>
</tbody>
</table>

In the Planning phase, the operational modes and working tools were decided upon; the training package (the context, key messages, information material, etc.) and the project schedule were drafted. During the short Pilot phase the training package of 1 hour was given in two work units (Environmental Protection Office and Bureau of Education) in order to test it. These pilot training seasons resulted in small changes in the training package.

Staff training aimed at the whole city staff was carried out during the city’s “Energy Saving Week” in October 2004. As explained in section 5, one person from each work unit of the city (roughly 330 in total) was invited. The participants were asked to hold a short information session at their work unit in order to disseminate the information to the whole staff. In addition to the main training, around five additional training sessions were held in the work units.

After the training, the issue was kept active with the help of e-mail reminders, articles in staff magazines and additional project material (e.g. a project poster for each work unit).

Monitoring of results was started immediately after the training and the first results were communicated to the whole staff, first by e-mail and later via the city intranet. Monitoring, communication of results and reminders of the issues were continued until the end of the project.

In addition to the training, targeted at the staff as a whole, the project contained the following Training elements targeted at specific groups of staff:

- Training on ecologic/economic driving for three work units: health care services delivered at home (e.g. for elderly), Kuopio Water and Kuopio Energy.
- Custom-made training for the kitchen personnel of the Kuopio Catering Unit.
• Creation of the “Office’s Environmental Certificate” tool as a scholarly thesis by an engineering student.
• Assessment of how to better take into account energy efficiency and environmental criteria in the city’s public procurement.

The last months of the project were mostly spent in the project’s phase of analysing the results and final reporting. Three work units (one office, school and kindergarten) were also rewarded for their significant reduction in electricity consumption (around 10% reduction over 15 months). The complete monitoring results were available on the city’s intranet and internet site after the end of the project.

No delays in the schedule were encountered, but finally there was not as much time for all the planned activities (especially the element targeted at specific groups of staff) as had been foreseen at the start of the project and somewhat less attention was paid to these than planned (see section 13).

8. Problems and obstacles

No specific problems were encountered in the planning and implementation phases. However, among the large target audience of the project, there were, and there are always likely to be, people whose motivation proved to be a challenge or indeed impossible within the specific project. Lack of motivation might have different causes. The motivational barrier identified and possible solutions (for future projects) are given in Table 2.

<table>
<thead>
<tr>
<th>Table 2 – Motivational barriers and possible solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivational barrier</td>
</tr>
<tr>
<td>The saved energy costs do not directly benefit the work unit concerned</td>
</tr>
<tr>
<td>General ignorance / lack of interest in environmental issues</td>
</tr>
<tr>
<td>Wrong ideas about energy saving in general (perceived to compromise comfort, e.g. resulting in cold and dark offices)</td>
</tr>
<tr>
<td>Incorrect “knowledge” regarding energy use and saving opportunities (see below)</td>
</tr>
</tbody>
</table>
Common incorrect “facts” that the target audience had about lighting and office equipment (see the box below) were explicitly taken up and “thrown out” in the training.

**Common incorrect “facts” about lighting and office equipment:**

- Fluorescent tubes suffer from being turned off and on, thus during the day they should be left on all the time – Wrong! The current lamp technology does not suffer from frequent switching. It pays to switch off when the room is left for 10 minutes or more.
- Computer monitors will suffer if frequently turned off and on; Monitor does not significantly affect the energy consumption of a computer – Wrong! Modern monitor technologies do not suffer from frequent switching. Monitors contribute significantly to the energy consumption of a computer.
- Screen savers save energy – Wrong! Screen savers are supposed to protect the image from “burning on the screen”, but fancy screen savers increase the electricity consumption of a monitor that is not in use.

Regarding the objective of promoting energy-efficient and environmentally-friendly ways of operating among key decision makers responsible for public procurement, the project was confronted with the negative/non-motivated attitude of the procurement manager. Thus, this objective was dropped half way through the project and resources were concentrated on more fertile activities. This illustrates that the reluctance of a key person in a public administration can effectively block improvements.

### 9. Costs and funding of the project

Total budget for the project was €88,500, of which:

- 55%, i.e. €48,500, from the local authority (the different operational units of the City of Kuopio):
  - City of Kuopio (Environmental Centre and Facility Management) €30,000
  - Kuopio Energy €12,500
  - Jätekukko Oy €6,000
- 45%, i.e. €40,000 from Motiva (state funding).

The costs were not specified per project phase. In principle, they went to the salary of the full-time project coordinator and thus the costs are proportional to the length of each project phase. Total costs of the project did not exceed the original budget, but some of the planned activities had to be reduced to stay within the budget and timing of the project.

A payback period of approximately 1 year was expected for the local funding part. It was not estimated for the total funding.
10. Results

10.1 General results

The general objectives of the project were achieved: the electricity consumption was reduced through changes in user behaviour. Total annual energy savings resulting from the project have been estimated at 450,000 kWh. An important result, which might be relevant for similar projects to be implemented in the future, is that in all the work units that hosted a training/information session, electricity consumption went down 5-10%. In other units results varied significantly.

Regarding the different types of public buildings, the achieved electricity savings were greatest in schools where the consumption was reduced by 4.5% on average. Also kindergartens achieved an average reduction of 2.2%.

In the best individual work units, electricity consumption fell by around 10% over the project period. For example at the Council office (Valtuustovirastotalo) electricity consumption was reduced by 11% during the project. This is also the general estimation of the maximum savings that can be achieved via users.

10.2 The socio/economic impacts/benefits

Within the project, around 300 persons (roughly 5% of the staff) participated personally in the training/information sessions. The information dissemination targeted the whole city staff (6,500 persons) via city intranet, e-mails, city journals and information material. In principle, all of them were reached at least by the informative e-mails that were sent. Based on the feedback, the key instructions/messages (see section 5) were well adopted and the energy efficiency issue were widely discussed in the work units.

In monetary terms, the project resulted in a €25,000 reduction in the total electricity invoice over one year.

The total awareness raising and resulting energy savings from the project are expected to be greater than was measured in the work units, as it is probable that people have also discussed these issues with their family and friends and have paid attention to them at their homes.

The employment impact of the project was rather limited: one full-time post (project coordinator) was created for the length of the project.

10.3 The environmental impacts/benefits

The implementation of the project resulted in total annual energy savings of 450,000 kWh based on the comparison of energy consumption before and during the project. This amounts to €25,000 with the energy price of 0.056 €/kWh. In the final project report, the direct CO₂ emission reduction
corresponding to the saved electricity were calculated at 175 tonnes, using the official emission factor of the electricity provided by Kuopio Energy in 2004 (390 g CO₂/kWh) [Ympäristökeskus & Motiva 2006]. This reflected the 2004 electricity production at Kuopio Energy from peat by CHP generation.

Using the methodology explained in Annex 2, it has been determined that the actualised benefits of the project outweigh the actualised costs, assuming an interest rate of 3.4% and a project lifetime of 5 years. This means that the project is a cost effective investment, as the economic savings are worth more than the initial capital investment.

As the project is profitable, the cost per tonne of CO₂ avoided is in fact a benefit. Indeed, it has been estimated that the cost per tonne of CO₂ avoided due to the implementation of this project is -28.49 €/tonne of CO₂ (under the assumptions mentioned above). This means that after the payback period (estimated at 4 years in this case), there is no further cost associated with the reduction of GHG emissions.

Regarding the ecological/economical driving, the fuel consumption of the participants decreased by around 10% during the training.

The environmental benefits of the training aimed at the Catering service were very modest and have not been quantified. Changes in the paper consumption in the offices were not monitored.

The results of this project, together with the previously implemented, more technical measures can be estimated to have made a significant contribution to the reduction in energy consumption and energy costs at local level.

11. The overall energy efficiency situation in Kuopio and comparison with the national and European situation

As explained in section 4, regarding public buildings, the energy efficiency situation in Kuopio is above the national average. An inventory study carried out in 2006 in Kuopio and surrounding municipalities estimated that the local organisations had already achieved 4%-6% savings (5.5% for the City of Kuopio) which count towards the 9% target of the European 2006/32/EC Directive. As the baseline and targets are based on the average national situation, the results indicate that the local energy efficiency

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32 Actualised benefits: All the annual net savings during the life cycle of the project, expressed in present money value.
33 Actualised costs: Present value of all the annual capital costs during the life of a project.
The situation is above the national average [Ympäristökkeskus & Motiva 2006]. More detailed information about the current energy efficiency situation in Kuopio could not be identified.

In Finland, most municipal and governmental facility management organisations and housing companies are generally partners in voluntary national energy savings contracts. Energy audits have been carried out in many buildings. The energy saving potential identified in the audits has already been partially captured by actions with a payback time of less than 3 years. Projects with longer payback times still offer further possibilities [Swärd et al. 2005].

Energy audits do not only concern public buildings. Finland’s Energy Audit Programme (EAP), put into practice in January 1994, is one of the oldest national energy efficiency grant schemes in place. Its main objective is to conduct energy audits to identify energy-saving opportunities. The goal is to have 80 percent of the total building stock of industrial and tertiary sectors audited by the year 2010. The coverage of the EAP by the end of year 2001 in industry was approximately 60% of total energy use. In the service sector, the coverage is also significant, some 1/3 of the building stock is covered by the EAP [Energie-Cités 2003, Motiva 2007].

EAP is a voluntary programme promoted by a 40% to 50% subsidy from the Ministry of Trade and Industry. The total amount of subsidies up to the year 2004 amounted to €18.8 million. It has been estimated that over the same period, over €250 million have been saved by the improved energy efficiency of the audited buildings [Energie-Cités 2003, Motiva 2007].

Regarding new buildings, requirements are laid down in the National Building Code of Finland. A new Building Code concerning thermal insulation and indoor climate and ventilation in buildings has been in application since October 2003. The insulation requirements were made stricter and focus was also put on energy-efficient ventilation systems. It is estimated that the new requirements will result in energy savings of 25%-30% in new buildings.

In industry, the voluntary energy conservation agreement covers 85% of the sector’s energy use. In 1998-2004, the cumulative energy savings in the scope of the agreement were 4.4 TWh/a in heat and fuels and 0.8 TWh/a in electricity [ODYSSEE, 2006-07].
In Finland, since 1995 the energy efficiency index\textsuperscript{34}, developed under the EU-funded project Odyssee, shows that the overall energy efficiency has improved by 7% from 1995 to 2004, more than the EU average index, that improved by 5%.

12. Ongoing applications of the project

Exact ongoing and future impacts of the project are difficult to estimate. In order to maintain the achieved reduction in energy consumption, the Environmental Centre plans to remind the city staff from time to time about the energy efficiency issue and the key messages (see section 5). These will be highlighted especially during the Energy Saving Week which is held every year in October 2007. Many local organisations and other stakeholders Finland-wide have been interested in the results of the project. In 2007, the Environmental Centre of Kuopio will give training sessions (based on the model of this project) in about 10 other organisations in Kuopio, such as the university, regional main hospital and the vocational college. This work will be included as part of the normal activities of the Environmental Centre and no extra personnel or specific budget have been allocated to it. Motiva Oy is also going to promote similar projects in other municipalities, based on the model developed in Kuopio.

As a follow-up to the energy management programme, a new project was launched on energy and climate issues in Kuopio. This new project will assess the past energy consumption of the different actors in the Kuopio region, the impacts of the energy savings initiatives in the past as well as the remaining energy saving potential. This new project will also serve as a preparatory study for the implementation of the energy end-use efficiency and energy services directive in Finland. Therefore, it is financed from the national budget of this directive.

13. Key factors for success

The energy management programme project is part of a continuum of actions that the City of Kuopio has carried out in recent years in order to save energy and combat climate change. “The Climate Strategy of Kuopio”, which was finalised in 2003, played an important role in raising awareness on climate issues and setting the foundation for actions, of which the energy management programme is an example. The city management in general has a positive attitude towards such projects. The local partners of the project and the relevant

\textsuperscript{34} An energy efficiency index has been developed under the EU-funded Odyssee project (http://www.odyssee-indicators.org/). It provides an overall perspective of energy efficiency trends by sector and combines the trends of indicators by end-use or sub-sector. A decrease means an energy efficiency improvement [ODYSSEE, 2006-07]
people, although belonging to different administrative units, form a “team” which was previously involved in different projects in the city. Satisfaction with previous projects and co-operation made it easier to plan and implement new activities.

Specific success factors include:

- The project was launched with the support of the municipal management (a letter from the mayor to the work units of the city).
- The training sessions were well organised and rather short, but sufficiently informative (1 hour).
- Guidelines given during the training were clear and there were only 3 key messages.
- Participants were given a summary of guidelines (one A4 sheet).
- Active follow-up and reminders about the issue after the training (e-mail reminders to the city staff, posting of additional information material to the work units, dissemination of information via the city intranet).
- Results were communicated to all the city staff as soon as they were available; and results were communicated regularly (once a month) during the project.
- Three work units showing the best improvements were rewarded.

In addition, the expertise and the additional funding that Motiva brought into the project played an important role.

14. Potential to replicate a similar project by other local/regional authorities

Such a project could easily be replicated by other local/regional authorities. Planning and organisation of the training is straightforward. The factual content (key messages) of the project is very simple and clear. The challenge is to come up with effective communication tools and methods to convey the message and motivate people. They can easily be adapted to the local culture and social context.

If the project manager was to repeat the project, he would focus even more on the training sessions in the work units to maximise the number of staff participating in person – the reports show that the results were good in all the work units who hosted a training/information session. To enable this, he would limit the scope of the project, for example by leaving out the training related to driving. “You cannot do everything at once!”

He also recommends planning similar projects with care and starting the brainstorming as early as possible. In his opinion, it is all about motivating people and new ideas and ways to convey the message are always needed. He thinks that different and humoristic messages or ones that appeal to feelings can
offer alternative approaches, as information alone is not always enough to change behaviour. He points out that communication about climate change is a two-edged sword - the issue may be perceived as important and the communication useful. On the other hand, the dimensions of the issue may be perceived too wide for an individual to be able to impact; this may discourage people to act. According to the project manager, rewards – even if they are modest – are a good way to motivate people.

15. Contacts / Acknowledgements

**Organisation:** City of Kuopio - Environmental Centre (Kuopion kaupungin ympäristökeskus)
Type of organisation: Local authority

**Main activities:**
The Environmental Centre of the City of Kuopio promotes and supervises environmental protection and aims at achieving a healthy and pleasant environment in Kuopio. About 60 employees work in the centre, the expertise of which is available for residents and other customers. The duties of the Environmental Centre include veterinary services; the Environmental Health Laboratory and Kuopio Natural History Museum.

The Environmental Centre is part of the city administration. In general, the city of Kuopio, like other Finnish municipalities, is responsible for providing a multitude of basic services to its residents, including education, social services, health care, cultural activities, basic urban infrastructure and energy. In total, the city of Kuopio has approximately 6500 employees.

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16. References

ANNEXES


[Kuntaliitto] Kuntaliitto. Available at: www.kunnat.net (viewed 01/03/2007)

[Kuopio] Website of the city of Kuopio. Available at: http://www.kuopio.fi/


http://www.kuopio.fi/ymp.nsf/TD/140207113039262?
OpenDocument (viewed 07/05/2007)
Building refurbishment in Skåne

RegionFastigheter Skåne established a contract with a service provider for the refurbishment and upgrading of three hospitals in the region based on substantial saving potentials in energy and operational costs. The established contract covers extensive rebuilds of Heating, Air Ventilation and Cooling (HAVC) systems and implementation of numerous energy conservation measures in all three hospitals. During a contract period of seven years, the performance contractor will monitor and follow up RegionFastigheter’s energy consumption. With a savings guarantee the performance contractor assumes a considerable part of the responsibility and does everything to ensure that the savings accrue as planned. The total energy savings over the last two years are approximately 23,000 MWh in district heating. Furthermore, the rest of the maintenance staff of RegionFastigheter Skåne has learnt from the behaviour in the project and is now applying these new measures to many more public buildings buildings.

1. Project background

RegionFastigheter Skåne is a regional authority in Sweden’s southernmost province (the region is Skåne), mainly responsible for health care, but also for public transportation and regional growth and development (33,000 employees). It had experienced an increasing need for the refurbishment and upgrading of its premises, and also identified a substantial saving potential in energy and operational costs. Thus, they established a PPP and an EPC with a service provider for the three hospitals of the region.

The department in charge of the project (350 employees) is responsible for producing and maintaining the buildings needed for the core-services, mainly hospitals and office buildings.

Skåne (Scania) is Sweden’s southernmost region and offers a great diversity of landscapes covering an area of 11,027 km² (of which 10,983 km² is land area).
Skåne has a temperate, humid climate with no extreme temperatures. It enjoys a modern and growing economy and has 1,184,500 inhabitants (as of December 2006) for a density of 106 inhabitants per km² with an ageing population (like many other European countries) and a life expectancy above 78 years. The main cities are:

- Malmö in the southwest with its cosmopolitan atmosphere: 276,244 inhabitants
- Helsingborg in the northwest: 123,389 inhabitants.
- Kristianstad in the northeast: 76,540 inhabitants.
- Lund: 103,286 inhabitants.

2. Scope of the project and objectives

RegionFastigheter Skåne for a number of years had experienced an increased need of refurbishment and upgrading of their premises, and also identified substantial saving potential in energy and operational costs. Nevertheless, due to its limited investment potential, restrains in public spending and the lack of internal resources regarding large-scale energy saving projects, it had severe difficulties in achieving any major improvement of the energy efficiency.
RegionFastigheter Skåne had previously been contacted by different private companies offering energy services, and therefore decided to launch a call for interest, to see if energy services could be used for achieving its goals.

A PPP can be established for a large range of services, such as:
- Project conceptualization and origination;
- Design;
- Financial Planning and finance;
- Construction;
- Operation;
- Maintenance;
- Program Management.

These activities are typically bundled into contract packages. One of the typical procurement packages is Design, Build, Finance and Operate (DBFO)\(^35\). In this case, the project consisted in establishing a PPP in the form of an EPC. An EPC is a type of PPP. It consists in a shared savings contract, where an ESCO guarantees a certain amount of energy savings to its customer (the LRAs) for a certain remuneration of its services. The investment can be financed either by the ESCO or the customer, or by a third party, a bank or another financial institution. For this service, the service provider took the responsibility for detailed energy analysis, full project implementation, development of financial solutions, and provide guaranteed results (e.g. firm guarantees of energy savings).

Since RegionFastigheter Skåne wasn’t interested in outsourcing all of their operational and maintenance work, they already from the beginning aimed for a combined technical, organisational and knowledge transfer-based project. Therefore the operational part of the DBFO contract was limited to critical parts of the operational and energy management work,

The aims of the project were a quick and radical reduction of energy consumption in one third of the buildings, with an unaffected or improved indoor climate.

The main objectives were:
- Massive reduction in energy consumption (>25%)

\(^{35}\) With the Design-Build-Finance-Operate (DBFO) approach, the responsibilities for designing, building, financing and operating are bundled together and transferred to private sector partners. The private sector designs, finances and constructs a new facility under a long-term lease, and operates the facility during the term of the lease. The private partner transfers the new facility to the public sector at the end of the lease term. [UNECE, 2007].
• Profitable investments (pay-off <7½ years)
• Positive environmental effects
• Use of established technology

3. The role and responsibilities of the organisations that participated in the project
RegionFastigheter Skåne, owner of the buildings, is the promoter of the project. It issued the call for tenders under the laws of Public Procurement and established the main-frame of the PPP.

The energy service private company which won the call for tenders was a private company named T.A.C Energy Solutions. This company is now in charge of the energy analysis, technology/know-how, implementation of solutions, issuing of reduction guarantees and for generally keeping order (for further contact details see section 14).

4. Decision-making process
The different technical and socio-economic reasons for conducting this project were put forward by RegionFastigheter Skåne, including:
• Poor energy performance in the buildings.
• Increasing operational costs for the premises and a need to improve on these despite rampaging energy prices.
• Old, ill maintained installations in urgent need of renewal.
• Environment becoming a political issue.

Thus, due to the limited investment potential, restrictions on public spending and the lack of internal resources regarding large-scale energy saving projects, RegionFastigheter Skåne decided to launch a call for interest, to see if energy services could be used to achieve its goals regarding energy efficiency improvement.

In order to do this, a mandate from the board of executives and from the politicians from the region of Skåne was needed to carry out a PPP project. The decision-makers agreed with the project when the prequalification made and the outcome of the process showed that a number of different companies and consortiums were interested in the project and thus good competition in the tendering process could be expected.

The financial department, the technicians of RegionFastigheter Skåne and the regional politicians were all involved in the project’s decision-making process, the politicians making the final decision. There was no public consultation.
5. Technical aspects of the project

RegionFastigheter Skåne manages in total 1.5 million m² of public premises. The project was carried out in the three hospitals of the region which represent 35% of the portfolio (443,215 m²). The project was implemented in the following three hospitals:

1. University Hospital of Lund (USIL)
   - 8 000 employees
   - 1200 beds
   - Turnover: 500 million €/year

2. Helsingborg Hospital
   - 2 500 employees
   - 356 beds
   - Turnover: 150 million €/year

3. Kristianstad Hospital
   - 2 260 employees
   - 313 beds
   - Turnover: 130 million €/year

They are 30-40 year old buildings with old Heating, Air Ventilation and Cooling (HADV) equipment, a lot of variations between new and old installations (difficult operation and maintenance) and a large backlog of maintenance and re-investments.

RegionsFastigheter Skåne chose the strategy of negotiated procedure for the establishment of the EPC. This strategy demanded an open pre-qualification process that was done taking into consideration the following criteria:

1. Experiences and references of the private company regarding energy savings in real estate development
2. Competence, methodology and service levels of the proposed project teams
3. The terms and conditions regarding contracts, financing and savings guarantees.

The pre-qualification process resulted in five potential ESCOs, which received the final request for tender. Out of these five candidates, three came up with complete tenders, while two couldn’t cope with conditions and opted out. In the following negotiation process the three candidates offered more or less the same amount of savings.

What distinguished the selected company from the four others was their better understanding and strategies for the organisational implementation and how to interconnect the project and its investments with RegionFastigheter Skånes' normal maintenance and re-investments within the premises, and thereby extract additional values.
During the summer of 2004, the contractor performed a detailed Energy Audit on the three hospitals. Everything was investigated (insulation, lighting, temperature settings, air-flow, heating, cooling, ventilation, tap water, steam production, auxiliary power, pumps, generators, transformers). In order to reduce energy consumption, all well-known and widespread technologies for saving energy in buildings were investigated. Based on the results of the audit, the final agreement was signed on 26 January 2005, covering extensive rebuilds of Heating, Ventilation and Air Conditioning (HVAC) systems and the implementation of numerous energy conservation measures in all three hospitals. The only conditions given to the private partner were that the pay-off time of the entire project should not exceed 7.5 years and the pay-off time for a specific building should not exceed 14 years. Installation work started in February 2005. Many solutions were implemented including:

- Heat recovery on air conditioning
- Variable speed drives on fans and pumps
- Building insulation
- Day lighting and natural ventilation strategies
- Lighting controls
- Energy awareness campaigning and training
- Integration of renewable energy in buildings
- Water savings equipment.

Some measures were hard to fit within the pay-off terms such as thicker constructional insulation and energy-saving windows.

During a contract period of seven years, the performance contractor will monitor and follow up RegionFastigheter’s energy consumption in the three hospitals. With a savings guarantee the performance contractor assumes a considerable part of the responsibility and does everything to ensure that the savings accrue as planned.

The contract between RegionFastigheter Skåne and the ESCO, enabled own financing, focusing strongly on the crucial performance guarantees and the guaranteed savings.

More detailed information regarding the concrete EPC were not provided by the contact person in RegionsFastigheter Skåne.

6. The citizens' attitude to the project

The operational and maintenance staff of the three hospitals where the project was implemented reacted positively because care was taken from the beginning of the project to gain their adherence to the project. This was done by making a clear statement that the intention of the project was to develop the premises and
organisation, by realising savings potential, not by outsourcing staff. On a more general level, citizens were neither affected nor informed of the project.

The manager of the project mentioned that it was a deliberate choice to only involve their own personnel and tenants to ensure that it would be reasonably feasible, easy to explain, and quick to produce results.

7. Implementation and project life span

The project was launched on 1 June 2003 with a procurement procedure, explained in the previous section. The contract between RegionFastigheter Skåne and the ESCO (T.A.C Energy Solutions) was agreed on at the end of 2004 and was signed for a period of 7.5 years. The provisional date of completion, with the end of the guarantee and monitoring, is 30 June 2014. The implementation period, scheduled to last about 2 years, started in early 2005 after the signature of the contract with training, optimisation and capacity building efforts. In 2007, the second phase of the project was launched.

Table 1 – Different phases of the project and their planning

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start date</th>
<th>End date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initialisation of prequalification</td>
<td>15/09/03</td>
<td>31/10/03</td>
</tr>
<tr>
<td>Initialisation of procurement</td>
<td>21/11/03</td>
<td>15/02/04</td>
</tr>
<tr>
<td>Signing main-frame agreement</td>
<td>04/08/04</td>
<td>30/06/14</td>
</tr>
<tr>
<td>Signing agreement on energy analysis</td>
<td>04/08/04</td>
<td>31/12/04</td>
</tr>
<tr>
<td>Signing agreement on delivery</td>
<td>13/01/05</td>
<td>31/12/06</td>
</tr>
<tr>
<td>Actual period of guarantee, monitoring &amp;</td>
<td>01/01/07</td>
<td>30/06/14</td>
</tr>
<tr>
<td>education</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The goal of the project was to reduce energy consumption in the buildings without impairing the indoor climate. This was intended to be achieved mainly by changing settings (operating times, temperatures, air-flow, etc.) on existing installations and/or by installing new, well-known technologies. It was necessary to find an easily understandable description of what the RegionFastigheter Skåne wanted to achieve within the framework of the EPC, without having to go into details.

In the end, according to the manager of the project, this can be summarised in four easy steps: find a partner, investigate, agree on delivery based on results of investigation, agree on monitoring, education and agree on the guarantee of energy savings.
The different phases of the establishment of the PPP can be summarised as follows:

- Select a number of candidates seen to be good, solid, long lasting, technically competent partners (prequalification under the law of public procurement).
- Select the most skilled one with the widest technological scope, the best business concept and educational programme (to transfer their knowledge to the personnel).
- Let the partner inspect the buildings to find and present a package of savings potentials with a pay-off period shorter than 7-7.5 years (based on the ratio of investment/annual savings potential).
- Negotiate solutions, price, brands, and so forth until a mutual understanding of all terms, conditions and technical specifications is reached. Agree on delivery based on the negotiated results of the detailed Energy Audit on the three hospitals carried out by the ESCO.
- Sign a contract of continuous transfer of knowledge and surveillance/monitoring of the actual savings vs. the projected savings and make the partner guarantee that either a certain percentage will be reached or the partner will pay the difference (often 85% of the projected savings over the pay-off time).

8. Problems and obstacles

RegionFastigheter Skåne mentions the lack of knowledge and interpretation capacity among the public branch organisations regarding financial, accounting and contractual aspects of PPP, TPF and EPC in Sweden.

Another barrier is the attitude of employees saying “we already know what to do, so let us do it”. The preventive solution put in place by RegionFastigheter Skåne lies in three words: information, participation, and explanation. It is important to inform the targeted audience of the project, in this case the maintenance personnel, about the objectives of the project and explain them the importance of energy management in public buildings and how their participation and collaboration is crucial for its success.

9. Costs and funding of the project

The total cost of the project is €11,800,000. This includes substantial training and capacity building of the operational and maintenance staff. The planning phase of the project represents €20,000 and the implementation phase €11,200,000. The payback period is expected to be less than 7.5 years.
Table 2 – Cost of the different phases of the project

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cost (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial planning &amp; procurement process</td>
<td>20,000</td>
</tr>
<tr>
<td>Energy analysis</td>
<td>230,000</td>
</tr>
<tr>
<td>Implementation of solutions</td>
<td>11,200,000</td>
</tr>
<tr>
<td>Guarantee &amp; monitoring</td>
<td>350,000</td>
</tr>
</tbody>
</table>

The final total cost is not expected to be higher than initially estimated because the whole idea of this concept is to do as much as possible within the pay-off limitations, thus the more invested - the more saved.

In the beginning, a TPF setup was proposed. However due to severe internal difficulties interpreting the legal and accounting regulations regarding TPF, this was changed and finally, only the financing resources of RegionFastigheter Skåne were used. These can be separated into two types:

- Investments for normal maintenance
- Firm guarantees of savings of slightly more than €1 million per year.

Additional savings are also foreseen through optimised operation and maintenance.

10. Results

10.1 General results

Currently, the objectives of the project have been achieved up to 85% and this is still improving. RegionFastigheter Skåne hopes to reach 100% in 2007 and the objectives will probably be exceeded in 2008, but only marginally. Since the rest of the maintenance staff of RegionFastigheter Skåne learnt from the behaviour in the project and is now applying these new measures to many more buildings, counting the spin-off effect on the daily maintenance of the remaining two thirds of the buildings, further reduction in energy consumptions are expected to be achieved.

The total energy savings in RegionFastigheter Skåne in the last two years have been approximately 23,000 MWh in district heating, as all the other hospitals have been influenced by the project.

All improvements concerning energy efficiency in the region originate from this project as it focused attention of the general public on energy issues.
10.2 The socio/economic impacts/benefits

The project created 3 new jobs in RegionFastigheter Skåne. Furthermore, this project was a pilot in opening a new segment on the Swedish market. According to RegionFastigheter Skåne, the public sector has “taken the concept to its heart” and the market is booming. At least 10 more regions and 25 municipalities are following.

Also, the procurement methodology can be applied to other energy concepts as well, such as the establishment of production of wind-power on publicly owned land.

Reaching ambitious energy consumption goals demands a strong implication of the operating staff as well as the tenants. The customers/tenants of the three hospitals have now started their own, internal, campaigns to reduce the use of electricity. This is important since tenant behaviour affects the use of electricity more than technical modifications of the building. The tenants benefit fully from the savings as the cost of energy is included in the rent.

Since the population was not directly concerned, no effect on population awareness is foreseen. However, a solid impact on the professional real estate sector was observed. No new technology was used, but this project was a real trend-setter.

From an indirect and long-term perspective, the local citizens are beneficiaries. Indeed, the county council can refurbish parts of the buildings and improve public services without increasing or reallocating county council taxes.

The average energy price in the area where the project was implemented is 0.06 €/kWh\(^{36}\) for district heating. The energy price was not affected by the implementation of the project but followed the market. The efficiency project resulted in the following savings in 2007\(^{37}\):

- 13,000 MWh of district heating
- 300 MWh of electricity.

However, not all the planned technical measures have been implemented in the buildings by the time this report was elaborated, and therefore further savings can be expected by the end of the year. And the following savings this year are expected\(^{3}\):

- 19,143 MWh of district heating

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\(^{36}\) Figure provided by RegionFastigheter Skåne

\(^{37}\) Figures provided by RegionFastigheter Skåne.
• 500 MWh of electricity.

District heating savings are equivalent to the energy needed to supply a small town with a population of approximately 8,000 people or equivalent to the elimination of a small heat plant. This represent savings of 1.2 M€/yr, to which 0.2 M€/yr of “soft savings” (those coming from measures that do not require the installation of technology or equipment, i.e. energy awareness campaigning and training) can be added\(^\text{38}\).

10.3 The environmental impacts/benefits

A lot of district heating capacity was released in the municipalities where the capacity can be used for new settlements, without expanding the district heating production capacity. All improvements concerning energy efficiency in the region originate from this project, as it focused attention on energy. According to RegionFastigheter Skåne, this project enabled 3,886 tonnes of CO\(_2\) to be avoided.

Table 3 – Annual emission reductions of pollutants resulting from the implementation of the project

<table>
<thead>
<tr>
<th>CO(_2)</th>
<th>CO</th>
<th>NOx</th>
<th>Sulphur</th>
<th>Radioactive emissions</th>
<th>Particulates</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,886 tonnes</td>
<td>0.9</td>
<td>3.5</td>
<td>0.35</td>
<td>75 mSv</td>
<td>0.075 tonnes</td>
</tr>
</tbody>
</table>

Source: [Johansen, 2007]

Using the methodology explained in Annex 2, it has been determined that the actualised benefits\(^\text{39}\) of the project outweigh the actualised costs\(^\text{40}\), assuming an interest rate of 3.4% and a project lifetime of 20 years. Indeed, it has been estimated that the cost per tonne of CO\(_2\) avoided due to the implementation of this project is -102.83 €/tonne of CO\(_2\) (under the assumptions mentioned above). After the payback period, there is no cost associated with the reduction of GHG. In other words, there are benefits rather than expenses. This means that the project is a cost effective investment.

11. Overall energy efficiency situation in Skåne and comparison with the national and European situation

In 2004, when the project was launched, energy consumption was 288 kWh/m\(^2\)\(_\text{39}\).

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38 Figures provided by Energikontor Sydost.
39 Actualised benefits: all the annual net savings during the life cycle of the project, expressed in present money value.
40 Actualised costs: Present value of all the annual capital costs during the life cycle of a project
in public buildings owned by RegionFastigheter Skåne. In 2005, RegionFastigheter Skåne established targets for reducing energy consumption in its buildings each year. The targets were achieved in 2005 (energy consumption almost 5% below the target limit), but not in 2006 (almost 10% above the established target). More detailed information about the current energy efficiency situation in the region of Skåne could not be identified in spite of the in-depth research that was carried out (i.e. literature review and communication with relevant persons in the region).

In Sweden, in the period 1990-2004 the technical energy efficiency index for the whole economy decreased by 11 %, which equals the energy efficiency index reported for EU-25 in the same period. The efficiency improvement in Sweden was greater than the average EU-15 (10%). The transport sector showed the greatest improvement, whereas the energy efficiency index of the other sectors decreased less than average.

Almost 40% of Sweden’s use of energy is related to the public sector. Different Swedish reports and other documents at the European level show that it is economically possible to reduce the use of energy in buildings with approximately 20%. However, much of this potential is not realised due to a combination of relatively low priority and insufficient resources to realize projects with public real estate companies. Therefore the concept of EPC has been promoted by the Swedish Energy Agency since 2002. However, many public bodies are still inexperienced and reluctant to use private services.

The success of this project helped to focus public attention as well as the region’s policy priorities on energy management. In Skåne three other similar projects have since been launched:

- RegionFastigheter Skåne signed a new contract with a company called TAC in May 2007 concerning premises of 650,000 m². TAC is currently implementing the energy analysis phase.
- Vellinge Kommun launched the same type of PPP contract.
- LundaFastigheter is also running a contract at this moment.

12. Ongoing applications of the project

Activities scheduled in 2007 (among others):

- Launch of the second phase of the project consisting in the revision of the energy savings guarantee and monitoring.
- The energetic assessment will be continued.
- Information campaign involving the tenants
- Installation of a new energy meter
- The consumption goal will be closely followed and communicated each
month.
- Training of the operation and maintenance staff will be continued.

This project was so successful that the Region Skåne is now proceeding with the rest of their buildings in a similar project that is currently being procured.

13. Key factors for success
The internal preparation was crucial in order to avoid internal opposition and to maximise the success of the future project. Care was taken to involve all stakeholders (almost the entire organisation) in the early preparation work. This proved to be especially useful when the TPF was abandoned.

Internal and possible trade union opposition was also prevented by clearly communicating that this project didn’t aim to outsource staff.

Key factors in the negotiation process were progressivism (to explore new alternatives), transparency (to provide all the necessary information available and necessary to the parties that will be involved in the negotiation phase), and a win-win project (to create a situation that is beneficial for all the parties involved).

Other external factors which contributed to the success of the project were:
- Rising energy prices
- Dawning environmental awareness
- Good understanding and use of the code of Public Procurement.

The main experiences gained and lessons learnt are the following:
- The need to be aware that it is a profitable project despite the massive investments as long as the pay-off is set at < 8-10 years (with present interest rates).
- TPF solutions were not favourable in the context of this project.
- Leasing may present a problem depending on the local interpretation of its definition.

Also, education, monitoring and guarantee of savings are extremely important elements to keep up pressure on the buyers’ personnel during the entire pay-off period. If not, they may turn their back on "yet another stupid project that just meant a lot more to do without a raise” says the project manager.

14. Potential to replicate a similar project by other local/regional authorities
The initiative could be easily, quickly, and profitably replicated by other parties elsewhere in Europe.
The project manager from the RegionFastigheter Skåne also points out that he would have included all buildings in the project from the very beginning: “By waiting we have lost three years’ savings.”

15. Contacts / Acknowledgements

<table>
<thead>
<tr>
<th>Organisation:</th>
<th>Regionfastigheter Skåne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of organisation:</td>
<td>Regional authority</td>
</tr>
<tr>
<td>Main activities:</td>
<td>1/ Responsible for health care, but also for public transportation and regional growth and development.</td>
</tr>
<tr>
<td></td>
<td>2/ Department more specifically responsible for producing and maintaining the buildings needed for the core-services, mainly hospitals and office buildings.</td>
</tr>
<tr>
<td>Contact Information:</td>
<td>Peter Jansson</td>
</tr>
<tr>
<td></td>
<td>Box 1</td>
</tr>
<tr>
<td></td>
<td>SE - 22100 Lund</td>
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<td>Tel: +46 467550038</td>
</tr>
<tr>
<td></td>
<td>Email: peter.j.jansson@Skåne.se</td>
</tr>
<tr>
<td></td>
<td>Website: <a href="http://www.Sk%C3%A5ne.se">www.Skåne.se</a></td>
</tr>
</tbody>
</table>
**Organisation:** T.A.C Energy Solutions  
**Type of organisation:** Private company  
**Main activities:**  
TAC’s Energy Solutions group combines the latest energy saving technologies and practices to upgrade existing equipment, reduce maintenance expenses, lower utility bills and improve building comfort.  
**Contact Information:**  
Jonas Tegström  
European Business Area Manager  
Tel: +46 70 675 26 54  
Email: jonas.tegstrom@tac.com  
Website: http://www.tac.com/energysolutions/

---

**Organisation:** Energy Agency for Southeast Sweden Ltd (Energikontor Sydst AB)  
**Type of organisation:** Regional authority  
**Main activities:**  
Energikontor sydost was established in 1999 and acts in the provinces of Kalmar, Kronoberg and Blekinge in Sweden. It is commissioned by the Swedish Energy Agency. Its task is to develop environmentally-friendly and efficient energy systems such as wind, solar and biomass on a regional level, by increasing the use of renewable energy and by gaining a more rational use of energy. This work also has a positive effect on the labour market and regional finances.  
The Energy Agency for Southeast Sweden Ltd is a regional centre for information and development and a regional resource in the sphere of energy. The aim is to have an influence on production, distribution and use of energy for heating, transportation, lighting and motor operation. The Energy Agency for Southeast Sweden provides co-ordination and education for the local energy advisers. Energy Agency for Southeast Sweden Ltd direct towards energy and environmental issues both for companies and for municipalities.  
Furthermore the task is to be the contact between the European Commission and the region in energy matters.  
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Mobile : +46 (0)733-70 74 40  
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Website: http://www.energikontor-so.com/
16. References


Public Lighting in the Town of Gödöllő

The project, led by the local authority (Municipality of Gödöllő), consisted of changing the old, inefficient mercury lamps in public street and park lighting to more efficient sodium and compact fluorescent lamps. In parallel, general improvements were made to the public lighting systems. Improvements resulted in a 55% reduction in the electricity consumption and costs of public lighting.

1. Project background

Gödöllő is a town of approximately 30,000 inhabitants. It is situated 10-15 kilometres North-East of Budapest in the Central Hungarian Region, which comprises Budapest and the Pest county (see Figure 1).

Gödöllő has a temperate climate with warm summers and cold winters. Winters are fairly short, the very cold weather arriving in mid-December, usually cloudy and damp with odd bright sunny days and frequent, but light, snow. In summer, from April to September, Gödöllő has a high proportion of sunny, warm days.
with relatively high humidity, the sun shining for about 10 hours a day.

The town hosts the centre of the Szent István University which was founded in 2000 by a merger of five separate institutions. The university gives high priority to agricultural and rural development. Important agricultural research is carried out in Gödöllő while agricultural production in itself is not a key activity in the municipality. There is also automotive, pharmaceutical and logistics industry in the town. Many people work in Budapest.

The town of Gödöllő employs around 110 persons in its administration services. A further 1,000 people work in public services (e.g. in schools and health care), but they are employees of the state. It is a middle sized municipality, among the 3,156 municipalities in Hungary. More than 2,900 of them are villages, while only 23 municipalities are considered major metropolitan areas. This size distribution presents a challenge to energy efficiency at the municipality level in general. Many municipalities do not have energy managers, and they lack both the technical and the financial capacity to identify and implement energy efficiency measures. Local authorities’ finances are heavily dependent on allocations from the central state budget; two-thirds of the spending power of municipalities comes from central government. [ECEE 2002; UNDP 2000]

2. Scope of the project and objectives

The main objective of the project was to bring energy and related cost savings to the municipal administration through modernisation of the public street lighting. More specifically, the objectives of the project were to:

- Change over from old, inefficient mercury lamps in public street and park lighting to more efficient sodium and compact fluorescent lamps
- Improve lighting quality in streets and parks.

3. The role and responsibilities of the organisations that participated in the project

The project took place at the initiative of the Town of Gödöllő, who was also the leading organisation. The Head advisor to the municipality worked as project manager during the planning and implementation of the project. Furthermore the municipal authorities:

- Ordered a preparatory study.
- Searched and applied for external sources for funding.
- Negotiated with, and convinced, the Budapest Electric Works (see below) to participate in the project.

Budapest Electric Works (Budapesti Elektromos Művek) was the only, but indispensable partner in the project. This private electric company owns the public lighting system of Gödöllő (while the public administration pays the
energy bill) and the project could not have been implemented without its participation. Electric Works did all the technical work: renovation of the system (e.g. cable network) and changing the lamps/lamp posts.

4. Decision-making process

The original idea for the project dates back to the beginning of the 1990’s. At the time, the town’s new Deputy Mayor looked into the poor energy efficiency situation of the town, public lighting being one of the key areas. Furthermore, the privatisation of the energy sector, which was part of the post-socialist political and economic reforms implemented in the 1990’s, was accompanied by a considerable increase in energy costs in Hungary. This further motivated the municipality to introduce energy efficiency improvements in order to halt the increasing energy spending. However, the lack of funds delayed the project by almost 10 years.

Therefore, from the start, the municipality of Gödöllő was convinced of the benefits of the project. The Town Operation Department was in charge of the project planning. The first step was to contract external experts to classify the streets and parks according to the appropriate lighting levels. Based on this preparatory study, detailed plans were drafted. They helped the town to get external sources of finance (see section 9), which finally enabled the project to be implemented. For the project to take place, the co-operation of the Budapest Electric Works, the owners of the public lighting system, was needed. Originally, the interests of Budapest Electric Works were in the beginning against the project. After all, the project aimed to reduce electricity consumption, while the company makes its profit from electricity sales. Once the municipality had obtained the external funding, it was possible to involve the Electric Works in the project, as the lighting system was outdated and major refurbishment work would have been needed anyway. The project provided the funding for the work which the company would have had to do on its own sooner or later. Thus, the electricity company became a co-beneficiary of the project – a win-win situation had been created.

After the engagement of the Budapest Electric Works, the Town Operation Department prepared the project proposal, on the basis of which the final decision was taken by the town’s Delegates’ Body. Finally, the contract was signed by the Mayor.

The choice of the type and brand of the lamps was made by the Electric Works based on technical specifications and references. Quality was an especially important criterion, as so it was the price.
5. Technical aspects of the project

In Gödöllő, prior to the project, public street lighting comprised over 4,000 mercury vapour lamps. These lamps were developed in the 1930s and have been widely used in street lighting applications since then. Mercury vapour lamps produce a bluish light, which is good for night vision. However, both the efficacy and colour rendering ability are poor. The efficacy of mercury vapour lamps also deteriorates significantly with age. As a result, mercury vapour installations are often "over-designed". This means that more lamps are installed than initially required so that required illumination levels can be maintained towards the end of the service life [AGO 2002]. No significant progress in the technology has been reported in the last decades [VITO, 2007].

During the project, 4,269 mercury lamps were changed into 3,241 sodium and compact fluorescent lamps from a leading manufacturer. Part of the luminaires and lamp posts were also renewed, as switching from old mercury vapour lamps to new energy efficient products often means replacing not just the lamps but also the equipment trays or the total fittings.

The substitute lamp technologies are known for their high efficiency. When comparing different luminaires/lamp types, high pressure sodium luminaires have a factor of 2.5 to 3 less environmental impacts for the same light output than mercury luminaires. Compact fluorescent lamp luminaires generate the least impacts per functional lumen output; however they may not be suitable for all applications [VITO, 2007].

6. The citizens' attitude to the project

Citizens were satisfied with the outcome of the project. Thanks to the thorough renewal of the street lighting system, all the lamps work whereas prior to the project some lamps/lamp posts were broken. New lamp posts installed during the project are also considered to be more aesthetic. In the context of the project, some additional streets were equipped with lighting, which was welcomed by the citizens. Local/regional interest groups did not specifically react to the project.

7. Implementation and project life span

The project started at the end of 1999 and was completed at the end of

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41 A "luminaire" is an “apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting the lamps to the electric supply” [VITO 2007]
November 2000.
The project was relatively simple and the main phases were:
- Planning & Preparatory study (roughly 6 months)
- Implementation, which consisted of the technical work i.e. changing lamps and lamp posts (from spring 2000 to November 2000).

After implementation, the lighting system was in full use in normal conditions. No special monitoring was carried out on the results of the projects. They were quantified based on the annual electricity invoices of the street lighting (separate billing).

The project included the promotion of energy efficiency via information activities. Articles in the local weekly paper informed the citizens about the aims and phases of the project.

8. Problems and obstacles
The implementation of the project was delayed due to the lack of financing and the opposing interests of the electricity company (Budapest Electric Works). External funding solved the first issue and it also enabled the involvement of Electric Works as co-beneficiary.

9. Costs and funding of the project
The total project budget was approximately €327,650 (84 million Forints), of which:
- 51% came from the Town of Gödöllő
- 37% came from a commercial credit
- 12% came from the EU through the PHARE Fund

The payback period was estimated at 3-3.5 years.

10. Results
10.1 General results
The project’s objectives, cited in section 2, were fully realised. The new lamps and the improved lighting system reduced the energy consumption by 55%, resulting in savings of 1,376,000 kWh per year.

10.2 The socio/economic impacts/benefits
The public lighting project was an important step towards halting the increase in the energy expenditure of the town of Gödöllő. At the 1999 electricity price level (0.03 €/kWh), the project resulted in annual savings of €41,280. However, the electricity price has been constantly increasing and based on the current
price level of 0.067 €/kWh, the annual energy savings translate as €92,192. The price increase is related to the privatisation of the electricity sector in Hungary as part of the political and economic reforms in the post-socialist era. The average household electricity price in Hungary increased by 153% between 1995 and 2000. In the 2000-2005 period, the increase was “only” of 32% [EASAC, 2006].

The articles about the project and its results were published in the local paper. Consequently, the project is expected to have raised public awareness about its importance and the good results have demonstrated the potential that energy saving measures offer. In addition to the lighting project itself, the published articles also dealt with other energy saving possibilities in the Hungarian context: namely house/window/door insulation and the possibility of obtaining state and EU funding for such improvements.

10.3 The environmental impacts/benefits

According to the information provided by the city of Gödöllő, the project resulted in annual electricity savings of 1,376,000 kWh. This is estimated to correspond to 787 tonnes of CO₂ per year, which are avoided due to the introduction of a more efficient lighting system. In addition to the emissions from the power plant, this figure also takes into account emissions from the whole life cycle of the energy generation process, e.g. the extraction of energy sources. It has been calculated based on the “Hungarian electricity mix”⁴² data and the relevant emission factors in the EcoInvent life cycle analysis database. Using the methodology explained in Annex 2, it has been determined that the actualised benefits⁴³ of the project outweigh the actualised costs⁴⁴, assuming an interest rate of 6.6% and a project lifetime of 20 years. This means that the project is a cost effective investment, as the economic savings are worth more than the initial capital investment.

As the project is profitable, the cost per tonne of CO₂ avoided is in fact a benefit. Indeed, it has been estimated that the cost per tonne of CO₂ avoided due to the implementation of this project is -43.21€/tonne of CO₂ (under the assumptions above mentioned and taken into consideration cost savings of €92,192). This means that after the payback period (estimated at 4 years in this case), there is no cost associated with the reduction of GHG.

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⁴² The “Electricity Mix” takes into account the shares of domestic electricity production by energy source/technology and imports from neighbouring countries (Austria, Slovak Republic and Ukraine). The emission factors reflect the 2000 average technology per energy carrier.

⁴³ Actualised benefits: All the annual net savings during the life cycle of the project, expressed in present money value.

⁴⁴ Actualised costs: Present value of all the annual capital costs during the life cycle of a project.
Phasing out the mercury street lights also helped to remove this hazardous chemical from circulation.

11. Overall energy efficiency situation in Gödöllő and comparison with the national and European situation

The current overall energy efficiency situation in Gödöllő is “extremely bad”, according to the municipality. The majority of public (and also private) buildings are old, with poor energy efficiency. New investments and renovations are implemented according to EU specifications, but for the moment lack of financing prevents the municipality from implementing renovation projects. According to the town council, renovation of the public buildings will not be possible for the next 2-3 years at least. However, Gödöllő has just completed energy audits in 17 of its public buildings (schools, kindergartens, social housing). These audits will form the basis for the energy-conscious renewal of the buildings when funds become available. More detailed information about the current energy efficiency situation in Gödöllő could not be identified.

Despite many energy savings projects funded by foreign agencies in Hungary in the past 10 years, in general, the energy efficiency in Hungarian municipalities remains low. Many municipalities have carried out projects on public lighting, but the energy performance of public buildings remain largely to be improved. With its energy audits, Gödöllő is a frontrunner in Hungary.

According to the International Energy Agency, Hungary has dramatically improved its energy efficiency during the last 15 years. Nevertheless, enhanced efficiency, particularly in the field of gas use will continue to play a key role for securing future national energy supplies. Significant room for progress has been identified particularly in the gas-to-power sector, where old power stations need to be replaced, and in the residential sector, where improved insulation of Hungarian housing could bring impressive results. For example, there is a 40% difference between the average efficiency of Hungarian and French gas powered power plants. [IEA, 2007]

In Hungary, between 1998 and 2004 the energy efficiency index improved by 10 %, against 5% for the EU-25. Significant part of the efficiency improvement resulted from energy efficiency improvements in the industrial sector, since the energy efficiency of households and transport sector remained stable [ODYSSEE, 2006-07].

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45 An energy efficiency index has been developed under the EU-funded Odyssee project (http://www.odyssee-indicators.org/). It provides an overall perspective of energy efficiency trends by sector and combines the trends of indicators by end-use or sub-sector. A decrease means an energy efficiency improvement [ODYSSEE, 2006-07]
12. Ongoing applications of the project

Since the implementation of the project, the municipal authorities have benefited, and continue to benefit, from the energy and cost savings. A completely renewed public lighting system is expected to benefit the municipality for dozens of years. The town advisor estimated the lifetime of the street luminaires and lamp posts to be around 10 years. However, many sources indicate that a lifetime of up to 30 years is more likely [VITO, 2007]. The lamps’ lifetime is obviously much shorter: it is estimated at 3 years for the mercury vapour lamps and 4 years for high pressure sodium lamps [VITO, 2007]. According to the town advisor, the price of new lamps does not significantly differ from the mercury lamps. The literature indicates a possible slight difference in replacement costs, but in any case these are largely compensated for by the saved electricity costs (see Figure 2), so the project’s impacts in the field of maintenance costs are considered to be insignificant.

Figure 2 – Comparison of the total cost of ownership of comparable sodium and mercury lamps

![Graph showing the comparison of electricity cost and lamp replacement/cost per annum for 70W high-pressure sodium lamp (€28) and 125W Mercury lamp (€50).]

Source: [Podsiadło, P. 2005]

13. Key factors for success

The project on public lighting is part of a continuum of actions that the City of Gödöllő has carried out in recent years in order to improve energy efficiency, save energy and promote RES. Two general success factors for these kinds of projects in Gödöllő have been identified:

- Interest and engagement of Gödöllő’s former deputy mayor in energy and climate change issues, which motivated the whole municipal team.
- Close relationship between the city of Gödöllő and the local university where work is carried out on energy issues (especially renewable energies).

Regarding the particular project on street lighting, a key factor that made the
project possible was the ability to create a win-win situation between the local authority and the electric company. External funding played an important role in this and helped to convince Electric Works to participate in the project despite its opposing interest at the start of the negotiations. The involvement of the energy company was crucial for carrying out the project.

14. Potential for other local/regional authorities to replicate a similar project

Technically, the Gödöllő lighting project was rather simple so there should not be any technical barriers to replicate it elsewhere. However, at least in Gödöllő, the external funding was an important enabling factor, which may not always be available to the local/regional authorities. Indeed, the initial purchase cost often prevents the adoption of new, more energy efficient, lighting technologies, even if upgraded alternatives can have a payback time of less than one year after which significant energy and cost savings will be achieved [Voltimum, 2007]. Short-term thinking creates a tendency to look mainly at the initial cost of a lamp. This ignores the more relevant cost of energy during the product's use, which is often more than 90% of the total cost.

The change from mercury vapour lamps to more efficient alternatives is relevant throughout the EU, not only in new MS. Despite widespread good practice in European municipalities, approximately one third of Europe's roads and motorways are still being lit using energy inefficient mercury lamps. In fact, considerable variations exist between different MS. For example, while in Germany almost half (45%) of the installed base of street lighting is composed of mercury lamps, this lamp type forms only 5% of the installed base in Belgium, and is not used at all in the UK. [VITO, 2007; Voltimum, 2007]

It has been estimated that if the remaining current stock of approximately 35 million mercury vapour lamp and gear systems were replaced by the latest lighting technology, European municipalities would save between €600 – 700 million per year in running costs and Europe would reduce its CO₂ emissions by 3.5 million tonnes per year, taking a big step forward towards reaching its Kyoto targets. Furthermore, indirect CO₂ savings result from the fact that the latest lamp and gear technology is up to 65% smaller than its predecessors, which means that less transport is needed to move the stock. The smaller size also reduces the use of raw materials. [Voltimum, 2007]

In fact, the preparatory study on street lighting in the framework of the Directive 2005/32/EC on the eco-design of Energy-using Products (EuP)\(^{46}\) recommends

\(^{46}\) Available at: http://ec.europa.eu/enterprise/eco_design/dir2005-32.htm
banning high pressure mercury lamps and introducing minimum efficiency standards for the other most popular type of street lamp, which are high pressure sodium lamps. [VITO, 2007]

15. Contacts / Acknowledgements

**Organisation:** Municipality of Gödöllő  
**Type of organisation:** Local authority  
**Main activities:**  
Like other Hungarian municipalities, Gödöllő is responsible for the provision of most local services, including street-lighting, kindergartens, elementary schools, provision of health care, basic social benefits and housing as well as a wide range of public buildings. Like in many other municipalities in Hungary, the district heating systems are also owned by the city.

The municipal assembly is headed by the mayor and the deputy mayor; in municipal matters the assembly passes regulations and governs independently; it may receive subsidies from the central government in addition to its own revenues, and may adopt local by-laws. The mayor is elected directly by the voters. [Magyarorszag 2007]

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16. References


Environmentally-friendly school building in Mirecourt, France

The council of the département des Vosges ordered the construction of a secondary school building based on the French concept of “Haute Qualité Environnementale” (High Environmental Quality), which seeks the integration of the principles of sustainable development in buildings. The school building was completed in June 2004. It made wide use of wood. Indeed, the building is energy efficient and the heating system is based on wood.

1. Project background

1.1 The département des Vosges

France is divided into administrative areas called “départements” (see chart). The administration of each “département” is led by a regional authority named the “Conseil Général”, which includes representatives elected by the population living in the corresponding area. In this case study, the authority that promoted the project was the Conseil Général of the département des Vosges (see Figure 1).
The département des Vosges has a total population of 381,000 inhabitants, with 264,145 living in cities and 122,115 in the countryside. Average population density is 65 inhabitants per km².

The département des Vosges has both rural and industrial features. Historically, the main industrial sectors are textile and wood furniture. Both are currently encountering severe crises. Metalwork, paper and cardboard and the food industries are all developing. The service sector is developing mainly thanks to tourism but is still below the national average.

The département des Vosges is the second département in France for its surface area covered in forest. Indeed, 48% of the 5,874 km² area is forest. Activities linked to wood exploitation account for 13,000 jobs. All stakeholders in the forest and wood sector work in the area, from sawmills to wood furniture makers. The 1999 great storm caused extensive damage to the forest. A multi stakeholder plan was developed to manage this crisis situation, including the increase of wood use for heating and construction purposes (see below).

- **Local policy to promote use of wood for heating and building purposes along with sustainable development objectives: the “Wood Charter” (Charte Bois)**

Since 1996, the département des Vosges has been developing the use of wood for producing energy for heating purposes. Several tools have been set up to
help public authorities implement such projects. The use of wood for building purposes was added to this initiative later on. The strategy is based on a “Wood Charter” from the Conseil Général of the Département des Vosges. In this Charter, the Conseil Général committed itself to promoting the use of wood in buildings and for heating purposes in order to create showcases for this material. Moreover, local authorities in the département des Vosges area (municipalities or group of municipalities) were asked to join this initiative. By doing so, they can benefit from support from the Conseil Général for the implementation of projects promoting the use of wood, which include:

- An increased financial support compared to other building / heating projects
- Free counselling during the design stage of the project and for pre-studies of feasibility

In return, local authorities have to respect technical requirements such as a minimum quantity of wood in building projects. For example, wood material and the corresponding workforce should count for a minimum 65% of financial expenses in the case of a new building.

Moreover, preference should be given to projects using wood from local sources.

In addition, the promotion of wood is an important part of the scheme. Both the Conseil Général and several local authorities have committed to creating a local network for showcasing the use of wood in the building sector. The use of wood for heating purposes is also promoted via informative campaigns that include written information such as brochures about the use of wood, organisation of information meetings, and guided tours to various showcase projects.


1.2 The French HQE approach

The “démarche HQE” stands for “High Environmental Quality approach”. It is the main French tool to reduce CO₂ emissions from buildings, and is included in many local “Agenda 21”, the Action Plan whose principle was adopted at the World Summit on Sustainable Development held in 1992 in Rio de Janeiro.

This French labelled approach is promoted by the “HQE association”. It aims to improve the environmental quality of buildings (both new and refurbished), in order to provide healthy and comfortable buildings, whose impact on the environment is as low as possible. The approach provides both:
• A common language to define environmental objectives
• A system for environmental management

HQE is a voluntary scheme based on the stakeholders’ responsibility. However, a certification process is being set up. At the beginning of 2005 certification was set up in cooperation with AFNOR, the French certification agency, for service buildings. Other certifications are scheduled for individual houses and apartment buildings [AHQE, 2006]. The council of the département des Vosges ordered the construction of a secondary school building based on the French concept of HQE.

2. Scope of the project and objectives

In France, administrative divisions named département are responsible, among other tasks, for the building and maintenance of secondary school buildings (for students of between 11 and 15 years old approximately).

The département des Vosges has many forestry resources. As explained before, the local Conseil Général has developed a strategy to exploit wood in buildings and for heating purposes. In this context, the Conseil Général itself sets the example by leading environmentally-friendly building projects in the context of the “Wood charter” (see above).

The present case study is about a state secondary school building that was commissioned by the Conseil Général of the département des Vosges for the town of Mirecourt. The overall objective was to build a state school that is environmentally-friendly throughout its complete life cycle. In particular, the specific objectives were:
• Achieving energy efficiency properties thanks to the structure of the building.
• Ensuring good acoustic and thermal properties.
• Providing comfortable indoor conditions for the users of the building.

3. The role and responsibilities of the organisations that participated in the project

The Conseil Général launched and funded this project. It carried out a tendering process. The winner of the call for tenders was the company “Architecture-Studio”. A contract was established with this company for the design and construction of the building (case of contracting).

4. Decision-making process

The Conseil Général decided to build a new school since the existing building was timeworn. The choice of wood as a building material and a power supply
was made in the framework of the regional plan for use of wood, energy efficiency and sustainable development. The Conseil Général was the only stakeholder involved in this decision-making process as the building of secondary schools is its legal responsibility (see above).

5. Technical aspects of the project

The school building is to hold 800 students. A school canteen is also included. Total surface area is 10,000 m². The building's energy efficiency is mainly ensured by its specific structure: a large overall structure with a modern design includes workplace “islands” (classrooms in one place, the library in another for example) separated by large inner areas with pathways. The external structure acts as a thermal regulator:

- In winter, sun coming through the glass bays heats up the inner space.
- In summer, a system of specific openings provides natural ventilation and cools the inner space. The position of the building with regard to prevailing winds was also studied. Moreover, the roof offered protection from the sun's rays thus contributing to the cooling.

Figure 2 - Views of the building

Source: [Architecturestudio, 2007, photo: C.BOURGEOIS]
Figure 3 - Diagram of the building, showing light entrance and ventilation

The building's heating system is based on wood, with additional gas heating coming from the standard city gas network. Compared to a solution based only on gas, the central heating boiler reduces both CO₂ emissions and financial costs (see section 11).

The wood boiler that was installed has a power of 720 kW. Widespread use of wood was made in the construction, with structure, floors, façade, siding and millwork made out of wood. Indeed, 1,500 m³ of wood was used.

6. The citizens' attitude to the project

During the design and early construction phases of the project, pupils' parents seemed afraid of the risks linked to wooden buildings in case of fire. Wooden buildings had a general bad image in the area.

Having been made aware of this problem, the Conseil Général of the département des Vosges organised a public meeting with pupils’ parents and firemen. Firemen explained the qualities of wooden structure buildings compared with metal structure buildings in case of fire: the structure lasts longer before collapsing if made out of wood, which leaves firemen more time to evacuate people. After this meeting, the image of wood buildings among the target audience (pupils and their parents) improved. Most of them were happy with the final building.

It is important to highlight that the building site was designed to minimise disturbance for the neighbourhood, which may have facilitated the acceptance of the new building.

7. Implementation and project life span

The project started in 1997 after the decision to build the school was made, and lasted until 2004, when the building phase was finalised.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Start date</th>
<th>End date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice to build a new school</td>
<td>1997</td>
<td>1998</td>
</tr>
<tr>
<td>Call for tender, choice of the architect</td>
<td>1999</td>
<td>2000</td>
</tr>
<tr>
<td>Building phase</td>
<td>about January 2001</td>
<td>June 2004; classes began September 2004 (French school year is September to June)</td>
</tr>
</tbody>
</table>

8. **Problems and obstacles**

The choice of wood as the construction material for the school caused some concerns to pupils’ parents. This problem was overcome thanks to the communication strategy described above.

9. **Costs and funding of the project**

The cost of the project was €14,000,000. Construction of the school was entirely funded by the Conseil Général des Vosges. Both the construction and maintenance of secondary school buildings are under the responsibility of the local Conseil Général for each French département. Therefore, the Conseil Général of the département des Vosges also funds the maintenance of the building. The additional cost of this building compared to a building not built according to an HQE approach and without using wood as its construction material and as the power supply for its heating is estimated to be about 3.5% (about €473,000).

10. **Results**

10.1 **General results**

The school was built on time as initially planned. All technical objectives were fulfilled.

10.2 **The socio/economic impacts/benefits**

The innovative indoor design of the building is greatly appreciated by users. The school manager saw a change in pupils’ behaviour. For example, less acts of vandalism (e.g. graffiti) were observed in the building in comparison to the old school.

Improvement of the image of wooden buildings was achieved among the local community (pupils’ parents for sure and probably other local residents) due to the information campaign carried out in the framework of this project.
10.3 The environmental impacts/benefits

■ Energy savings
As for the building’s energy consumption, the first estimate during the design phase was an average of 1,500 MWh per year, a figure that was afterwards reduced to 1,200 MWh.

During the school year 2005-2006, the actual consumption was 937.5 MWh. It is estimated that compared to a standard building with no specific energy efficiency feature, the school consumes about half the energy needed for its usual operations, which means about 940 MWh saved per year.

If assuming that most of this energy is used for heating, applying the methodology described in section 1.2.1, and assuming an emission factor of 0.24 kilograms (kg) CO₂ for kWh for heat produced from natural gas, this will be equal to annual savings of 226 tonnes of CO₂.

■ Renewable energy use and substituted CO₂
Compared to a solution based only on gas, the solution actually used in this building, with wood associated with a gas boiler for slight power adjustment, replaces 84 tons of petroleum equivalent⁴⁷ per year and reduces CO₂ emissions by about 197 tons per year.

■ Renewable material and captured CO₂
1,500 m³ of wood have been used in the building, which means about 1,350 tons of captured CO₂. This is one of the advantages of wood use for construction purposes: when trees grow, they take some carbon out of the atmosphere to build their own structure. Afterwards, as long as the wood material is not destroyed, the carbon is trapped in the material. This means that all the carbon that constitutes the wood does not pollute the atmosphere.

■ Estimation of the economical benefits of the project
Using the methodology explained in Annex 2, it has been determined that the actualised benefits⁴⁸ of the project outweigh the actualised costs⁴⁹, assuming an interest rate of 3.4% and a project lifetime of 30 years, the cost per tonne of CO₂ avoided was €-19.96 (taking into account both the energy efficient building and the renewable energy heating system) or €-11.35 (taking into account only the energy efficient building), which means that the project reduced CO₂ in a cost

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⁴⁷ A ton of petroleum equivalent is a unit of energy: the amount of energy released by burning one ton of petroleum.
⁴⁸ Actualised benefits: all the annual net savings during the life cycle of the project, expressed in present money value.
⁴⁹ Actualised costs: Present value of all the annual capital costs during the life cycle of a project.
efficient way. This means that after the payback period, there is no cost associated with the reduction of GHG emissions, only benefits.

Two hypotheses have been made for the calculations, as described below.

- Hypothesis 1: both the building energy efficiency and the renewable energy heating system are taken into account (for saved CO₂ and for costs). The additional cost of the building is considered to take into account both the heating system and the energy efficient building. In this hypothesis, the price of energy used in the calculation is the actual price paid during the first year of operation of the school, which reflects the price of the renewable energy used. In this hypothesis, it has been estimated that the cost per ton of CO₂ avoided thanks to the implementation of the project is a mean -19.96 € per ton of CO₂ for 30 years of operation (under the assumptions above mentioned). The payback period is estimated here at 15 years.

- Hypothesis 2: only the building’s energy efficiency is taken into account (for saved CO₂ and for costs). The additional cost of the building is considered to take into account only the energy efficiency of the building. In this hypothesis, the price of energy used in the calculation is the price of gas on the French market [Eurostat, 2007]. From the beginning of the building’s operation to date, the price observed during the corresponding period is used. For future years of operation, the current price is used. In this hypothesis, it has been estimated that the cost per ton of CO₂ avoided thanks to the implementation of the project is a mean -11.35 € per ton of CO₂ for 30 years of operation (under the assumptions above mentioned). The payback period is estimated here at 22 years.

Note that the more energy prices rise the quicker the project will be paid back and began to pay off.

11. The overall energy efficiency situation in the Département des Vosges and comparison with the national and European situation

Detailed information about the current energy efficiency situation in the département des Vosges could not be identified. Indeed, the in-depth research that was carried out (i.e. literature review and communication with relevant persons in the municipality/region) showed that information concerning the concrete energy efficiency situation for this region does not exist.

According to the information provided by the EU-funded project Odyssee, the energy efficiency of final consumers improved by 13% (or 1%/year) in France between 1990 and 2004. This is better than the EU-25 average (11% improvement). All the sectors participated to this improvement. Regarding households, energy efficiency improved by 13% between 1990 and 2004 mainly
due to progress realized for space heating (15% improvements) and for large electrical appliance (13%). Most of the progression took place until 1997. Since then, there is a relative stability of energy efficiency performance. [ODYSSEE, 2006-07].

Regarding renewable energies, in the framework of the “Wood Charter” (see above), development of wood for heating purposes was promoted in the Département des Vosges. At the beginning of year 2007, 39 wood heating systems were installed in public buildings and 26 studies are ongoing for new equipment. Together, the 52 systems account for more than 25 megawatt power, more than 30,000 tons of wood burnt yearly, more than 8,500 tons of oil equivalent that are substituted, with, as a consequence, reductions in CO₂ emissions of more than 20,000 tons per year.

No data is available for renewable energy production in the département des Vosges. Data is available for a larger area, Lorraine, which brings together 4 départements including the Département des Vosges.

In Lorraine, 2.7% of energy production comes from renewable sources, compared to almost 13% at national level (France). These values are currently being reviewed; unfortunately the new 2005 data will not be available publicly before September 2007. A possible increase of the percentage of energy production from renewable sources between 1999 and 2005 would show the beneficial impact of the efforts to use wood as a power source for heating [ADEME, 2002].

No data about the percentage of renewable energy in energy consumption is available at local level, which makes it impossible to compare local data with European reference data from EurObserv’ER (namely the share of renewable energies in primary energy consumption).

12. Ongoing applications of the project

- Estimation of cost savings thanks to the wood boiler
Cost of the wood material for use in the boiler is about 12.2 € / MWh (excluding taxes).
The combined wood and gas boiler provides savings of €21,000 per year (see below).
<table>
<thead>
<tr>
<th></th>
<th>Annual costs (excluding taxes) for the wood + gas boiler</th>
<th>Annual costs (excluding taxes) for a corresponding gas-only solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel cost</td>
<td>€18,000</td>
<td>€32,000</td>
</tr>
<tr>
<td>Maintenance cost</td>
<td>€27,000</td>
<td>€34,000</td>
</tr>
<tr>
<td>Total</td>
<td>€45,000</td>
<td>€66,000</td>
</tr>
</tbody>
</table>

**13. Key factors for success**

The choice of wood as a construction material and for the power supply was made in the framework of the regional plan for use of wood, energy efficiency and sustainable development, and closely linked to the area's large wood resources.

As for public acceptance of the building, possible bad acceptance of the building by one party (pupils' parents) was avoided thanks to the organisation of a meeting to explain the project.

**14. Potential to replicate a similar project by other local/regional authorities**

Since the key factor for success was the use of wood, such a project would be easiest to replicate – and all the more relevant – in a similar area with large wood resources.

As a public access building, this type of project should ensure a good acceptance of the building itself by its future users. In this case, the project confirmed the importance of implicating all future users as soon as possible in the design of the forthcoming building. Indeed, among all teachers in the school, those who were reluctant to participate in the debate about the future new building were the only ones who actually had difficulties adapting to their new work environment. Consequently, to successfully lead such a project, the local/regional authority should pay great attention to the attitude of future users of the building and should not hesitate to use communication tools (as simple as public meetings) to explain the project to citizens.
15. Contacts / Acknowledgements

**Organisation:** Conseil Général des Vosges, with 1,000 to 1,500 employees. Type of organisation: Public political head of the local area

**Main activities:**
In its area, the organisation is responsible for:
- social aid
- construction and maintenance of secondary schools
- public transportation for pupils
- road system
- rural equipment

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E-mail pballand@cg88.fr
Web http://www.cg88.fr/

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16. References


[Architecturestudio, 2007] Pages of the architect’s website that are dedicated to the project (French only). Available at: http://www.architecture-studio.fr/Architecturestudio.php?rubrique=ReaDetail&ID=MRC1


[Conseil Général des Vosges] Website of the Conseil Général of the département des Vosges. Available at:
http://www.conseil-general.com/conseil-general/conseil-general.htm

[Conseil Général des Vosges, 2007] Printed documentation has been kindly provided by the Conseil Général of the département des Vosges.


Augustenhof holiday village,
Schleswig-Holstein, Germany

Augustenhof Beach Village is a holiday complex which consists of 15 guest houses and a community house, the latter being built with a passive house design. The whole village is eco-designed according to low energy consumption standards and the materials and technologies used have a low impact on the environment. Solar energy from both PV and solar thermal plants as well as wood pellets provide most of the energy that is used for heating. 56.9 tons of CO$_2$ have been saved thanks to the implementation of low energy standards and to the use of renewable energy sources.

1. Project’s background
Augustenhof Beach Village aims to prove that the tourist industry and conservation can get along while being profitable.

1.1 Schleswig-Holstein

Location and population
Germany is a Federal Republic made of sixteen States (Länder, singular Land), one of them being Schleswig-Holstein. Schleswig-Holstein is subdivided into 11 counties (Kreise) and 4 cities without counties (kreisfreie Städte). Schleswig-Holstein is the only German federal state that lies between the North and the Baltic Sea. Between these runs the Kiel Canal, the busiest man-made waterway in the world. Schleswig-Holstein is bordered:

- In the north by Denmark and the Baltic Sea
- In the east by Mecklenburg-Western Pomerania and the Baltic Sea
- In the south by Hamburg and Lower Saxony
- In the west by the North Sea.

With an area of 15,763 km$^2$, Schleswig-Holstein is home to circa 2,833,000 people. The capital city is Kiel.
■ Economic activities

Business and industry in Schleswig-Holstein mainly focus on the following activities:

• The maritime industry: Schleswig-Holstein intends to make a name for itself as Europe’s model region for maritime science and industry. More than 20,000 young people from all across Schleswig-Holstein have already enrolled on degree courses that relate to this area. At the beginning of 2004, Schleswig-Holstein launched the initiative “Sea: our future”, in which representatives from science, trade and industry, politics and associations work together to make further progress on marine-related industry and knowledge.

• Tourism: Schleswig-Holstein’s tourist industry is known for its top-flight Spa and health offerings.

1.2 Passive Housing

The project at Augustenhof Beach Village, located in Schleswig-Holstein, aims to prove that the tourist industry and conservation can get along while remaining profitable.

The three main challenges encountered in conducting this project were:

• To build a holiday village in harmony with nature rather than in conflict with it.
ANNEXES

• To be at the cutting edge of innovative environmental technology whenever and wherever possible.
• To build houses, and use the surrounding areas as aesthetically as possible.

To this end, as will be further described, some of the houses at Augustenhof have been built on the premise of “Passive Housing”. The term Passive house (Passivhaus in German) refers to a building in which a comfortable interior climate can be maintained without active heating and cooling systems.

Passive houses in Europe must comply with standards for energy use. These require that:
• The building must not use more than 15KWh/m².a in heating energy.
• The specific heat load for the heating source at design temperature must be less than 10 W/m².
• The building is pressurised to 50 Pa by a blower door. The building must not leak more air than 0.6 times the house volume per hour.
• The total primary energy consumption (primary energy for heating, hot water and electricity) must not be more than 120 kWh/m²a.

With this as a starting point, additional energy requirements may be completely covered using RES.

2. Scope of the project and objectives

The project’s main aim was to build a modern holiday village in harmony with ecological, economic and social considerations. Another important goal was to position the holiday village at the cutting edge of innovative ecological technology wherever possible.

The project’s objectives were to build an eco-designed holiday village, with low energy consumption and low impact on the environment. To this end, it was decided that a passive house design would be used. The target audience for this project ware the holiday-makers at Augustenhof beach village and political decision makers.

3. The role and responsibilities of the organisations that participated in the project

The Schleswig-Holstein Energy Foundation (Energiestiftung Schleswig-Holstein) was the leading regional organisation in this project. It was assisted by the Investitionsbank of Schleswig-Holstein, which is the state’s main development bank that finances projects of all kinds.
Following the recommendations of the Investitionsbank, a small district heating network was developed for the Augustenhof beach village. The Investitionsbank contributed to a part of the investment and also proposed to build the community house as a passive house construction in order to get more information on passive houses used for commercial purposes.

After the opening of the beach village, the Investitionsbank contacted the "Institute for future energy systems" (IZET Saarbrücken, Institut für Zukunfts Energie Systeme) to obtain a small district heating system under the scientifically controlled SOLLET programme (European network strategy for combined solar and wood pellet heating systems for decentralized applications). For more information, see http://www.sollet.info

The Ministry for Agriculture, Environment and Rural Areas of Schleswig-Holstein also took part in the project, and:

- Recommended the use of PVC-free materials
- Helped to get the houses a green roof
- Helped to build the houses using better standards than low energy houses.

4. Decision-making process

The owner of the holiday village could see the potential of developing eco-friendly tourist accommodation. Erhard Stammberger-Riemer, consultant, made an assessment of the economic perspectives of this ecological holiday village, in co-operation with the Investitionsbank of Schleswig-Holstein.

The regional authorities provided technical advice and financial support for this project (see section 3).

5. Technical aspects of the project

Houses at Augustenhof are windproof, perfectly insulated and have triple-glazed windows. A weatherproof house has to have special ventilation devices, and therefore all rooms contained regulated openings to the outside, protected by pollen-filters. There is a variable vent in the bathroom.

For environmental reasons, the use of PVC-based materials was avoided during construction of the holiday homes, especially as there were PVC free alternatives readily available for almost all building materials, including underground sewage pipes and green-roof foil, both of which are usually made from PVC.

The community house is the communal part of the holiday village. It hosts an office, a café, a small health-food shop, places for playing games and reading as well as washing machines and tumble dryers.
Some of the houses have two layers of clay plastering on the inside. The clay plastering is about 2cm deep and regulates the air in the rooms, i.e. it absorbs excessive moisture and releases it when the air becomes too dry, e.g. when the radiators have been turned on. Clay plastering also helps to keep a constant temperature.

All rooms in the community building except for the kitchen and bathrooms have the same clay plastering as some of the other houses.

The community building is one of the first commercially used "passive houses" in this area. With a surface area of 54 square metres, the first houses that were built could not be considered as "passive" buildings, as houses with a base area below 60 square metres fall outside the German Passivhaus standard. Furthermore, the sophisticated ventilation system required by passive housing scheme would have been too expensive for such small accommodation. It made sense, however, for the community building, which measures 127 square metres, to attempt to keep within the German energy saving laws (less than 15 KWh/m² yearly energy input).

<table>
<thead>
<tr>
<th>Thermal Transmittance Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Thermal Transmittance Values (W) of every building component shows how much energy is needed per square metre to maintain a temperature variant of 1 Kelvin.</td>
</tr>
<tr>
<td>(The lower the value the better the insulation).</td>
</tr>
<tr>
<td>holiday houses --- community building</td>
</tr>
<tr>
<td>Outer wall</td>
</tr>
<tr>
<td>Roof</td>
</tr>
<tr>
<td>Windows</td>
</tr>
<tr>
<td>Floor</td>
</tr>
</tbody>
</table>

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51 K = °C + 273.15
°C = K – 273.15
Figure 2 – A view of the holiday village

Source: [Strandom, 2006]

It was decided during the planning stage that the holiday village would use solar power to heat water and that the grid would be used only if and when there was insufficient sunlight or when too many people taking showers would empty the tanks. The Energy Foundation of Schleswig-Holstein suggested that the holiday village should build one central energy plant for all the 15 buildings which would include a pellet burner next to the planned solar collectors.

Figure 3 – A view of the community centre with PV power plant

Source: [brochure by Strandum Augustenhof]

19 solar collectors were installed on the roofs of the energy plant and the building next to it. The solar power collected is stored in three water cisterns. Once the temperature in the storage tanks is high enough, the water is pumped through a pipe into all 15 holiday homes, where it goes into either another hot water tank or directly into the heating system as needed.

In order to optimise the use of any existing solar energy, the warm water from the pellet stove only flows into the top third of the tank. The rest of the water is pre-heated by the water from the three solar tanks via heat exchange. This way, it is ensured that the energy from pellet burning is really only used when
necessary.

### Technical Specifications of the Local Energy Plant

**Solar collectors:**
- Surface area of solar collectors: 47.5 sq m
- 4 storage containers with 700-litre capacity each
- Manufacturer: Tecalor GmbH

**Pellet Stove:**
- 32 KW
- Storage Silo:
  - 6.2 tonnes
  - Manufacturer: Paradigma Energie & Umwelttechnik GmbH & Co KG
- 1 tonne of wooden pellets is equivalent to 500 litres fuel oil.
- They deliver 5,000 kWh and cost between € 150 and € 200.

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**Figure 4 – A view of the local energy plant**

Source: [Stranddorf, 2006]
During the first phase of construction in spring 2004, 15 holiday homes were built, all of which were connected to the energy plant. A further 15 low energy consumption homes were planned for the village, three of which were built in the winter of 2004/2005. As the capacity of the solar collector/pellet stove system was fully utilised by the 15 original houses, the new houses have a different heating system: each house has solar collectors (3.5 m²) and a gas burning system for further heating needs. In order to maximise the use of solar energy, the new houses all have under floor heating, which can use water temperatures as low as 30° C. This is added to the energy system in the community building, which receives its warmth from the expelled air. A PV system in the roof of the community building completes this solar energy programme.

6. The citizens' attitude to the project
The principal target group of this project (tourists), were very enthusiastic about the Augustenhof beach village. Most of them considered it to be more than a “normal” beach village, which is why they chose to spend their holidays in Augustenhof. Other guests, who were unaware of the beach village’s characteristics, were often positively impressed by the eco-buildings and picked up some ideas to replicate at home.
Besides tourists, Augustenhof receives visitors that are:
- Local and national politicians
- Staff from other tourist facilities (campsites, hotels, agro-tourism)
- Members of advanced training courses in eco-design.

7. Implementation and project life span
It took seven years to obtain a licence to build the beach village (see next section 8 for further explanation). It took four months to build the first 15 guest houses.
The planning phase of this project can be divided in 3 different phases:

The first planning stage included:
- The design of the holiday village
- The negotiations to get the approval to build the beach-village.

The second planning stage included:
- The search for a competent construction company.
- The search for the right innovative technologies.
- The search for government or non-government aid.
- A first set of negotiations about financing with the banks.

The third planning stage included:
- Extensive negotiations to get the final approval to build the beach village.
- Extensive negotiations about financing with the banks.
Here is a description of the different building phases:

<table>
<thead>
<tr>
<th>Table 1 – Project’s phases and their implementation date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
</tr>
<tr>
<td>Building of 15 summer residences</td>
</tr>
<tr>
<td>Grand opening of the beach village in presence of the Minister for the environment</td>
</tr>
<tr>
<td>Building of three more summer residences</td>
</tr>
<tr>
<td>Building of the community house</td>
</tr>
<tr>
<td>Building of the bike cottage</td>
</tr>
<tr>
<td>Building of the woodshed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 – Upcoming projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building of two more summer residences</td>
</tr>
<tr>
<td>Building of one more summer residence and a sauna</td>
</tr>
<tr>
<td>Building of nine more summer residences</td>
</tr>
</tbody>
</table>

The local press and TV-station have made documentaries about the beach village, which is now well-known as a pioneer of sustainable tourism in the region.

8. Problems and obstacles

The location of the beach village was controversial and the local district planning authorities fought against it. Conservationists were also opposed to the project as the beach village is built directly on the beach. For this reason, it took seven years to get the licence for the building of the village. Nevertheless, the owner of the Augustenhof beach village saw this long planning stage as an opportunity to learn more about innovative technologies and funding opportunities. The promoters of the project defended it by pointing out that they only used 3 hectares out of 15 for the beach village, the 12 remaining hectares were left wild.
9. Costs and funding of the project

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cost (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning stage</td>
<td>€150,000</td>
</tr>
<tr>
<td>Building costs</td>
<td>€ 1,900,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Total funding (€)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energiestiftung Schleswig- Holstein</td>
<td>€65,000</td>
<td>Finance the passive house and small district heating system</td>
</tr>
<tr>
<td>Ministry for Agriculture, Environment and Rural Areas of Schleswig- Holstein</td>
<td>€97,000</td>
<td>Environmental engineering (€77,000) and urine separation toilets and plant - SWAMP project (€20,000)</td>
</tr>
<tr>
<td>EU</td>
<td>€17,000</td>
<td>Urine separation toilets and plant – EU- funded SWAMP project^52</td>
</tr>
</tbody>
</table>

The building costs are 100,000 € more than what was planned, because of the following additional features:

- Terraces
- Extra comfort in the houses
- PV solar plants
- An increase in the planning costs

10. Results

10.1 General results

All technical objectives were fulfilled. Although the following aspects were planned, their implementation has been postponed:

- Building of 10 more summer residences
- Building of a sauna
- Building of a house for the caretaker
- Building of storerooms
- Building of seminar rooms
- Building of one more utility room.

10.2 *The socio/economic impacts/benefits*

This project created 5 jobs in the area of implementation. Furthermore, because of the construction of a small district heating system in the beach-village, many people were motivated to use PV solar power plants and pellets for their energy production.

Also, the Augustenhof beach village was one of the four chosen locations to be a demonstration site for the SWAMP EU programme (for been an eco-designed holiday village).

The average energy price was as follows:
- Electric energy: 19.93 ct/kWh
- Natural gas for heating (air and water): 6.16 ct/kWh
- Petroleum for heating (air and water): € 53.3/100L.

10.3 *The environmental impacts/benefits*

In the first six months, 24.6 MWh of energy were produced. Of this, 18.2 MWh were created through pellet combustion and 6.4 MWh by the solar collectors.

The amount of energy generated by the pellet stove equals annual savings of approximately 12 tonnes of CO₂ per year. The solar collectors can provide savings of approximately 4.2 tonnes of CO₂ per year\(^{53}\). This has been estimated using the national heat production share in Germany (45% from natural gas, 40% from oil, 7.5% from coal and 7.5% from renewable energy), using the methodology explained in Annex 1.1, and based on the data from the EcolInvent database, (assuming an emission factor of 0.24 kg CO₂ for 1 kWh of heat produced from natural gas, 0.312 kg CO₂ for kWh of heat produced from oil, and 0.46 kg CO₂ for kWh of heat produced from coal).

CO₂ emission reductions can also be expected from the use of passive house design: reduction can range from 85% to 93% of energy consumption in comparison with traditional buildings. It has been estimated that 56.9 tonnes of CO₂ were saved thanks to the implementation of low energy standards.

It can be assumed that a passive house consumes an average of 15KWh/m²a and that, on average, a typical house consumes:

- Houses built between 1950 and 1995: 200 kWh/m²a
- Houses built after 1995: 100 kWh/m²a

\(^{53}\) The estimates of the annual amount of CO₂ avoided are an extrapolation of the results obtained from the first 6 months of operation of these systems.
Using the methodology explained in Annex 2, it has been determined that the actualised benefits of the project outweigh the actualised costs, assuming an interest rate of 3.4%, an energy price for heating of 0.08 €/kWh and a project lifetime of 20 years. This means that the project is a cost effective investment, as the economic savings are worth more than the initial capital investment.

It has been estimated that the cost per tonne of CO₂ avoided due to the implementation of this project is € -39.07 (under the assumptions mentioned above). This means that after the payback period (estimated here to be 16 years), there is no cost associated with the reduction of GHG emissions.

11. The overall energy efficiency situation in Schleswig Holstein and comparison with the national and European situation

The State of Schleswig Holstein, whose carbon footprint was more than 23,500,000 tonnes of CO₂ equivalent in 2001, now has the goals to:

- Reduce CO₂ emissions by 15% in 2010, as compared to 1990 levels.
- Increase the share of renewable energies in end energy consumption 25% by 2010, as compared to 1990 levels.
- Increase the share of electricity from renewables in electricity consumption 50% by 2010, on 1990 levels (under evaluation by new government elected in 2005).
- Increase the share of electricity from CHP in electricity consumption 30% by 2010, on 1990 levels.

So far Schleswig-Holstein has:

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54 We consider that the production of a KWh in Germany produces an equivalent average of 753g of CO₂.
55 Actualised benefits: all the annual net savings during the life cycle of the project, expressed in present money value.
56 Actualised costs: Present value of all the annual capital costs during the life of a project.
• Reduced its CO₂ emissions by 10% in 2000, as compared to 1990 levels.
• Reduced its GHG emissions by 13% in 2000, as compared to 1990 levels.
• Increased its share of renewables in end energy consumption by 7% in 2000, as compared to 1990 levels (excluding transport sector).
• Increased its installed wind energy capacity by the end of 2006 to 2390 MW.
• Increased its share of renewables in electricity consumption by 33% in 2006, as compared to 1990 levels.
• Increased its share of electricity from CHP in electricity consumption of 16% in 2001, as compared to 1990 levels.

No detailed information about the overall energy efficiency situation in Schleswig-Holstein could be identified in spite of in-depth research that was carried out (i.e. literature review and communication with relevant persons in the region).

In Germany’s public buildings over €2 billion energy costs are spent each year, 70% of these costs occur in municipalities. According to the information provided by the EU-funded project Odyssee (http://www.odyssee-indicators.org/), in the period 1991-2004 the energy efficiency index for the whole economy decreased by 15 %, compared to 11 % for the EU-25. Especially the industrial sector contributed to this development, whereas in the other sectors the decrease was less than average. With regard to households, between 1991 and 2004, the technical energy efficiency index in the household sector as a whole decreased by about 9 %. Energy efficiency both improved for electrical appliances and space heating.

12. Ongoing applications of the project

Considering the interest and the growing number of tourists that come and stay at the holiday village, users seem to be very satisfied with the facilities. As a result, the construction of new buildings is planned for the near future (see table 2).

13. Key factors for success

The project was supported by the local authorities. It notably received major funding and help from the Energiestiftung Schleswig-Holstein and the Ministry for Agriculture, Environment and Rural Areas of the Land. Another key factor in the success of this project is the promoter’s capacity to sell

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57 An energy efficiency index has been developed under the EU-funded Odyssee project (http://www.odyssee-indicators.org/). It provides an overall perspective of energy efficiency trends by sector and combines the trends of indicators by end-use or sub-sector. A decrease means an energy efficiency improvement [ODYSSEE, 2006-07]
this innovative concept to stakeholders and to motivate funding institutions.

14. Potential to replicate a similar project by other local/regional authorities

It was fairly difficult to find a bank as the financial partner due to the declining number of overnight stays in the entire region and the general dependency of tourism on the economic cycle. To convince the banks of the innovative and unusual concept pursued with this project proved to be even more difficult. After all, there were no comparable projects already existing.

This experience shows that it is possible to use a passive house building for a commercial purpose and eco-friendly buildings as tourist accommodation. Similar projects could be developed provided that tourist promoters agree to take the environment into consideration and realise that higher investments related to energy efficient buildings can pay off. Finally, some locations would be more appropriate for the implementation of this type of project than others. For instance, it would be difficult to build holiday buildings with such low energy consumption in countries where air conditioning is appreciated.

15. Contacts / Acknowledgements

| Organisation: | Ministerium für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (Ministry for Agriculture, Environment and Rural Areas of Schleswig-Holstein) |
| Type of organisation: | Regional authority |
| Main activities: | Agriculture, Coastal protection, sea protection and flood protection, Climatic protection, nature and environmental protection |

Contact Information:
Thomas PUPHAL, V 603 Technologie- und Innovationsförderung, Umweltmanagementsysteme, Klimawandel, Ministerium für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein, Mercatorstr. 1-3, 24106 Kiel, phone: +49 (0)431/988-7218, fax: +49 (0)431/988-7239, E-mail: Thomas.Puphal@mlur.landsh.de
16. References

This fact sheet is based on the information provided by the Stranddorf Augustenhof GmbH and the Ministry for agriculture, environment and rural areas of Schleswig-Holstein, through means of a questionnaire that was developed in the context of this project and telephone interviews.


RENEWABLE ENERGY PROJECTS
Project for solar energy use at Český Krumlov Council offices

The city of Český Krumlov in cooperation with the České Budějovice Energy Centre and the Energiesparverband (Regional Energy Agency of Upper Austria) launched in 2006 launched a project to install solar thermal equipment and a photovoltaic system on the town’s council offices in Český Krumlov. 48 solar collectors (with a surface of 85 m²) and a 1 kWp photovoltaic system were installed. The project also strove to increase the awareness and skills of local authority officials, company employees and the general public regarding the use of renewable energy sources (RES) through training seminars and the dissemination of information materials. The total annual yield of heat energy is estimated at 41,300 kWh/year from the solar thermal system and up to 1,200 kWh from the photovoltaic system. This avoids emissions of 9.5 tonnes of CO₂ per year in total.

1. Project’s background

1.1 City of Český Krumlov

Český Krumlov is a small city in the South Bohemian Region of the Czech Republic, best known for the fine architecture and art of the historic old town and Krumlov Castle (see Figure 1).

Figure 1 – Location of Český Krumlov in the Czech Republic
The significance of Český Krumlov as an unusual Historical Monument was pointed out in 1992 by the act of the International Association of UNESCO. The town of Český Krumlov is increasingly becoming a tourist destination for both national and international visitors. It has become an important cultural centre, hosting a number of festivals and other events each year.

Český Krumlov has a total surface area of 2,215.44 ha, and has approximately 13,797 inhabitants. The average temperature is 7°C. The coldest month is January with an average monthly temperature of -2.9° C. Summer months are the most abundant in rainfall, with a maximum average of 102 mm in June. The average summer temperature is 15.7°C.

1.2 Solar thermal systems and potential of solar energy use in the Czech Republic

The Czech Republic is located in a temperate zone and receives around 1,000 W/m² from solar radiation. There are two ways in which solar energy can be used in these conditions:

- Conversion of solar energy into heat energy – solar thermal.
- Direct conversion of solar energy into electricity – PV.

These two systems are further described below. To support the use of RES, the national Energy Regulatory Office fixed a purchase price for energy produced by these sources. These prices for the various types of energy are set out in Price decision no 10/2005 of 18 November 2005. The price set for electricity produced from solar radiation after 1 January 2006 was 467 €/MWh. This means that solar energy can also be used for commercial purposes [ECCB, 2006].

Solar thermal systems

Various types of solar collectors are used to convert solar energy into heat. The simplest are made out of plastic. They are used mainly for supplying swimming pools. They are not well suited to providing water for household use. Their advantage is the low purchase price. Flat panel collectors with simple or double glazing are suitable for domestic use. Yet another type is vacuum-tube collectors, in which a vacuum is created in a glass tube containing the absorber to provide perfect heat insulation.

The accumulation tank is an important part of the installation. When the solar collectors provide a surplus of heat energy, this is delivered to the accumulation tanks and tapped as required to heat household water or to preheat water for

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58 1 EUR = 28.2791 CZK
heating. Conversely, when not enough solar energy is available for heating household water, an electric heating element can be used in the upper part of the accumulation tank.

Collectors are most often installed on rooftops. The roof must, however, be facing in the right direction – preferably south or south-east – to get the optimum amount of energy. The angle of the collector is also important. An angle between 35 and 50 degrees is suitable for year-round operation.

### PV systems

Direct conversion of solar energy into electricity requires the use of solar panels, which are large-surface, usually ceramic, semiconductor units. When the PV element absorbs solar radiation, direct current electricity is produced in the semiconductor. The strength of the current is directly related to the surface of the photo-cell and the intensity of the radiation. PV cells can be joined as required in series or in parallel to obtain the amount of direct current electricity of the required voltage and power.

There are different types of solar panel technologies and the size of available roof space, angle to the sun, pitch of the roof and budget will have an effect on how much solar electricity is produced.

#### 2. Scope of the project and objectives

The main goal of this project was to install solar collectors and PV panels at the council offices in Český Krumlov and – through training seminars, the so-called "Energy consulting courses for multipliers" programme and dissemination of information materials – to increase the awareness and skills of local authority officials, the staff of companies and the general public regarding the use of RES. The project also aimed at achieving the knock-on effect of encouraging increased use of these resources to achieve effective energy management and environmental protection. Furthermore, the project intended to improve cross-border cooperation and the exchange of know-how in energy conservation, RES, and modern technologies between the Upper Austria and the South Bohemia Region.

More specifically, the project aimed at:

- Increasing the share of renewable energies in total energy production by using the experience of the Upper Austrian partners in this area
- Installing solar thermal and PV equipment on the roof of the applicant's building
- Supporting the training of people who are expected to be significant disseminators in the use of RES.
The target group were public administration officials, planners from South Bohemia Region's border area, Český Krumlov residents and visitors and the residents of nearby towns and villages.

3. The role and responsibilities of the organisations that participated in the project

The project organiser was the city of Český Krumlov and the project partners were the Energy Centre České Budějovice (ECCB - regional energy agency on the region of South Bohemia), and the O. Ö. Energiesparverband (ESV), which is the regional energy agency in Upper Austria. Other organisations from Austria also participated in the project, including Energieinstitut (Energy Institute), Klimabündnis Österreich (the Austrian Climate Alliance) and OÖ für Umwelt und Natur (an environmental department of the Upper Austrian government).

The local authority was mainly in charge of the decision making and financing, while ECCB and ESV took over the technical aspect, planning and organisation of the promotional activities, and also contributed to the financing.

ECCB's main responsibilities were to:
- Provide specialist advice and assistance on the technical aspects of the project, (including supervision of the installation of solar thermal and PV equipment and of the evaluation of results).
- Prepare and organise seminars and the "Energy consulting courses for multipliers" training programme.
- Assist in promoting the project and organising the press conference.
- Compile the information for the brochure.

ESV's main responsibilities were:
- To provide specialist advice in the preparation of the project.
- To help in putting together the programme of seminars and excursions.
- To choose sites to be visited and to secure speakers from Austria for the seminars and for excursions.
- Active participation in seminars and excursions.

A contract was established with a private company, Intersekc s.r.o., Plzeň, for the supply and installation of the solar thermal and PV system (case of contracting)

4. Decision-making process

The main reasons for carrying out this project were to:
- Reduce use of natural gas and obtain lower running costs for hot water and heating.
• Cut environmentally harmful emissions.
• Set a good example for other institutions and citizens in the use of RES.
The main actors involved in the decision-making of the project included the city council of Český Krumlov, the head of investments, land development and conservation department of the city, the regional development department, and the Energy Centre České Budějovice (ECCB). Český Krumlov city took the final decision to carry out the project.

5. Technical aspects of the project
The solar thermal system installed at Český Krumlov Council offices is used for hot water and heating. The structure is installed on the flat roof, where an armature was anchored to the attic gable and buttressed in three places by supports in the roof. The support chosen is reinforced for heights over 20 metres above ground level.

The actual collector module is made up of 48 Heliostar 300N-2-L collectors. These are highly selective flat collectors arranged into banks which are big enough to heat water and provide additional heating at the site. The total accumulated capacity of the solar thermal collectors was 85m². The output of the collector bank depends on the season. The energy obtained from the system covers the needs of water heating and supplementary heating in winter and transitional period.

The system includes two 2,500-litre accumulation tanks (total capacity of 5,000 l), the first being solar for water heating. An external exchanger and circulator pump supplies this tank with energy collected in the solar collectors. This solar accumulation tank has a hot water outlet into the second tank which is further heated by a gas boiler through a 2m² heat exchanger. This set-up was chosen to protect against damage and to increase the amount of hot water. A WILO TOP S/30/10 circulator pump delivers an anti-freeze solution between the collector and exchanger. The whole system is regulated by an RVA 65.642 regulator which has sensors in the collector, the solar tank and the hot water valve. Depending on the information provided by the sensors, heat energy is directed from the collectors either to the solar tank or to the heating unit where it is used to moderate the temperature of the collectors and reduce it when there is an energy surplus. The energy provided by the solar thermal system is measured by a Siemens Megatron meter so that the efficiency of the system and its energy production can be monitored.

A PV system with an installed output of 1.1 kWp\(^{59}\) was also installed on the

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\(^{59}\) kWp: Kilowatt-Peak
roof. The energy obtained by the PV system is used for powering the circulation pumps through a 24/230V/1.5 kW transformer and a back-up system for a computer network.

**Figure 2 – The Český Krumlov council offices with the installed collector module (left) and a detail of the selective collectors**

Source: [ECCB, 2007]

6. The citizens’ attitude to the project

According to one of the project managers from ECCB, only positive public reactions were observed upon implementation of the project. The public information campaign that was carried out during the project (see section below) contributed to the good acceptance of the project by the general public.

7. Implementation and project life span

There are two parts to the project for solar energy use at Český Krumlov council offices: the technical part – the actual installation of solar and PV equipment on the roof of the building, explained in the previous section – and the educational part, which comprises the "Energy consulting courses for multipliers" training programme, two seminars on solar energy and the publication of promotional materials. The whole project ran from December 2005 to August 2006.

### Technical part

As can be seen in Table 1, the whole process of planning, design and implementation of the technical part lasted approximately 8 months, with the actual installation of solar and photovoltaic equipment taking place during the summer months.

**Table 1 – Different phases of the implementation of the Solar collectors and related equipment at Český Krumlov council offices**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation of contract specifications</td>
<td>12.05-3.06</td>
</tr>
</tbody>
</table>
### Promotional and Educational Part

The training programme lasted from May to August 2006. One of the most important activities that were carried out in the framework of the educational part was the so-called “Energy consulting courses for multipliers” training programme. This took the form of six seminars and six site-visits on the following subjects: energy policy and Czech legislation, energy for buildings, energy-efficient houses in the Czech Republic and Upper Austria – public and private sector, low-energy and passive houses, use of RES in the Czech Republic and the EU and support for RES, examples of global use of RES in Upper Austria, solar power and solar equipment in the Czech Republic and Upper Austria, biomass and biogas, equipment for the use of biomass and biogas in the Czech Republic and Upper Austria, wind and hydro power, and wind power stations and small hydroelectric power stations in the Czech Republic and

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60 After an initial inspection of the building, it was determined that further work will be required for the installation of the collectors and consequently an annex had to be added to the construction contract. See section 8 for further details.
Upper Austria.

**Figure 3 – One of the seminars carried out in the framework of the educational activities of the project**

Source: [ECCB, 2006]

The training programme involved 111 participants and 33 speakers, who were carefully selected from among leading specialists on each topic in the Czech Republic and Upper Austria. The site-visits also met the expectations of the participants, who were able to see for themselves and put what they had learnt at the seminars to the test. They visited a total of 18 sites in South Bohemia and Upper Austria using RES and employing energy efficiency measures. There were also two seminars on "Solar Energy", one of them for mayors and the other for the public at large.

An information brochure entitled *"Pilot project for solar energy use in the municipality buildings in Český Krumlov"* was published with a print run of 5,000 copies.

Media coverage was arranged, with articles in the daily press and specialist journals, reports on the web and radio and TV programmes. A press conference was held at the conclusion of the project, when the solar equipment was put into operation and certificates were presented confirming successful completion of the "Energy consulting courses for multipliers" training programme.

8. **Problems and obstacles**

A detailed technical inspection and examination of the building load led to the supporting steel structures being strengthened during the project, which involved building work and required the project to be extended and the contract price to be raised. An addition to the contract (a new annex) was therefore agreed with Intersekce s.r.o. Plzeň and approved by the Czech Republic's Centre for Regional Development. The cost resulting from the revised contract was 9% higher than initially envisaged (see section 9).

Once the project had been approved and EU support obtained, suppliers were chosen and contract specifications drawn up. The contract specification could
not directly stipulate the product type, which meant that the parameters of the equipment had to be described in a complicated way. This meant that a supplier might provide equipment which was similar to that requested in the contract specifications but would turn out to be of inferior quality. The technical documents clearly specified the equipment, but the contract specification could not do so. This meant that the final parameters of the equipment could not be guaranteed. This needlessly prolonged the tender procedure and selection of supplier at the expense of time for implementation, possibly impacting the quality and functionality of the system.

The solution to solve this problem was to provide suppliers with technical documentation about the equipment, have the bid evaluated and compare the bid price with the price of suitable equipment, giving the supplier enough time to perform the contract, and ensure regular monitoring by the investor.

9. Costs and funding of the project

The total project budget was €62,815.92, of which 75% was provided by an EU grant (Phare CBC 2003). The other 25% of the total cost was financed by the local authority (69%), ECCB (27%) and ESV (4%). From this amount, € 42,947 was designated to the installation of solar equipment (excluding the planning). A breakdown of the costs of the technical part of the project is presented in Table 2.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cost (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>567.20</td>
</tr>
<tr>
<td>Construction work</td>
<td>5,482.91</td>
</tr>
<tr>
<td>Technology</td>
<td>37,464.95</td>
</tr>
</tbody>
</table>

The payback period, including the grant, is anticipated at 19 years based on a total cost of € 42,947 for the PV and solar thermal system and yield calculated at 2007 prices. Discounting the 75% grant, the return will be even shorter, calculated at approximately 4 years.

10. Results

10.1 General results

Both the technical and educational parts of the project fulfilled the objectives, namely the reduction in fossil fuel use, the protection of the environment, as well as greater awareness on the part of the general public and multipliers.
10.2 The socio/economic impacts/benefits

The total annual yield of heat energy from the solar thermal system is estimated at 41,300 kWh/year. The annual yield of the PV system is estimated at 900 to 1,200 kWh.

The energy produced by the solar thermal system covers about 87% of hot water needs. Between 8,000 and 10,000 kWh/year will be delivered to the heating system and around 17,000 kWh/year to the ventilation system. The energy produced by the PV system supplies around 80% to 90% of the energy requirements of the photothermal system (for the circulation and feed pumps).

The average price paid for heating in the area where the project is implemented is around 0.0714 €/kWh and the average price of electrical energy is around 0.1428 €/kWh. Taking this into consideration and the given yield of heat energy and electricity, it has been estimated that the saving from the photo thermal system if used to the full could amount to up to €3,000 per year and €143 from the PV system. As the PV system supplies the energy for the pumps, the system can be considered to be almost self-sufficient, and therefore, after the payback period, these estimated savings can be expected per year. Therefore, the project has contributed to reducing the energy expenditures of the Český Krumlov council offices, where the solar and PV equipment was installed. No new jobs were created upon implementation of this project in the area.

10.3 The environmental impacts/benefits

As indicated above, the photothermal system produces between 41,300-42,000 kWh/year. The system avoids the generation of the same amount of energy by traditional sources of energy, which in this case would be natural gas burnt in a thermal plant. According to ECCB estimations, this system avoids the burning of 5,425 m³ of natural gas, thus avoiding 8.4 t of CO₂.

For the PV system, the production is approximately 1,000 kWh/year of electricity, which can provide savings of 1.17t of CO₂, as estimated by ECCB. Therefore, the installation of the solar equipment system will avoid the emission of 9.57 tonnes of CO₂ per year in total.

Using the methodology explained in Annex 2, it has been determined that the actualised benefits of the project outweigh the actualised costs, assuming an interest rate of 3.4% and a project lifetime of 20 years (without taking

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61 Actualised benefits: all the annual net savings during the life cycle of the project, expressed in present money value.
62 Actualised costs: Present value of all the annual capital costs during the life of a project
maintenance costs into consideration). This means that the project is a cost effective investment, as the economic savings are worth more than the initial capital investment.

As the project is profitable, the cost per tonne of CO₂ avoided is in fact a benefit. Indeed, it has been estimated that the cost per tonne of CO₂ avoided due to the implementation of this project is € -7.28 (under the assumptions mentioned above). This means that after the payback period (estimated here at 19 years, or 4 years discounting the grant), there is no cost associated with the reduction of GHG.

11. Overall renewable energy situation in the area of implementation of the project and comparison with the national and European situations.

The use and share of RES in energy production is not adequately monitored at regional level in the Czech Republic, so very limited information exists regarding the current contribution from the different LRAs to the implementation of renewable energy systems.

The Czech Republic's national target for the share of renewable energies in gross electricity consumption for year 2010 is 8%. In 2005, renewables accounted for 4.3% of direct energy sources for the Czech Republic as a whole [EurObserv’ER, 2006].

Regarding PV systems, the total installed capacity in the Czech Republic in 2005 was 0.53 MWp. The same year, the cumulated installed capacity in Europe was 1,791.7 MWp.

The total surface area of solar collectors installed in Czech Republic in 2005 was 18,780 m². The annual installed surface area in Europe in 2005 was 2,073,391m² [EurObserv’ER, 2006].

12. Ongoing applications of the project

The system is almost self-sufficient as the PV system supplies power to the circulation and feed pumps in the solar thermal system. Therefore, the solar energy system does not create any extra electricity demands and the system works even in the event of grid failure. The only running costs of the system will be the occasional inspection of the boiler and logging the amount of heating and electrical energy produced. Other costs will come later and include those of checking the anti-freeze solution and overhauling of the pumps after five years of operation.

13. Key factors for success

According to ECCB, an important element that contributed to the success of the
project was the support from all the different stakeholders. The grant from the EU (Phare CBC 2003), which financed 75% of the total costs, was also essential for carrying out this project. Indeed, the project would probably never have taken place if it were not for this grant.

The promotional part as well as the campaign awareness (i.e. the “solar energy” seminars) contributed to the acceptance of the project but also to increased awareness and understanding about the problem of climate change and renewable energy technologies. Furthermore, one of the seminars especially targeted the mayors of surrounding municipalities, who can contribute to disseminating know-how among municipalities and to promoting the implementation of similar projects in the region.

An important aspect of the “Energy consulting courses for multipliers” training programme was the practical sessions or site-visits that helped the participants to learn about the principles of low-energy construction and encounter various types of equipment for different RES. Indeed, the training programme was a success, with an increase of 64% in the number of attendees compared to the number of participants originally expected.

Moreover, the careful selection of the speakers at the conferences was important in order to give the programme a scientific and professional image.

Finally, cross-border exchanges of know-how in renewable energy technologies between experts from Austria and the Czech Republic helped to establish new and professional contacts that may be extremely useful in the future for the implementation of similar projects.

14. Potential to replicate a similar project by other local/regional authorities

Such a project could easily be replicated by other local/regional authorities, as it is not complicated from a technical point of view. Depending on the particular area of implementation, funding might be a key element for the launch of the project.

Planning and organising the training are straightforward. Nevertheless, the involvement of specialised consultants could be extremely useful.
15. Contacts / Acknowledgements

**Organisation:** Energy Centre České Budějovice  
**Type of organisation:** Non-governmental organization  
**Main activities:**  
The Association of Energy Centre České Budějovice (ECCB) is a centre of energy advice that focuses mainly on the region of South Bohemia. ECCB was established with support from the Commission for the Co-operation of Upper Austria and South Bohemia in 1997.  
One of the tasks of ECCB is to arrange the exchange of technologies and know-how between Upper Austria and Southern Czech Republic. It co-operates with important partners from the Czech Republic and foreign countries, who are engaged in the energy field.  
The Energy Centre's main focus is the support of energy efficiency, utilization of non-traditional and renewable energy sources and increasing the interest of the general public in those problems.  
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**Type of organisation:** Local authority  
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16. References

This fact sheet is based on the information provided by the Energy Centre České Budějovice, one of the project partners, through means of a questionnaire that was developed in the context of this project and telephone interviews.

[Ckrumlov, 2007] Ckrumlov.cz, Official website of the city (20/04/2007)  
Biomass district heating plant in Las Navas del Marqués, Ávila

The implementation of a biomass district heating plant in the municipality of Las Navas del Marqués, in the province of Ávila, was carried out in the framework of the Bioreg-Floresta project, in collaboration with different European partners. The energy produced is used for heating purposes in public buildings. The project included a public awareness campaign. This project illustrates how the use of this indigenous renewable energy source brings a variety of advantages. These are primarily environmental, given that it reduces the use of more polluting fossil fuels, but also social, as supplying the plant with biomass creates new economic activities in the vicinity.

1. Project background

1.1 The area of implementation of the project

The municipality of Las Navas del Marqués, where this project was implemented, is located in the province of Ávila. This province is situated in the western part of Spain, in the southern part of the autonomous community of Castilla and León. It is bordered by the provinces of Toledo, Cáceres, Salamanca, Valladolid, Segovia, and Madrid. Figure 1 illustrates the location of the province of Ávila and the municipality respectively. The municipality has a surface area of approximately 94.5 km², with the city occupying approximately 165,000 m². The climate is characterised by long and cold winters and mild summers.

Las Navas del Marqués has more than 5,000 inhabitants, thus a population density of 53.86 inhab./km². Traditionally the main economic activity in the area has been cattle farming, although nowadays the main sectors are the building industry and the service sector.
1.2 Using biomass for the production of energy

Biomass can be defined as the "biodegradable fraction of products and remnants originating in agriculture (including vegetal and animal substances), in forestry and connected industries, and the biodegradable fraction of industrial and urban residues" [Biorreg-Floresta, 2006].

Wood is the oldest form of biomass known to mankind. For centuries, wood was used for heating, cooking and industrial purposes. In the 18th and 19th centuries, wood was gradually replaced by fossil fuels such as coal, oil and gas, which were easy to handle and had a higher energy density. Nowadays there is a growing interest in biomass which can be used in an efficient way using modern technologies for the production of heat, electricity and transportation fuels. Biomass, used in a sustainable manner, is a regenerative source of energy [AEBIOM, 2007].

Biomass originates from forest, agricultural and waste streams, as described hereafter [AEBIOM, 2007]:

1. Forest and wood-based industries produce wood which is the largest resource of solid biomass. Biomass procurement logistics from forest to bioenergy plants are subject to major improvements. The sector covers a wide range of different biofuels with different characteristics - wood logs, bark, wood chips, sawdust and more recently pellets. Pellets, due to their high energy density and standardised characteristics, offer great opportunities for developing the bioenergy market worldwide.

2. Agriculture can provide dedicated energy crops as well as by-products in the form of animal manure and straw. Available land can be used for
growing conventional crops such as rape, wheat, maize etc. for energy purposes or for cultivating new types of crops such as poplar, willow, miscanthus and others.

3. Biodegradable waste is the biomass that can cover several forms of waste such as organic fraction of municipal solid waste, wood waste, refuse-derived fuels, sewage sludge, etc.

Each biomass resource has different characteristics in terms of calorific value, moisture and ash content, etc. that requires appropriate conversion technologies for bioenergy production. Biomass can be used for heat and electricity generation and for the production of liquid biofuels.

2. Scope of the project and objectives

This project was carried out in the framework of the Biorreg-Floresta project63, whose main objectives are as follows:

- The promotion of exchanges of environmentally-friendly agricultural and forestry practices.
- The promotion of renewable energies inside the Atlantic Area.
- The development of environmental technologies.
- The valuation and use of forest residues for its energetic exploitation in identified regions.

Further, the project intends to:

- Disseminate information related to renewable energies among the public and stakeholders.
- Create mixed public-private companies for the exploitation of endogenous resources.
- Integrate renewable energies in sensitive environments.

The Biorreg-Floresta project is part of the programme on transnational cooperation Interreg III (B) Atlantic Area, and coincides fully with the contents defined in its C Priority: Environment promotion, sustainable management of economic activities and the natural resources; and concretely the C-3 measure: sustainable management of economic activities inside the Atlantic area. Since 1990, the aim of the European Community Initiative Programme (INTERREG) has been to promote the harmonious and balanced development of European territory. The objectives and priorities of the programme are to ensure, by developing suitable projects, a balanced development of the region and to answer to local needs, to extend cross-border networks and their exchanges, and to combine economic development with environmental protection.

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63 http://www.biorreg-floresta.org/index.php
In this context, the aim of the specific project in the municipality of Navas del Marqués was the development of the local bio-energy industry, supporting the establishment of a fuel supply from forestry residues and the installation of a medium-size biomass heating plant for the production of energy for heating purposes that could be used in public buildings of the municipality of Navas del Marqués.

3. The role and responsibilities of the organisations that participated in the project

The leading partner of this project was the County Council of Ávila (Diputacion de Ávila) through the Energy Agency of the province of Ávila (APEA). This regional authority was the project manager and co-ordinator. It represented the other participants in dealing with the public authorities, was the contact for all participants and managed the funding.

The city council of Las Navas del Marqués, where the project was carried out, is a local authority member of the Energy Agency of the province of Ávila. With its participation in the Biorreg-Floresta project, the city council intended to develop its competencies in the field of environment and energy through the implementation of the biomass plant. It contributed to the funding of the project, the facilitation of the implementation of the biomass plant in its territory, the decision-making, and the dissemination and promotion of the best practice and know-how gained through this project.

A call for tenders was launched for the supply and installation of the biomass plant. A private company was selected upon receipt of the offers, and a contract was signed (case of contracting for the installation of the RES). The City Council of Las Navas del Marqués took charge of the management and operation of the plant as well as the collection and recovery of the biomass that is used in the plant’s boiler.

The Biorreg-Floresta project was developed in collaboration with different European partners in Ireland (Mayo Energy Agency), Portugal (Associacao de productores florestais de Setubal, Centro de Biomassa para a Energia, Villa de Ponte de Lima, Ponte de Barca), and the United Kingdom (Severn Wye). In Spain, the Monte Industria association (forestry industry associations) and the Forestry Association of Galicia also participated in the project. The project's target beneficiaries were citizens, decision-makers and energy sector professionals.

4. Decision-making process

The area where the project was implemented has large forestry resources.
Indeed, the surface area covered in forests accounts for 13% of the total surface area of the municipality of Las Navas del Marqués. The idea of implementing the biomass boiler was born when the public organisation Sociedad Montes de Navas, created by the municipality of Las Navas del Marqués, the County Council of Ávila and the Committee of Castilla y Leon, purchased a forested area in the municipality to perform forestry logging. The project was intended to promote the utilisation of forestry residues for energy generation, thus allowing for the creation of new and long-term jobs in this rural area, contributing to the energetic independence of the municipality and promoting the utilisation of RES.

Expert working committees were created for the planning, and execution of the biomass plant. The mayors of the municipalities in the area, the president of the County Council of Ávila and the different project partners were involved in the decision-making of the project. The president of the County Council of Ávila was the final decision-maker, with the assistance of technical experts and consultants that were working on the details of the project.

5. Technical aspects of the project

Two feasibility studies were carried out before the actual implementation of the project. These studies helped the authorities and partners involved to take sound decisions regarding the technical aspects of the biomass district heating plant.

- **Biomass availability in the area where the project was implemented**

The information presented hereafter is based on the study on viability of the use of the biomass generated in the municipality of Las Navas del Marqués that was carried out at the beginning of the project.

The study determined that the total surface area covered by forests was 637.04 ha., of which 635.95 ha was public. The most common tree species are Pinus pinaster Ait. ssp. mesoaeensis (98,5%) and Pinus pinea L. (1,5%)

Three different sources of biomass were considered for the biomass district heating plant:
- Forestry residues: Constituted by the material obtained from the woodland undergrowth clearance in the forests that is carried out under the forest management plans of the area.
- Industry: Certain industries, such as furniture factories, generate wooden waste (e.g. splinters, shavings, sawdust, etc) that can be used as biofuel. Different factories operating in the area were identified.
- Green areas and parks: The residues from gardening both in public and private parks can also be used as biofuel. They were estimated by means of questionnaires completed by technicians working for the municipality.

In total, it was estimated that 5,076.74 t/year could be available for use in the
biomass plant. The calorific value was estimated in 3.5 kW/kg (3,000 kcal/kg=12.6MJ/kg) for biomass with a humidity of 30%.

The biomass plant

A LH 1,000 boiler was installed, which has an efficiency of approximately 90%. It has a heat output of 1,000 kW or 860,000 kcal/h. It has the following characteristics:
- Length: 3.3 m
- Width: 2.2 m
- Height: 2.53 m
- Weight: 7,000 kg
- Capacity: 7,000 l.

This boiler was also selected for certain features, including:
- Automatic fire-tube cleaning system
- 3 pass-high efficiency- hot water boiler
- Water cooled burner providing extra heat output with less burner abrasion
- Boiler and burner integrated hot water circuit that minimises radiation losses
- Easy to clean boiler, quick-open tube section with shock absorbers
- Facilities for gas or gas oil burner if necessary
- Excellent emission levels.

The boiler supplies energy for heating and hot water to different public buildings in the area: the city hall, a multi purpose building, the exhibition and congress centre and the public swimming pool. In total these buildings account for approximately 3,500 m². It was estimated that to meet the energy demand of these buildings, it was necessary to use 23.44% of the total amount of biomass available in the area (5,076.74 t/year), thus 1,190 tonnes per year, which equals 4,165,000 kWh/year. The silo has a capacity of 15 tonnes and is filled with the sawdust that is used in the boiler. The heat generated in the burner is distributed to the 4 buildings through 700 meters of pipes.

The plant works “on demand”. During the winter, when the demand is higher, the boiler can operate 24 hours a day, while in the summer, it only supplies the swimming pool, the exhibition and congress centre and the city hall, and is operational only 4-5 hours per day.
6. The citizens' attitude to the project

At the beginning of the project, the general public was sceptical about the feasibility of the implementation of a biomass boiler in their municipality. Indeed, this was the first time that a project of these characteristics had been implemented in the province of Ávila and only the second time in the whole community of Castilla y Leon (there is a biomass plant in Segovia).

According to the APEA, the seminars and awareness campaigns that were carried out within this project helped to dissipate these initial doubts and nowadays the support for, and acceptance of, the biomass plant is unanimous.

7. Implementation and project life span

The project was launched on 1st April 2004, and the completion date was first planned to be in March 2006. Nevertheless, the biomass plant was not finalised until December 2006. The main phases of the project were as follows:

1. Resource Evaluation. At the beginning of the project, a quantification of the availability of the biomass resources was carried out. As mentioned before, one of the main outputs of this phase was a study on viability of the use of the biomass generated in the municipality of Las Navas del Marqués. This study also analysed the options for the collection, treatment and storage of the identified biomass resources.

2. Evaluation of opportunities for application of biomass for energy generation. An analysis of the available technologies was carried out within this phase, including district heating, electricity generation, domestic uses and industrial application. Also, previously implemented demonstration projects for the application of biomass were identified in order to benefit from the experience gained. A study of the energy demands to be met and the feasibility of the different technical options for the implementation of the plant was carried out.

3. Analysis of the biomass project market. Localisation and identification of possible installations and evaluation of the possible environmental impacts of the planned biomass plant.
4. Installation of biomass plant/Mixed companies creation. A call for tenders for the supply and execution of the planned plant was launched. Upon selection of the contractor, the installation of the plant was initiated.
5. Diffusion. Awareness campaigns and promotion of the project were carried out.

■ Promotion and information campaigns.
Eight seminars were carried out for all the project partners, including the European organisations involved in the Biorreg-Floresta project. The consultants and experts that participated in the planning and evaluation of the project were also present. The seminars were mainly carried out between October 2004 and December 2005. International seminars were also organised in Ireland and Portugal.

The results of the project were promoted through the local and regional press (Diario de Ávila, Ávila Siete, etc.) and the websites of the local press (aviladigital.com, avilared.com, electronic version of the Diario de Ávila). A project website was also developed and launched to disseminate the project's development and results. Promotional material, including a project brochure and a CD-ROM, were disseminated among the general public and the mayors of the surrounding municipalities.

8. Problems and obstacles
As discussed above, one of the main obstacles encountered at the beginning of the project was a disbelief that it was feasible to carry out this type of project in the area, in particular regarding the ability of this plant to provide energy for the municipality. The awareness campaigns contributed to solving this initial problem.

Secondly, another important problem encountered initially was the inexperience of the authorities and partners in carrying out this type of project, in particular involving biomass. The creation of the expert working committees allowed the decision makers to take the best decisions.

9. Costs and funding of the project
The total cost of the Biorreg-Floresta project was €2,048,178.58. The European Regional Development Fund (ERDF)\(^4\) grant contributed with 57% of the total

\(^{64}\) The European Regional Development Fund (ERDF) is intended to help reduce imbalances between regions of the Community. The Fund was set up in 1975 and grants financial assistance for development projects in the poorer regions. In terms of financial resources, the ERDF is by far the largest of the EU’s Structural Funds. Source: DG Regional Policy – INFOREGIO Website - glossary
programme cost, while the different partners financed the remaining 43%.
Regarding the implementation of the biomass district heating plant, the total
investment was €515,000.

10. Results

10.1 General results
In general, all the initial objectives of the project were realised. Even though the
energy demand did not vary, the biomass plant allowed 70% savings compared
to the traditional fuel for district heating (natural gas), which in turn contributed
to a reduction in GHG emissions.

10.2 The socio/economic impacts/benefits
The use of this indigenous renewable energy source brings a variety of
advantages. These are primarily environmental, given that it reduces the use of
more polluting fossil fuels, but also social, as supplying the plant with biomass
creates new economic activities in the vicinity. For example, two new direct jobs
were created upon implementation of the plant in the municipality.
Due to the short life of the biomass plant, information is not yet available
regarding the maintenance and operational costs. If considering the price
estimated for the biomass used in the plant determined in one of the feasibility
studies (0.067 €/kg), for the 1,190 tonnes used per year, the cost of the biomass
per year can be calculated to be 79,730 €/year.

According to one of the feasibility studies, the price of energy from natural gas
in the area can be estimated at 0.032 €/kWh [HC, 2005]. If considering the
biomass costs mentioned above, the price of energy produced in the biomass
plant can be estimated at 0.019 €/kWh. This means that the electricity generated
from the biomass plant will be cheaper than the energy generated from natural
gas. This, in turn would lead to a reduction in the energy bill of around 40% in
the long term.
The following results were also obtained:

• Lower dependency on external sources. The biomass plant uses fuel that
can be obtained in the area.
• The economic resources destined to cover the heating costs remain in the
municipality.
• For the population of the area and surrounding municipalities, the biomass
plant will act as a demonstration project. If it works as expected in the
future, it will contribute to increased awareness of the feasibility of
renewable energies and their role in combating climate change.
• A system for the collection of biomass was established through the
implementation of the biomass plant, which may be useful for the future
development of this renewable source of energy in the region.
10.3 The environmental impacts/benefits

The biomass plant will reduce the emissions of CO₂ into the atmosphere. According to APEA, the plant helps to reduce approximately 1,126 tonnes of CO₂ per year.

The collection of forest residues helps to reduce the risk of fire during the dry and hot Spanish summers.

Using the methodology explained in Annex 2, it has been determined that the actualised benefits\(^\text{65}\) of the project outweigh the actualised costs\(^\text{66}\), assuming an interest rate of 3.4\%, an average price of the energy for heating of 0.032 €/kWh, and a project lifetime of 20 years. This means that the project is a cost effective investment, as the economic savings are worth more than the initial capital investment. This is due to the fact that the energy produced by the plant is considerably cheaper that the cost of the energy that will be generated in a plant using natural gas as a fuel, as explained in section 10.2.

As the project is profitable, the cost per tonne of CO₂ avoided is in fact a benefit. Indeed, it has been estimated that the cost per tonne of CO₂ avoided due to the implementation of this project is -11.23 €/tonne of CO₂ (under the assumptions above mentioned). This means that after the payback period (estimated at 12 years in this case), there is no cost associated with the reduction of GHG.

11. Overall renewable energy situation in Ávila and comparison with the national and the European situation

According to the national Spanish 2005-2010 Renewable Energies Plan (PER), 12.1\% of the primary energy consumption for the year 2010 will be supplied with renewable energies. The share of renewable energies in primary energy consumption in 2005 was 6.03\%.

In the autonomous community of Castilla y Leon, where the province of Ávila is located, the share of renewable energies is 11.4\% of the total energy consumption, and 15.7\% in the case of total electricity. In this autonomous community, the electricity output from biomass is 11 MW.

The PER estimates that biomass resources in Spain amount to 19,000 ktoe\(^\text{67}\), of which 13,000 ktoe are associated with residual biomass and 6,000 ktoe with

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\(^{65}\) Actualised benefits: All the annual net savings during the life cycle of the project, expressed in present money value.

\(^{66}\) Actualised costs: Present value of all the annual capital costs during the life of a project.

\(^{67}\) toe (tonnes of oil equivalent)= 11,630 kWh
energetic crops. Nowadays, biomass represents a share of 45% of the renewable energies in Spain, which is equal to 2.9% of the primary energy consumption, including traditional sources of energy.

The PER establishes a new target for 2010 of 5,040.3 ktoe, from which 4,457.8 ktoe/year would be for electricity generation and 582.5 ktoe/year for heating applications. The plant biomass of Las Navas del Marqués would then contribute 0.061% of the target established for 2010. It has been estimated that the amount of CO₂ that will be avoided if these targets are met will be approximately 9 million tonnes, 1,788,326 tonnes of CO₂ per year from biomass for heating purposes. The biomass plant of Las Navas del Marqués would then contribute by approximately 0.06% to the expected amount of CO₂ avoided per year.

In 2005, the primary energy production of solid biomass in Europe was 58,783 Mtoe, with Spain being the fifth major producer.

12. Ongoing applications of the project
At the beginning of the project, it was planned to install a biomass plant to provide heating and hot water, not only to the public buildings of the municipality but also to 623 new dwellings in the municipality. Nevertheless, in the first instance, the mayor preferred to supply only certain municipal buildings and to wait to see the results and development of the plant. If the plant proves to be a sustainable source of heating and the LRAs decide to extend the supply of the plant to the dwellings, it will be necessary to triple and even quadruple the current capacity and heat output of the plant.

In this regard, the mayor of Las Navas del Marqués announced an agreement with different municipalities of the area (El Tiemblo, Cebreros, El Hoyo de Pinares y San Bartolomé de Pinares) in order to increase the amount of forestry residues, and thus the biomass available for the plant through the logging and cleaning activities that are carried out in the forests of such municipalities [Avila Digital, 2007; Avilared, 2007].

13. Key factors for success
Centralized district heating systems supply energy directly to users, avoiding the need for them to oversee their own installations or handle and store fuels. Such systems have a long tradition in countries such as the United States and in the centre and north of Europe (in Denmark and Sweden they provide half of all heating). By contrast, in Spain the installation of such heating grids is still very new.
According to APEA, one of the most important factors contributing to the success of the project was the close collaboration between the different project partners and the local authorities. Also, the contribution from the technicians and specialised consultants that advised and assisted the authorities in the decision-making was essential for the success of the project.

14. Potential for other local/regional authorities to replicate a similar project

According to the APEA and the president of the county council of Ávila, a similar project can be replicated in other municipalities with forestry resources. The use of waste biomass to fuel a district heating network like that described is a replicable alternative. Applications of this kind do not need such a large supply of biomass as other projects, such as electricity generation.

The experience gained through this project can be helpful for other municipalities willing to implement similar projects. The know-how exchange between the municipalities of the region can contribute to the further development and application of renewable energy projects. Nevertheless, European funding was essential for this project, as the technology is expensive due to the limited implementation of this type of energy source to date.

The investment costs depend on the final use of the energy that is produced, with 450 €/kW in the case of domestic heating and 100 €/kW in the case of heating for the thermal uses in the industry. Regarding the cost of the biomass, this will depend on the source, the type of treatment and the transportation that is necessary. The price varies from 60 €/t for large domestic heating to up to 200 €/t for packaged pellets in unfamiliar dwellings.
Therefore, before considering solid biomass for heating or electricity production, it is important to consider the availability of biomass in the area of implementation of the plant, the quality of the material that will be necessary and the associated costs.

**Lessons learned about biomass**

**Drawbacks:**
- Generally low energy content.
- Possible competition for the resource with material applications like particle board or paper.
- Generally higher investment costs for conversion into final energy in comparison to fossil alternatives.

**Advantages:**
- Widespread availability in many areas.
- Contribution to securing of energy supplies.
- Generally low fuel cost compared with fossil fuels.
- Biomass as a resource can usually be stored in large amounts and bioenergy can be produced on demand.
- Creation of stable jobs, especially in rural areas.
- Developing technologies and know-how offer good opportunities for technology exports.
- CO₂ mitigation and other emission reductions (SOx, etc.).
15. Contacts / Acknowledgements

**Organisation:** APEA - Agencia Provincial de la Energía de Ávila- (Energy Agency of the Province of Ávila)

**Type of organisation:** Local authority

**Main activities:**
1. To introduce a culture based on the rational use of energy and a permanent improvement of energy efficiency in all sectors, in order to reduce costs, carrying out campaigns, raising public awareness and providing information on technological advances and regulation.
2. To disseminate different EU initiatives and programs and specially those which promote renewables and energy efficiency (SAVE, ALTENER, ENERGIE 5FW RDT, etc) among public and private enterprises (specially SMEs), as well as consumers and citizens of Ávila. In this field, the Agency will become the referee for those actions concerning tenders, grant application procedures, monitoring and implementation of actions.
3. To disseminate in an efficient way, all the national and regional plans (such as IDAE –Instituto de Diversificacion y Ahorro de la Energía –Plan de promoción de las energías renovables, etc.) in order to promote investments that take advantage of subsidies and incentives.

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16. References

This fact sheet is based on the information provided by the Energy Agency of the province of Ávila, one of the project partners, through means of a questionnaire that was developed in the context of this project and telephone interviews.


[Biorreg-Floresta, 2006] Website of the Project Biorreg-Floresta (www.biorreg-floresta.org/)


<table>
<thead>
<tr>
<th>Reference</th>
<th>Source</th>
</tr>
</thead>
</table>
Building refurbishment with CHP and solar thermal in Frankfurt am Main

Wohnheim GmbH - a social housing company - has gradually modernised its real estate property by following a standard scheme of renovations, which included the installation of solar thermal plants, optimal thermal insulation as well as the use of combined heat and power. Energiereferat Stadt Frankfurt am Main provided advice on how to upgrade these buildings into eco-friendly dwellings.

1. Project’s background

This project, which involved the city of Frankfurt (Energiereferat) and the Wohnheim GmbH (a social housing company), aimed at improving the sanitation of buildings and at developing an exemplary heating system with CHP and solar thermal plants.

1.1 The city of Frankfurt am Main

- Location and population

Located on the Main River, in South-West Germany, Frankfurt is home to circa 650,000 inhabitants. It is the largest city in the German Land Hessen and the fifth largest city in Germany, covering 248.3 km², including 15.4% forests. The average annual temperature is 11°C.
- **Economic activities**
  The former home city of Goethe, Frankfurt is nowadays mostly known for being one of the leading European financial and trading centres. Indeed, more than 300 national and international banks are represented in the Main metropolis. Among others, the European Central Bank and the German Bundesbank have their headquarters in Frankfurt. The gross annual wage/salary per employee is around €33,362 (2005 data).

1.2 *Use of CHP technology and solar thermal systems for the production of energy*

- **CHP-technologies**
  CHP technologies produce both electricity and heat simultaneously from a single fuel at a facility located near the consumer. The process minimises waste by recovering heat that would normally be lost in an electricity generator, and saves the fuel that would otherwise be used to produce heat or steam in a different unit. All types of fuels can be used, even renewables, such as biomass.

- **Solar thermal energy**
  Solar thermal technologies now available on the market are efficient and highly reliable, providing solar energy for a wide range of applications like domestic hot water and space heating in residential and commercial buildings, support to district heating, solar assisted cooling, industrial process heat, desalination and swimming pools. (source: ESTIF - European Solar Thermal Industry Federation)

2. **Scope of the project and objectives**
The main goal of this project was to improve the residential environment and the sanitation of social housings by creating dwellings that will be profitable in the long term. To this end, the project aimed at:

- Installing solar thermal plants on every building to provide hot water in summer.
- Refurbishing the buildings to low energy standards of 60 kWh/m² per annum.
- Switching to natural gas (which can be changed in the future when more renewable fuels are available).
- Developing energy efficiency with a district heating system with CHP.
- Reducing CO₂ emissions by more than 80%.

A total of 200 dwellings, housing approximately 280 inhabitants were targeted with this project.

3. The role and responsibilities of the organisations that participated in the project

The Energiereferat was founded as part of the City’s Environmental Department in 1990. Its aim is to set up and implement the energy and climate protection plan for the City of Frankfurt am Main.

Its work focuses on three fields:
- Office buildings and electricity saving
- Energy planning and CHP
- Residential buildings and renewable energies.

The Wohnheim GmbH is a social housing company which owns residential buildings and which was founded in 1951 by the city of Frankfurt and the Land Hessen. In this project, it set up the installation of decentralized solar thermal plants and a district heating system with a cogeneration unit.

The Energiereferat offers a free consulting service for projects that save energy and CO₂ emissions. The Energiereferat set up several energy concepts for different housing companies to convince them to reduce the energy demands of buildings and to use energy-efficient techniques. Within this framework, it offered advice to the Wohnheim GmbH.

4. Decision-making process

The main reason for the project was the desire of the Director of the Wohnheim GmbH to create dwellings that will still be competitive on the market 30 years from now. The Wohnheim GmbH was the promoter of the project and made all the final decisions.
The main contribution of the Energiereferat took place during the decision-making process phase, when it was decided how the dwellings should be refurbished, and which heat supply system should be installed. Firstly, the Energiereferat carried out a preliminary study to evaluate different concepts for the refurbishment of buildings, in order to see which measures would allow this project to decrease the demand for heat as much as possible and to get the maximum support from the KfW Bankengruppe (KfW banking group) though the CO₂ Building Rehabilitation Programme [KfW, 2007].

The KfW banking group's CO₂ Building Rehabilitation Programme offers the following advantages:

- Partial debt relief for the KfW loan once the level of a low-energy house has been attained.
- Financing of up to 100% of the investment costs including ancillary costs.

Secondly, the Energiereferat calculated the economic and environmental benefits resulting from different versions of heat supply for the remaining heat demand.

It turned out that a Central Boiler, Cogeneration unit and a district heating system with decentralized solar thermal plants was the most favourable solution for the environment and the tenants. Of course, solar thermal plants are not economically favourable for the housing company in the first place. But there are additional values, notably for the tenants, as solar thermal plants provide them with free hot water. This can be considered as a long term competitive advantage in the housing market.

5. Technical aspects of the project

Five decentralized thermal plants, each measuring 51 m² were installed to supply domestic hot water. This represents 1.3 m² of solar thermal plant per dwelling and will be enough to provide 40% of the domestic hot water that is needed. The solar thermal plants produce 70,000 kWh/a.

Furthermore, a CHP unit with a capacity of 30 kW (electrical) and 60 kW (thermal) was installed, together with a boiler for peak demand that has a capacity of 390 kW to provide heating for the buildings. Forty per cent of the electricity that is used could be provided by the CHP unit only. As a matter of fact, all the electricity that is produced goes to the grid, because of a lack of legal regulation. This means that it is not possible for the housing company to deliver and sell electricity to its tenants directly.

Finally, the buildings were refurbished to low energy standards (60 kWh/m²a) and the energy source used was natural gas. This type of energy was chosen as it
will be easy to switch to renewable energies when these are more developed in the future.

**Figure 2 - A view of the building**

Source: [Energiereferat, 2007]

**Figure 3 - A view of the boiler**

Source: [Energiereferat, 2007]

6. **Citizens' attitude to the project**

Approximately 280 dwellers benefit from these facilities and enjoy a lower electricity bill thanks to the low energy standards that have been used for refurbishment, and the free domestic hot water in summer that is heated by the solar thermal plants. Furthermore, solar thermal plants are discreet and not visible (they are placed on the roofs). These factors contributed to the acceptance of the project. Indeed, no opposition to this project was encountered. It seems that people supported the project, because they had the feeling that the housing company cared for the environment. This project contributed to improve the image of the neighbourhood among dwellers.

7. **Implementation and project life span**

The project began in 2002 and was completed in 2004.

8. **Problems and obstacles**
In the first place, the promoters of this project wanted to sell the electricity produced by the CHP unit directly to the tenants. This was not possible for legal reasons. The German feed-in system, called the KWK-Gesetz (CHP-Law) guarantees producers of CHP-power a fixed price per kWh fed into the grid. Small units which produce under 50 kW of electricity, such as these, receive about €11ct/kWh in Germany. If it was possible to sell it to tenants, it would increase the profit to €18ct/kWh

9. Costs and funding of the project

The following table summarises the investment costs of the project.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cost (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar thermal Plants</td>
<td>€180,000</td>
</tr>
<tr>
<td>District heating line</td>
<td>€55,000</td>
</tr>
<tr>
<td>Central heating station</td>
<td>€170,000</td>
</tr>
</tbody>
</table>

The main source of funding for this project was the organisation KFW under the programme the CO₂ Reduction Programme (CO₂ Gebäude Sanierungsprogramm). This programme primarily targets energy saving measures in buildings. Renewable energy technologies for heating purposes may also benefit (however, the credit volume for renewable energy installation was only 2% of the total credit volume awarded). Loans are provided with an interest rate 2% below market interest level.

The investment cost for the solar thermal plants was €670 - 740 /m² (without VAT). For the district heating system, the price was approx. €200 /m for the pipeline. The total cost of the project was approx. 606 Euro/m². The total cost for energy related measures was approx. 240 €/m².

Including:
- 105 €/m² for thermal insulation (without windows - only roof, walls and ceiling of cellars).
- 85 €/m² for solar thermal plant, radiators, heating pipes, heating installations in the building.
- 50 €/m² for central heating station and district heating system.

The rest of the money was spent on other refurbishment work which had nothing to do with energy aspects. The payback period for the CHP unit is 8 years if the electricity is delivered to the grid, if the electricity could be sold to the tenants it would be 4 years.

10. Results

10.1 General results
All technical objectives were fulfilled, except that the electricity that is produced by the CHP plant goes to the grid instead of going to the tenants. 40% of the hot water that is used can be heated by the solar thermal plants, which produce 70,000 kWh during the warmer months.

10.2 The socio/economic impacts/benefits

Thanks to the refurbishment of the buildings and the use of solar thermal plants to heat water, tenants have seen their energy bill decrease.

10.3 The environmental impacts/benefits

According to Energiereferat Stadt Frankfurt am Main, all these measures together - low energy standard, CHP-unit and solar thermal plants- lead to a CO₂ reduction of 734 tonnes per year. This means CO₂ emissions have been reduced by 80%.

Using the methodology explained in Annex 1, and based on the data from the EcoInvent database (assuming an emission factor of 0.24 kg CO₂ for kWh of heat produced from natural gas, 0.312 kg CO₂ for kWh of heat produced from oil, and 0.46 kg CO₂ for kWh of heat produced from coal), the solar thermal plants avoid the emission of 23 tonnes of CO₂ per year. The solar plants can potentially generate 116,025 kWh annually (considering a thermal efficiency of 455 kWh/m²), which would be equal to 38 tonnes of CO₂ avoided.

Using the methodology explained in Annex 2, it has been estimated that the cost per tonne of CO₂ avoided by the solar thermal plants would be €13.04 (considering the potential annual energy production for water heating of 116,025 kWh, 20 years of operation, and assuming an interest rate of 1.4% and an average price for heating of 0.08 €/kWh68).

11. The overall renewable energy situation in Frankfurt am Main and comparison with the national and European situation

In Frankfurt, 240 GWh of electricity is produced locally from RES, which represents 5% of the local electricity demand. The City’s goal, as founding member of the “Climate Alliance”, is to reduce its CO₂ emissions by 50% by 2010.

The RES-E target to be achieved by Germany in 2010 is 12.5% of gross electricity consumption (10% of total energy consumption by 2020 and 20% of

68 The average price for energy for heating in Germany in the first semester of 2007 was 0.08€/kWh [Eurostat, 2007]
electricity consumption). In 2004, the annual installed surface of solar collectors was 780,000 m², a figure that increased by 25% in 2005. The installation of the 255 m² through this project in Frankfurt am Main would represent 0.032% of the total capacity installed in Germany in 2004. In Europe, the share of renewable energies in gross electricity consumption in 2005 was 13.97% (target of 21% established for 2010).

12. Key factors for success
This project was a success mainly thanks to the strong support it received from stakeholders, and notably thanks to the commitment of the Director of the housing company, who wanted his company to be competitive in the future. This is the reason why the refurbishment of all buildings is done using low energy standards and making the heating supply as efficient as possible.

13. Potential to replicate a similar project by other local/regional authorities
The initiative could be easily replicated anywhere else in Europe. It should be possible to find a solution to sell the electricity to the tenants; which could contribute to increase profits. This project shows that even in Central Europe, where there are less hours of sun, the installation of solar thermal plants represents an interesting opportunity to replace fossil fuels and fight climate change.
14. Contacts / Acknowledgements

**Organisation:** Energierreferat Stadt Frankfurt am Main  
**Type of organisation:** departement of the administration of a local authority  
**Main activities:**  
The Energierreferat was founded as part of the Cities Environmental department in 1990. Its aim is to set up and implement the energy and climate protection plan for the City of Frankfurt am Main.  
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Website: www.energiereferat.stadt-frankfurt.de

15. References

This fact sheet is based on the information provided by Energierreferat Stadt Frankfurt am Main (Energy department of the city of Frankfurt am Main), one of the project partners, through means of a questionnaire that was developed in the context of this project and telephone interviews.

[Europa] Europa Website. Available at:  
http://europa.eu/abc/european_countries/eu_members/germany/index_en.htm

[RFRM] Website of the Region of Frankfurt-Rhein-Main website. Available at: http://www frankfurt-rhein-main.de/

[kfW] Website of the KfW banking group. Available at:  
http://www.kfw-foerderbank.de/EN_Home/Housing_Construction/KfWCO2Buil.jsp for more information

[Energierreferat] Website of Energierreferat Stadt Frankfurt am Main Frankfurt (energy department of the city of Frankfurt). Available at:  
http://www.energiereferat.stadt-frankfurt.de/
Aberdeen Farmhouse Heat Pumps

Ground Source Heat Pump (GSHP) systems were installed in six “hard to heat” farmhouse properties on the outskirts of Aberdeen, North East Scotland. The objective of this pilot project, led by the Aberdeen City Council and company SCARF (Save Cash and Reduce Fuel) was to determine whether GSHP systems are a means to achieve “Affordable Warmth” in this kind of housing. Affordable Warmth is defined in Aberdeen City Council Fuel Poverty Strategy as “No more than 10% of a householder’s disposable income needs to be spent on fuel in order to cover the cost of heating up to 16 hours per day, along with light and power”. Results were available for four farm houses, and proved that GSHP systems were a good way to achieve affordable warmth.

1. Project’s background

Aberdeen is located in the North East of Scotland in an area known as as the Grampian region, which now comprises the unitary authorities of Aberdeen City, Aberdeenshire and Moray Councils. This area has approximately 500,000 inhabitants, of whom approximately 40% live in Aberdeen which is the largest town. Local business in the countryside is mainly tourism and agriculture, while the major income in the city is based on the offshore oil industry. The annual average temperature is 7.9 °C.
More than 20 farmhouses properties, situated on the outskirts of Aberdeen, are
owned by the Aberdeen City Council. Most of the properties are detached, solid
wall, and are exposed to the elements. They have had little or no insulation
added since they were built pre-1900 and are heated by a mix of solid fuel,
electric storage or stand-alone electric heaters. All properties are off the main
gas network and can therefore be considered as “hard to heat”.

“Affordable warmth” is achieved when “no more than 10% of a householder’s
disposable income needs to be spent on fuel in order to cover the cost of heating
up to 16 hours per day, along with light and power” was unlikely to be achieved
using oil, or electric heating systems. Since it was not practicable to extend the
gas network to any of the properties, alternative options of wood fuel and GSHP
systems were considered.

**GSHP**
Ground Source Heat Pump is the name for a broad category of space
conditioning systems that employ a geothermal resource – the ground,
groundwater, or surface water – as both a heat source and sink. GSHPs use a
reversible refrigeration cycle to provide either heating or cooling. GSHPs
operate in much the same manner as air-source heat pumps. Both use a
compressor to move refrigerant around a closed loop, transferring heat between
an indoor coil and another coil where heat is absorbed or rejected. As the name
implies, an air-source heat pump (ASHP) uses outside air, flowing over its
outdoor coil, as the heat source and sink. The main drawback of ASHPs is that
their performance depends on ambient air temperature, which can vary by as
much as about 40° C over a year. Both the capacity (i.e., the ability to produce
heating and cooling) and efficiency of an ASHP are significantly reduced at the extreme temperatures experienced in summer and winter. A GSHP system, on the other hand, uses a geothermal resource as its heat source and sink: the earth itself, a body of surface water, or water from a subsurface aquifer. Unlike ambient air, the temperature of the earth, beginning just five to 3 meters below the surface, is relatively constant, and provides a much better heat source and sink for a heat pump. The same is true for water from subsurface aquifers, as well as water from surface bodies at only slightly greater depths. The geothermal resource is generally cooler than outdoor air in the summer and warmer in the winter. For this reason, GSHPs are more efficient than air-source heat pumps.

The technical feasibility of GSHPs depends on the availability of geothermal resources and the specifics of the application. Given an ample supply of ground water (and an acceptable means of disposing of it), an open-loop system may be a viable option. Such systems usually include a plate heat exchanger to transfer heat between the ground water and a common water loop inside the building; zone heat pumps exchange heat with the common loop. Surface water from lakes and streams can also be used in an open loop system, but applications are usually limited to warmer climates, or to cooling-only applications in colder climates.

In closed-loop designs, the earth itself can be used as the heat source and sink by way of vertical or horizontal ground-coupled heat exchangers. Most large systems use vertical heat exchangers, which consist of polyethylene u-tube pipes in deep boreholes. Horizontal loops require more land area, but are usually less costly to install, depending on the type of soil and rock formations encountered at the site. Closed loops can also be located in lakes, ponds and other bodies of surface water.

**Figure 2 – Photo of the Hillhead of a GSHP system**
2. Scope of the project and objectives

After assessing the options, taking into account the fuels available, current market conditions, and sources of external funding, the Aberdeen City Council decided to pilot the installation of GSHP systems wet central heating systems in six farmhouse properties with the objective of determining whether they would achieve affordable warmth in such properties.

In order to evaluate the pilot project in terms of affordable warmth, the tenants agreed to have the actual running costs of the properties independently monitored for 12 months post installation. All tenants agreed to collaborate, however one of them later on didn’t participate in the project.

3. The role and responsibilities of the organisations that participated in the project

- **Aberdeen City Council**
  Owner of the farmhouses, Aberdeen City Council participated in the project by co-funding, planning, tendering and managing the energy assessment of the houses.

- **EST (Energy Saving Trust)**
  The EST is a non-profit organisation, funded both by government and the private sector. It is one of the UK's leading organisations, set up to address the damaging effects of climate change and has offices in England, Scotland, Northern Ireland and Wales. Its aim is to cut CO₂ emissions by promoting the sustainable and efficient use of energy.
  The EST manages the Scottish Executive’s Scottish Community and Householder Renewable Initiative (SCHRI), which provided funding and officer support for the project.

- **SCHRI (Scottish Community and Householder Renewable Initiative)**
  The SCHRI is a one-stop shop offering grants, advice and project support to assist the development of new community and household renewable schemes in Scotland.
  The SCHRI is funded by the Scottish Executive and managed jointly by the Energy Saving Trust and a private company named Highlands and Islands Enterprise (HIE). The objectives of SCHRI are:
  - To support the development of community scale renewable projects
  - To support the installation of household renewables
  - To raise awareness of renewable technologies and their benefits to Scotland
The SCHRI Project Development Officer for North East Scotland is employed through SCARF (which is part of the EST Energy Efficiency Advice Centre Network).

**SCARF (Save Cash And Reduce Fuel)**

SCARF is a company limited by guarantee and a registered charity. Established in 1985 as an Urban Aid funded project in Aberdeen, SCARF today has 45 employees and aims to work through partnership to promote sustainable use of energy, eradicate fuel poverty and create sustainable employment and training opportunities. SCARF carried out the monitoring of the project.

A contract was established with a heat pump manufacturer for the supply and installation of the GSHP systems (case of contracting).

4. **Decision-making process**

The main driver for conducting this project was the necessity to reduce the cost of fuel in this type of housing, where standard solutions to insulate the envelope of the building are not possible. There are thousands of examples of this type of property throughout Scotland where there is no relatively low cost solution to reduce energy demand. These properties have no or little loft space. Tenants and owner-occupiers find it increasingly difficult to provide adequate warmth to maintain healthy temperatures at an affordable cost. While it is accepted that it is better to insulate the envelope before installing GSHP systems, this can not always happen given the budget of the local authority and maintenance plans. Therefore until the time when these properties can be insulated properly, it was hoped that GSHP systems could be a feasible alternative for reducing running costs (and carbon emissions) over the fossil fuel alternatives.

This was the first GSHP installation in social housing of any kind in the area so there was also much to learn for the technical officers of the Local Authority and other Housing Providers.

SCARF could find no example of heat pumps being installed in “Hard to Heat” housing anywhere in the UK (or in Europe), therefore there was an opportunity for installers of GSHP systems in the UK to learn whether this is a viable option in these circumstances.

The final decision to launch the project was taken by Janice Lyon, Home Energy Co-ordinator in the Aberdeen City Council.

5. **Technical aspects of the project**

The properties were off the gas network, so when the City Council looked at
trialling renewable alternatives, the only options available at the time were wood-fuel and GSHP systems. Due to difficulties in obtaining wood pellets and storage issues amongst other issues, the council felt at the time that a GSHP system was the best option. The availability of grant funding for renewables made GSHP systems a more economical choice to the local authority than oil. The table below provides technical information on the project:

Figure 3 – Technical information about the project - Case Study on Social Housing Heat Pumps

<table>
<thead>
<tr>
<th>Property:</th>
<th>six hard to heat farmhouses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor space:</td>
<td>79m² to 150m²</td>
</tr>
<tr>
<td>System:</td>
<td>5.7 and 9kW heat pumps</td>
</tr>
<tr>
<td>Heat collection:</td>
<td>trenches</td>
</tr>
<tr>
<td>Heat distribution:</td>
<td>radiators</td>
</tr>
<tr>
<td>Hot water:</td>
<td>165-ltr tanks (integrated)</td>
</tr>
</tbody>
</table>

Source: [Ice Heating, 2007]

- **Monitoring methodology**
  
  Prior to the installation of the GSHP system, the six tenants agreed to allow SCARF regular access to collect electric meter readings, i.e. information on electricity consumption, and to provide verbal information about deviations on heating patterns between meter readings e.g. decreased consumption due to the property being empty while away on holiday, increased consumption due to visitors staying or particularly cold weather.

  To allow time for the tenants to become familiar with GSHP systems and to minimise the impacts of any initial or post-installation snags, it was decided to wait a few months after the systems were installed before beginning to collect the meter readings.

  For the first few months of monitoring, SCARF advisors visited the properties to take the meter readings and discuss with the tenants how they were finding the new systems. As time progressed, the tenants became confident to take meter readings themselves and phone them back to SCARF. To ascertain accuracy on tenants’ meter readings, advisors asked tenants to provide the readings from the meter screens that showed the standard units, the off-peak units and the total units used. SCARF advisors visited the tenants at least every 2 months to check readings.

- **6. The citizens' attitude to the project**

  According to the SCHRI Project Development Officer, the six tenants involved in the project were all very sceptical of the Heat Pump Technology during the first visit but finally they agreed, with the thought that it could not be worse than
what they had.

One of the tenants needed more persuasion to agree to participate. No pressure was put on them to accept the system as the Council had a list of over 20 houses to choose from. The Council chose the properties that had very low NHER Energy Ratings\(^6\) and/or were most in need of new heating.

All agreed to go forward to the tendering stage with one in particular waiting to find out more about the technical and logistical aspects of installation before fully committing. After the tender was complete, all participants were visited again to confirm whether they still wanted to proceed and it was confirmed at this stage that all were willing to participate.

7. Implementation and project life span

The project started in May 2004 and was completed in July 2006. The different phases of the project are listed in the table below:

---

\(^6\) National Home Energy Ratings (NHER) give a building a score of 0-10, with 0 demonstrating the worst energy efficiency and 10 excellent. NHER surveys were carried out before and after installation. Without the heat pump, all but one of the farmhouses scored less than 3. More information: http://www.nher.co.uk/
Table 1 – Project’s phases and their implementation date

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start date</th>
<th>End date</th>
<th>Cause of delay if any</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying houses and tenant agreement</td>
<td>January 2004</td>
<td>June 2004</td>
<td>N/A</td>
</tr>
<tr>
<td>Tender process (towards the heat pump manufacturers)</td>
<td>May 2004</td>
<td>September 2004</td>
<td>N/A</td>
</tr>
<tr>
<td>Grant application</td>
<td>September 2004</td>
<td>December 2004</td>
<td>N/A</td>
</tr>
<tr>
<td>Installation</td>
<td>January 2005</td>
<td>March 2005</td>
<td>There was a delay in completing some of the works due to the fact that the Electric Distribution Network Operator insisted that upgrading the electric supply was required at some of the properties and their lead time to carry out these works was around 6 - 8 weeks</td>
</tr>
<tr>
<td>Monitoring</td>
<td>July 2005</td>
<td>July 2006</td>
<td>N/A</td>
</tr>
</tbody>
</table>

N/A: Not Applicable

**Promotion of the project**

In Scotland awareness of GSHP systems is very low so there was great interest in this pilot experience. The following actions were implemented to promote the project:

- After the installation of the GSHP systems, visits were arranged for key staff from the Local Authority and other Social Housing Providers.
- Further to this, through the SCHRI (who provided the majority of the funding), site visits were offered to Social Housing Providers across a wider area of Scotland. This was a successful initiative, as people from around 14 different organisations were represented.
- The SCHRI Project Development Officer gave a presentation on the project at a large renewable conference in the South of Scotland.
- The Home Energy Co-ordinator at Aberdeen City Council presented the project at the HECA Forum, which is a Scotland Wide Forum for officers who have responsibility in their region for reducing energy demand / carbon emissions.
8. Problems and obstacles

The table below summarises the main problems encountered and how they were overcome:

<table>
<thead>
<tr>
<th>Barrier/Problems</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer's instructions for controlling the system were complicated and not</td>
<td>SCARF published their own simplified pictorial instructions on how to control heating and hot water</td>
</tr>
<tr>
<td>easy to understand</td>
<td></td>
</tr>
<tr>
<td>Tenants were wary and unsure of this new technology</td>
<td>SCARF visited tenants at home at the very beginning of the project to explain GSHP, and left them a fact sheet and a case study. They also gave a contact number for a local advice centre for impartial advice.</td>
</tr>
<tr>
<td>Tenants were worried about costs</td>
<td>Indeed, as there were no similar installations to compare against to allay fears, it was a step into the unknown. This was one of the reasons why SCARF asked the heat pump companies to give their predicted running costs as part of their tender return.</td>
</tr>
</tbody>
</table>
9. Costs and funding of the project

The total estimated capital cost of the project was £76,274, i.e. about €701 09,800 (2007)

- Sources of funding:
  - Aberdeen City Council: £12,000, i.e. about €17,280 (2007)
  - Scottish Community and Householder Renewable Initiative: £62 105, i.e. about €89,430 (2007)
  - Scottish Power: £5,000, i.e. about €7,200 (2007)

- Breakdown of costs
  - Loft/Cavity Wall Insulation Works: £2,000, i.e. about €2,880 (2007).
  - Council approval and tendering process: £1,250 i.e. about €1,800 (2007).
  - Upgrade of electricity supply to the 6 farmhouses: £10,134 i.e. about €14,593 (2007).
  - Install 6 x GSHP: £62,872.93 i.e. about €90,537 (2007).
  - Installation of heat distribution system: £16,098.07 i.e. about €23,181 (2007).
  - TOTAL: £92,355, i.e. about €132,991 (2007).

The final total cost was higher than initially estimated because of unexpected costs of upgrading the electrical supply in some of the properties. The cost of heat pumps was also higher than indicative figures usually quoted by companies and government web sites.

10. Results

10.1 General results

Two properties were excluded from the monitoring report. In one case, it was not possible to fully differentiate the domestic element from the business consumption, and the other one withdrew its cooperation.

Of the four remaining properties, 12 months data is available for two, 8 months data for one and 6 months for the fourth property (this was due to tenants moving out). By comparing the changes in consumption at the properties where 12 month data was available, which took into account seasonal variations, an estimated annual consumption was calculated for the properties for Westside of Carnie and Fernhill where 8 and 6 month data was available. The table below details the actual annual consumption and fuel cost calculation for the GSHP system, together with the minimum annual disposable income required by the

---

70 Exchange rate as of December 2003 : 1 £ for 1.44 €
ANNEXES

household in order to achieve affordable warmth:

**Table 3 – Fuel consumption and “affordable warmth” related calculations**

<table>
<thead>
<tr>
<th>Property</th>
<th>GSHP Consumption Actual Consumption</th>
<th>GSHP Fuel Costs €</th>
<th>Affordable Warmth Minimum Net Annual Income Required (Dec 2003) €</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard rate units</td>
<td>Off-peak rate units</td>
<td>Total</td>
</tr>
<tr>
<td>Woolhillock Farm</td>
<td>6,612</td>
<td>5,028</td>
<td>11,640</td>
</tr>
<tr>
<td>Hillhead of Pitfodels</td>
<td>13,416</td>
<td>9,502</td>
<td>22,918</td>
</tr>
<tr>
<td>Westside of Carnie</td>
<td>9,754</td>
<td>6,821</td>
<td>16,575</td>
</tr>
<tr>
<td>Fernhill Farm</td>
<td>12,351</td>
<td>8,980</td>
<td>12,131</td>
</tr>
</tbody>
</table>


Based on the information gathered during the monitoring, and assuming that household net income exceeds that in the table above, it can be concluded that these GSHP systems have achieved affordable warmth for the tenants.

- **Tenants were satisfied with the new heating system.**

The installed heating systems have external and internal sensors to control the temperatures in the properties. The temperatures are set and controlled by a programmer on the heat pump unit. Feedback from all tenants throughout the monitoring indicates that they were happy with the heating levels in all areas of the property.

There were one or two issues with placements of the sensors during December at Hillhead of Pitfodels but this did not have any significant effect on the one property. The temperature setting on the heat pump unit was checked on each visit by the SCARF advisor, allaying this with the feedback from the tenants themselves we can safely assume the properties were heated to adequate temperatures throughout the day.

After installation of the heat pumps, all the farmhouses had a respectable average NHER score of 6.75 (compared to less than 3 before the installation).
10.2 The socio/economic impacts/benefits

- GSHP systems reduced fuel costs by more than 40% in the four farmhouses under study

By installing the GSHP systems instead of electric or oil systems, fuel costs were reduced by more than 40% in each property. The table below provides details of annual running costs for traditional electric or oil heating systems and the actual running costs for the GSHP system together with the % annual fuel cost savings for each property.

<table>
<thead>
<tr>
<th>Property</th>
<th>Annual Cost (€ May 2007)</th>
<th>% Annual Fuel Cost Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electricity</td>
<td>Oil</td>
</tr>
<tr>
<td>Woolhillock Farm</td>
<td>1,672</td>
<td>992</td>
</tr>
<tr>
<td>Hillhead of Pitfodels</td>
<td>4,535</td>
<td>1,875</td>
</tr>
<tr>
<td>Westside of Carnie</td>
<td>2,481</td>
<td>1,382</td>
</tr>
<tr>
<td>Fernhill Farm</td>
<td>4,362</td>
<td>1,743</td>
</tr>
</tbody>
</table>


Tenants at Woolhillock and Westside of Carnie, both of whom had total electric storage heating installed prior to the GSHP installations, expressed great satisfaction with the new heating system both in terms of heat provided and costs.

The other two tenants indicated that they were happy with the heating but it is not possible to compare costs before and after GSHP installation because one was new to the property and the other property did not have its own domestic meter prior to the installation of the GSHP system as the domestic electricity was supplied via the farm meter.

Also it has to be noted that in terms of installation costs, GSHP systems are currently more expensive to install than the traditional oil, LPG, or electric wet or electric storage systems. In assessing the value for money the capital investment costs and whole life cycle of the system need to be taken into account when looking at the overall cost-effectiveness of this system. Since the operating costs of GSHP systems are considerably lower than the ones for oil, LPG or electricity, it is likely to be cheaper to have a GSHP system in the longer term.

This pilot project did not enable any direct job creation, however a local heating
and plumbing company was used to install systems so it gave them an opportunity to get involved in this potential new market.

In terms of technological innovation, as far as the SCHRI project Development Officer is aware, this was the first installation of heat pumps in houses with high heat loss.

10.3 The environmental impacts/benefits

According to Ice Heating, the company which installed the heat pumps in the farmhouses, GSHP systems enabled approximately 75% annual CO₂ emissions savings, compared to standard electricity mix.

For 2 of the 6 properties, no accurate data was obtained therefore consumption at these 2 properties is not included. During the monitoring period the total annual consumption for all electricity used (in the 4 properties) was 63,714kWh. The project development officer estimated approximately 15%-20% of this figure would be for power and lighting in the house.

The before and after carbon emissions have not been calculated as this project was primarily about affordable warmth for occupants and therefore looking at the financial cost of installing and running a heat pump system. Prior to the installation, an energy audit was carried out at each property and NHER Surveyor 3 programme was used to calculate, amongst other things, predicted CO₂ savings. With the new heating system and improved insulation, the combined annual reduction in CO₂ across all properties in this project was calculated to be \textbf{112.5 tonnes per annum}. This assumed each property was being heated to a standard heating regime. It would however be reasonable to expect the actual figure to be a bit lower than this because, due to the high running costs, the occupiers are unlikely to be heating their homes sufficiently and will have a lower heat load than with a standard heating regime. This figure may also be affected if the actual COP\textsuperscript{71} of the heat pumps differs from the figure assumed by the NHER surveyor programme.

Using the methodology explained in Annex 2, it has been determined that the actualised benefits\textsuperscript{72} of the project outweigh the actualised costs\textsuperscript{73}, assuming an interest rate of 3.4% and a project lifetime of 30 years. This means that the

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\textsuperscript{71} Coefficient of performance (COP). It is defined as the ratio of heat delivered by the heat pump and the electricity supplied to the compressor.

\textsuperscript{72} Actualised benefits: all the annual net savings during the life cycle of the project, expressed in present money value.

\textsuperscript{73} Actualised costs: Present value of all the annual capital costs during the life of a project
project is a cost effective investment. As the project is profitable, the cost per tonne of CO₂ avoided is in fact a benefit. Indeed, it has been estimated that the cost per tonne of CO₂ avoided due to the implementation of this project is −1.48 €/tonne of CO₂ (under the assumptions above mentioned). This means that after the payback period, there is no cost associated with the reduction of GHG, and that overall, the project would result in net savings.

11. Overall renewable energy situation in Aberdeen and comparison with the national and European situations.

The current share of overall renewable energy production in Aberdeen territory is assumed to be less than 1%, according to SCARF. Generally speaking, according to EurObserv’ER 2006, there were 550 GSHP systems representing a total power of 10,2 MW\textsubscript{th} in the UK in 2006. The total number of installed GSHP in the EU in 2006 was 455,435 units, for a total capacity of 5,379 MW\textsubscript{th}.

12. Ongoing applications of the project

There were no tangible impact on the population at large, but there was increased awareness of energy matters for the tenants involved. Friends and relatives of the tenants have become aware of Heat Pumps. Indeed anecdotal evidence suggests that at least 2 friends/relatives installed Heat Pumps after seeing and experiencing the system. One of the tenants moved out and planned to install GSHP in the new house.

Aberdeen City Council now intend to install GSHP in all their remaining farm properties that are off the gas supply network. Further to this, the project contributed to increase awareness within Social Housing Providers.

13. Key factors for success

In the first instance, the visits to the tenants in their homes by an impartial energy advisor to explain the heating system and work involved was probably a major factor in achieving 100% agreement from the first five tenants chosen. Giving the tenants the information required to make an informed decision helped to make them feel part of the process. Therefore, according to the project manager, involving the tenants and keeping them informed throughout is important.

In general, grant funding and having support from the local authority, and SCHRI Development Officer, were key factors in driving the project forward. Also, a lot was learnt about the technical issues surrounding heat pumps, such as checking electric supply capacity beforehand, what to include in the tender’s technical specifications, the limitations of heat pumps, the both internal and
external space requirements.

14. Potential to replicate a similar project by other local/regional authorities

According to the project development officer, the installations appear to provide a more affordable heating system, but before fully committing to such a statement he recommends carrying out similar work with a more robust monitoring methodology.

So it is recommended that when assessing the most suitable replacement heating system to be installed in similar properties that:

- GSHP is considered along with the household net income to ensure that the occupants can afford to heat the house by using 10% or less of their net income.
- Prior to installation the following assessments must be carried out:
  - Current and expected future fuel use and costs
  - Heat loss
  - Installation of data loggers or alternative methods.
  - Employed to measure the heating and hot water consumption
  - Installation of data loggers, and/or routine monitoring of information from actual fuel bills, post installation, to check on actual fuel consumption and costs
- Estimated running costs should be supplied to the occupants prior to installation to enable them to make an informed decision on the type of heating system to be installed in their home.

The results of this monitoring clearly show that GSHP systems can be used to achieve affordable warmth for occupants of hard to treat and/or hard to heat properties that are off the gas network.
15. Contacts / Acknowledgements

**Organisation:** SCARF – Save Cash And Reduce Fuel  
**Type of organisation:** Company limited by guarantee and registered charity  
**Main activities:**  
Established in 1985 as an Urban Aid funded project in Aberdeen, SCARF today has 45 employees and aims to work through partnerships to promote sustainable use of energy, eradicate fuel poverty and create sustainable employment and training opportunities. SCARF carried out the monitoring of the project.

**Contact Information:**
Kevin CHRISTIE, Technical Officer, Renewables Connection  
1 Cotton Street, Aberdeen, AB11 5EE  
Tel: +44 01224 213005  
Email: kchristie@scarf.org.uk

16. References


Pilot implementation of biodiesel mixtures in public transport buses in Crete

The project consisted in a market assessment of the available quantities of used vegetable oils in Crete and a pilot implementation and scientific monitoring of the use of biodiesel made from these used oils in buses in Eastern Crete. Compared to buses using standard diesel, the emissions monitored for the 2 pilot buses using biodiesel showed reductions of smoke density, and in hydrocarbons, NOx, CO₂ and CO emissions. This pilot project proved the technical feasibility of introducing biofuels in public transport in Crete and showed that if implemented on a larger scale it could in the future contribute to:

- Increasing the security of the island's energy supply
- Creating a biodiesel market in the transport sector
- The establishment of fried oil collection companies
- The installation of a biodiesel production plant.

1. Project background

The project took place in the Greek island of Crete, which has a population of 606,000 inhabitants (urban 41.5%, semi-urban 12.3%, rural 46.2%). Crete is the largest of the Greek islands at 8,336 km² and the fifth largest island in the Mediterranean.

Crete is a popular tourist destination; its attractions include the Minoan sites of Knossos and Phaistos, the classical site of Gortys, the Venetian castle at Rethymno, and the Samaria Gorge, as well as many other natural sites, monuments, and beaches. Indeed, it received in 2005 over 3 million arrivals (average stay = 2 weeks). The capital is Heraklion.

The economy of Crete, which was mainly based on farming, began to change visibly during the 1970s. While an emphasis remains on farming and stock breeding, due to the climate and terrain of the island, there has been a drop in manufacturing and an observable expansion in its service industries (mainly
tourism-related). All three sectors of the Cretan economy (agriculture, processing-packaging, services), are directly connected and interdependent. The island has a per capita income close to 100% of the Greek average, while unemployment is at approximately 4%, half of that of the country overall. As in other regions of Greece, olive growing is also a significant industry; a small amount of citrons are still cultivated on the island.

![Map of Crete](image)

**Figure 1 – Location of Crete**

2. **Scope of the project and objectives**

The objectives of the project were as follows:

- The integration of biodiesel\(^{74}\) in public transport in Crete.
- The familiarisation of transport providers with biodiesel in Crete.
- Extending experience and know-how of biodiesel technology to the transport organisations and the relevant authorities.
- Recording valuable results by scientifically monitoring the buses using biodiesel mixtures.
- Raising awareness amongst the relevant stakeholders and the general public thanks to information and dissemination campaigns.

3. **The role and responsibilities of the organisations that participated in the project**

The project was led by a public body, the Regional Energy Agency of Crete (REAC), who was also the project manager. The REAC organised meetings and workshops and ensured the cooperation of very important regional and national

\(^{74}\) Fuel produced from renewable biological resources such as plant biomass and municipal and industrial waste
actors: public authorities, transport organisations and institutions. It was responsible for the planning, development, implementation, evaluation and dissemination of the project. The REAC guided all the involved actors, and performed promotional campaigns through press releases, brochures and leaflets, radio and TV broadcasts, special labels on buses, etc. Other partners and their role are summarised in the table below.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Role in the project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Bus Company of Eastern Crete</td>
<td>Contributed with two buses using biodiesel mixtures. Drivers and technicians were involved in the project.</td>
</tr>
<tr>
<td>Heraklion Technical Vehicle Control Centre</td>
<td>Emission measurement of the buses using biodiesel mixtures</td>
</tr>
<tr>
<td>National Technical University of Athens</td>
<td>Emissions measurement, lubricants and fuel analyses</td>
</tr>
<tr>
<td>Directorate of Transport of Heraklion Prefecture</td>
<td>Participation in the Steering Committee</td>
</tr>
</tbody>
</table>

**4. Decision-making process**

Being a famous tourist destination, Crete produces a very large quantity of used vegetable oils (fried oils), especially in summer. These fried oils can be used as feedstock for biodiesel production. Considering that Crete does not have enough available fields for energy cultivation, the collection of fried oils and the implementation of biodiesel production plants could be a valuable perspective, from both business and environmental points of view.

The Public Bus Company of Eastern Crete had already expressed its interest in alternative fuels – especially biodiesel- and its willingness to implement an innovative project in this field. The Regional Energy Agency of Crete, in the framework of the implementation and promotion of the European Directive for Biofuels, took the decision of implementing a pilot project for the use of high biodiesel mixtures into the public transport buses in Eastern Crete. To this end, the REAC created and implemented a working programme over many months for testing and evaluating in real conditions.
5. Technical aspects of the project

■ Implementation of biodiesel mixtures in public transport buses, emissions monitoring and lubricants and fuel analyses

A high level of 20% biodiesel was used in two public buses in Heraklion, following European specifications EN 14214 on biodiesel and EN 590 on regular diesel. Mixing was done in separate tanks and the fuelling was implemented directly from the special tanks (for each blend). No modifications of the bus engines were implemented. Detailed mechanical & technical control and service of the buses was implemented before, during and after each biodiesel mixture implementation.

The partners participated in two training courses in Austria (pioneer country in the use of biodiesel in vehicles), in order to acquire the necessary technical skills to conduct the project:

• “Biodiesel operation and evaluation in experienced fleets”: followed by the supervisor of the Heraklion Technical Vehicle Control Centre.
• “Quality Controls in Authorised Institutes”: followed by an expert of the Regional Energy Agency of Crete.

A seven-month special monitoring and control procedure was implemented, to check the technical and environmental performance of the 2 buses. The Technical Control Centre was in charge of opacity (smoke density) measurements, and the National Technical University of Athens took care of measuring hydrocarbons, nitrogen monoxide, NOx, O2, CO and CO2 emissions.

■ Market analysis for the use of biodiesel

The market analysis of the potential biodiesel resource in Crete was used for three purposes:

• To promote the establishment of new companies for the collection of used vegetable oils – as feedstock for biodiesel production – in Crete.
To stimulate the hotel, restaurant, canteen etc. owners to collect the fried oils and supply them to the oil collection companies.
To motivate entrepreneurs to invest in biodiesel production plants in Crete.
The Regional Energy Agency of Crete updated and completed the assessment of the available potential of used vegetable oils as well as the different scenarios of collection and logistics.
  - Scenario 1 (minimum): 1,370 tonnes/year.
  - Scenario 2 (medium): 1,990 tonnes/year.
  - Scenario 3 (maximum): 3,220 tonnes/year.
There are 148,039 vehicles using diesel in Crete
  - Trucks: 96,393
  - Buses: 1,617
  - Taxis: 2,155
  - Agricultural Vehicles: 47,874
The demand for diesel in Crete is 127,500 tonnes per year (2005).
The necessary quantities of Biodiesel are:
  - 2,550 tonnes in 2005 (2% of the demand).
  - 7,330 tonnes in 2010 (5.75% of the demand).
These results were used to assess whether a large implementation of the use of biodiesel in vehicles in Crete was feasible as for the supply side.

Promotion activities
  - A special DVD explaining the technology behind biodiesel use was created and distributed by REAC
  - Large labels were put on the buses promoting the use of biodiesel with special logos and slogans
  - An information leaflet was distributed by REAC for the use and the benefits of biodiesel
  - TV and radio adverts for the project were broadcast

Figure 3 – Brochure created for the project
6. The citizens' attitude to the project
As a result of the information campaign, the citizens that were initially sceptical were finally very enthusiastic about the project. Public transport providers were interested in using biodiesel in their vehicles. Also, REAC observed an interest in investing in fried oil collection companies and installing biodiesel production plants.

7. Implementation and project life span
The project started in January 2004 and was finalised in February 2006. The table below describes the different phases of the project:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start date</th>
<th>End date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Creation of a Network of regional actors: Regional Authorities,</td>
<td>01/2004</td>
<td>03/2004</td>
</tr>
<tr>
<td>Public Transport Companies, Technical Centres of Vehicles Control,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directorates of Transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Implementation protocols, Infrastructure, Procedures and Logistics</td>
<td>01/2004</td>
<td>07/2004</td>
</tr>
<tr>
<td>C. Training courses in Austria (Biodiesel operation and evaluation</td>
<td>02/2005</td>
<td>02/2005</td>
</tr>
<tr>
<td>in experienced fleets &amp; Quality controls in authorized institutes)</td>
<td>12/2005</td>
<td>12/2005</td>
</tr>
<tr>
<td>D. Public Event (participants: Public Transport companies,</td>
<td>04/2005</td>
<td>04/2005</td>
</tr>
<tr>
<td>Directorates of Transport, Technical Centres of Vehicles Control,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Authorities, Local, Regional and National Media -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>newspapers, radio, TV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Development and Implementation phase</td>
<td>05/2005</td>
<td>01/2006</td>
</tr>
<tr>
<td>G. Promotion of energy innovation and transfer of know-how</td>
<td>01/2006</td>
<td>To the end</td>
</tr>
<tr>
<td>(productive use of the Austrian experience and best practices).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation of potential investors on a) collection of biodiesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>feedstock-used vegetable oils, b) biodiesel production plants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Dissemination activities (press releases, information brochures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; leaflets, large labels on biodiesel buses, articles in newspapers,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>radio and TV broadcasts, workshops, events)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8. Problems and obstacles

The table below lists the problems encountered and the solutions found:

<table>
<thead>
<tr>
<th>Barrier/Problems</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative problems</td>
<td>In 2004, the legal framework for biodiesel was not finalized in Greece and REAC had to overcome various administrative problems. Nevertheless, they obtained the commitment of the regional and national politicians and continued as planned.</td>
</tr>
<tr>
<td>Pilot use of biodiesel</td>
<td>There was no know-how or experience in biodiesel use (biodiesel mixtures etc.) and therefore Greek experts had to participate in training courses in Austria.</td>
</tr>
<tr>
<td>Social barriers</td>
<td>The drivers and the public were very suspicious of the use of biodiesel but REAC organized workshops, events and very successful information campaigns and they achieved the acceptance of biodiesel.</td>
</tr>
</tbody>
</table>

9. Costs and funding of the project

The total budget of the project was €89,203.44, financed by the following organisations:

- National +Regional funding: €45,154.78
- European Community: €44,048.66

10. Results

10.1 General results

The REAC was very satisfied with the results of the project, which are detailed below.

10.2 The socio/economic impacts/benefits

This pilot project, by proving the technical feasibility of introducing biofuels in public transport in Crete, showed that if implemented on a larger scale it could in the future contribute to:

- Increasing the energy security of the insular supply.
- The creation of a biodiesel market in the transport sector.
- The establishment of fried oil collection companies.
- The installation of a biodiesel production plant (interest already raised).

Also the increase in know-how and technical experience in biofuels is to be listed as a socio-economic benefit.
10.3 The environmental impacts/benefits

Compared to buses using standard diesel, the emissions monitored for the 2 pilot buses using biodiesel showed:

- Reduction of up to 50% of the smoke density (opacity)
- Reduction of hydrocarbons emissions by 40 – 55% (low – high speed)
- Reduction of CO emissions

As a first approximation and considering biodiesel is made of used fried oils, we can estimate that the CO₂ emissions reduction is of the same order of magnitude as the share of biodiesel in fuel, i.e. 20%. Given that a bus emits the equivalent of 113 g CO₂/km\(^{75}\) to transport one person, on the assumption that a bus generally transports 15 people at the same time, runs 300 km per day 5 days per week, the equivalent amount of CO₂ saved by the use of biodiesel would be around 26 tonnes per year for the 2 buses using biodiesel.

The use of biodiesel had no impact on lubricating oil and the wear on metals was very slight. The volumetric fuel consumption was detected as being higher for biodiesel blends than for regular diesel. Finally, the fried oil collection system prevents oils being processed as waste (best option) or thrown away in sinks.

11. Overall renewable energy situation in Crete and comparison with the current national and European situation

The share of overall renewable energy consumption in Crete is 12% – 13%, which is higher than the current share at the national level (5.66% in 2005). In 2005, 3,000 tonnes of biodiesel were produced in Greece, as compared with 3,184,000 tons in the EU for the same period [EurObserv’ER 2006].

12. Ongoing applications of the project

As a result of the information campaign, which included the dissemination of informative leaflets and other promotional material and the broadcasting of news about the project in the regional TV and radio, the citizens who were sceptical in the beginning were finally very enthusiastic about the project. This project contributed to increase awareness about energy issues among the general public. As detailed above, there is current interest in the implementation of larger-scale fried oil collection systems and of a biodiesel production plant.

13. Key factors for success

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\(^{75}\) Source: EcoInvent Life Cycle Inventories database, “Transport, regular bus/CH S”
According to the project manager, the whole procedure finally proved to be very easy to implement in Crete. This facility of implementation was the project's main success factor. A lesson that was learnt is that it is important to obtain the active and full cooperation of key players (public authorities, politicians, private companies, institutions, etc.) . Political commitment needs to be ensured in order to avoid administrative problems.

14. Potential to replicate a similar project by other local/regional authorities
The use of biodiesel mixtures made from used fried oil, as in the best practice example in Greece, can be replicated in other areas where this type of waste is available in large quantities.

This project required the implementation of a system for the collection of the used fried oil from the main producers such as private households, hotels and restaurants.

Other transport companies can easily follow this example as no modification of the bus engine is required.

15. Contacts / Acknowledgements

<table>
<thead>
<tr>
<th>Organisation:</th>
<th>REAC – Regional Energy Agency of Crete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of organisation:</td>
<td>Regional authority</td>
</tr>
<tr>
<td>Main activities:</td>
<td>Energy planning – Policy</td>
</tr>
<tr>
<td></td>
<td>Environment – Climate Change</td>
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<tr>
<td></td>
<td>Renewable Energy Sources</td>
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<tr>
<td></td>
<td>Rational Use of Energy – Energy Saving</td>
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<td></td>
<td>Sustainable Mobility – Transport</td>
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<td></td>
<td>European &amp; International Collaboration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contact Information:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Nikolaos Zografakis, Director</td>
</tr>
<tr>
<td>Mr. Konstantinos KALITSOUNAKIS</td>
</tr>
<tr>
<td>Kountouriotis Square 71202 Heraklion Crete GREECE</td>
</tr>
<tr>
<td>Tel: +30 28 10 224 854</td>
</tr>
<tr>
<td>Email: <a href="mailto:enrg_bur@crete-region.gr">enrg_bur@crete-region.gr</a></td>
</tr>
<tr>
<td>Website: <a href="http://www.crete-region.gr/greek/energy/">http://www.crete-region.gr/greek/energy/</a></td>
</tr>
</tbody>
</table>

16. References
This fact sheet is based on the information provided by the Regional Energy Agency of Crete, through means of a questionnaire that was developed in the context of this project and telephone interviews.


Annex 4: Compilation of Useful Information

The EC’s Home Page for New and Renewable Energies contains useful information on the current state of renewable energies and energy efficiency in Europe, regulations, the European Strategies and best practice cases. Website: http://ec.europa.eu/energy/index_en.html

AGORES (http://www.agores.org) is the European Renewable Energies Portal. It provides useful information (not all updated) on relevant policies, areas and sources of renewable energies, key players, projects and useful links.

### Publications supported by the EC

<table>
<thead>
<tr>
<th>Publication</th>
<th>Website</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barometers EurObserv'ER</td>
<td><a href="http://ec.europa.eu/energy/res/publications/barometers_en.htm">http://ec.europa.eu/energy/res/publications/barometers_en.htm</a></td>
<td>This publication analyses the development of renewable energies in each of the RES sectors and for each of the MS. It is published every two months and it reports on the latest trends and perspectives in RES.</td>
</tr>
<tr>
<td>Altener Results</td>
<td><a href="http://ec.europa.eu/energy/res/publications/altener_en.htm">http://ec.europa.eu/energy/res/publications/altener_en.htm</a></td>
<td>Compilation of reports in the field of renewable energies supported by the European ALTENER Programme (for more information on this programme, see next section)</td>
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</tbody>
</table>

### 4.1. European Support Programmes

Over the last 20 years, the EU has launched different programmes to support the development of renewable energies in Europe.
<table>
<thead>
<tr>
<th>Programme</th>
<th>Objectives</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD Framework Programmes</td>
<td>FP7 focuses on innovation and knowledge for growth and is implemented via four specific programmes: cooperation, ideas, people and capacity. New funding possibilities are available under the 7th EU Research Framework Programme.</td>
<td>Demonstration projects under FP6: <a href="http://ec.europa.eu/energy/res/fp6_projects/concerto_en.htm">http://ec.europa.eu/energy/res/fp6_projects/concerto_en.htm</a></td>
</tr>
<tr>
<td>Managenergy</td>
<td>Information Services for Local and Regional Energy Actors. ManagEnergy is an initiative of the EC Directorate-General for Energy and Transport, which aims to support the work of actors working on energy efficiency and renewable energies at local and regional level. The main tools are training workshops and online events. Information is also provided on case studies, good practice, European legislation and programmes.</td>
<td><a href="http://www.managenergy.net">http://www.managenergy.net</a></td>
</tr>
<tr>
<td>Intelligent Energy - Europe</td>
<td>The Intelligent Energy - Europe programme is the EU's tool for funding action to move us towards a more energy intelligent Europe. The second Intelligent Energy – Europe programme begins soon and runs until 2013. It is part of a broader EU programme called Competitiveness and Innovation.</td>
<td><a href="http://ec.europa.eu/energy/intelligent/index_en.html">http://ec.europa.eu/energy/intelligent/index_en.html</a></td>
</tr>
<tr>
<td><strong>Sustainable Energy Europe 2005-2008</strong></td>
<td>The Sustainable Energy Europe 2005-2008 Campaign is an EC initiative in the framework of the Intelligent Energy - Europe (2003-2006) programme, which aims to raise public awareness and promote sustainable energy production and use among individuals and organisations, private companies and public authorities, professional and energy agencies, industry associations and NGOs across Europe.</td>
<td><a href="http://www.sustenergy.org">http://www.sustenergy.org</a></td>
</tr>
<tr>
<td><strong>CONCERTO</strong></td>
<td>Throughout the 9 participating CONCERTO projects the focus is primarily on demonstrating the environmental, economic and social benefits of integrating RES together with energy efficiency techniques through a sustainable energy-management system operated on a community level.</td>
<td><a href="http://www.concertoplus.eu">http://www.concertoplus.eu</a></td>
</tr>
</tbody>
</table>

The ManagEnergy **Sectoral Advice (SA) Facility** was launched on 9 May 2007. The purpose of the Sectoral Advice Facility is to make short-term expert technical assistance available free of charge to Local and Regional Energy Actors, such as Energy Agencies, in a rapid and uncomplicated manner. Simply put, this enables Local and Regional Energy Actors (LEAs) to request the services of an expert in a specific area, and LEAs can expect to receive approval within a couple of weeks (provided the application request is thorough and professionally presented). Joint applications from a number of LEAs are particularly welcome. Initially, it is envisaged that each individual sectoral advice mission would be for a maximum of 5 man-days. For more information follow the following link: [http://www.managenergy.net/sa.html#opt7](http://www.managenergy.net/sa.html#opt7)
Some programmes that were developed within these frameworks are further described below:

■ SAVE Programme
It is the only Union-wide programme dedicated exclusively to promoting energy efficiency and encouraging energy-saving behaviour in industry, commerce and the domestic sector as well as in transport through policy measures, information, studies and pilot actions and the creation of local and regional energy management agencies.
SAVE III is the vertical action of the Intelligent Energy - Europe programme that focuses on:
- Multiplying success in buildings
- Retrofitting social houses
- Innovative approaches in industry
- Transforming the market: Energy efficient equipment and products

■ ALTENER Programme
ALTENER III is the vertical action of the Intelligent Energy - Europe programme that focuses on:
- RES-E.
- RES-Heat
- Small scale RES applications
- Alternative fuels and vehicles

IntellEbase (http://ec.europa.eu/energy/iebase/introduction.cfm) is the EC’s public dissemination database for non-technological projects supported by the Community in the field of energy efficiency (SAVE programme) and RES (ALTENER programme). It contains detailed and summarised information on most of the 700 SAVE and ALTENER projects from 1996 and onwards. All future projects under the new "Intelligent Energy - Europe" programme (EIE) will later be added to this database.

4.2. European Legislation and Policy

Renewable energies

■ Community Strategy and Action Plan
- White Paper for a Community Strategy and Action Plan COM(97)599 final. It sets out a strategy to double the share of renewable energies in gross domestic energy consumption in the EU by 2010 (from the present 6% to 12%) including a timetable of actions to achieve this objective in the form of an Action Plan. The main features of the Action Plan include internal market measures in the regulatory and fiscal spheres; reinforcement of those Community policies which have a bearing on
increased penetration by renewable energies; proposals for strengthening co-operation between MS; and support measures to facilitate investment and enhance dissemination and information in the renewables field.


Furthermore, in January 2007 the EC presented a proposal for a long-term Renewable Energy Roadmap. The proposal includes an overall binding 20% renewable energy target and a binding minimum target of 10% for transport biofuels for the EU by 2020, and a pathway to bring renewable energies in the fields of electricity, heating and cooling and transport to the economic and political mainstream.

■ **Electricity production from RES**

The Directive 2001/77/EC on the promotion of the electricity produced from RES in the internal electricity market (legislation in force) concerns electricity produced from non-fossil, RES such as wind, solar, geothermal, wave, tidal, hydroelectric, biomass, landfill gas, sewage treatment gas and biogas energies. The definitions in Directive 96/92/EC concerning common rules for the internal market in electricity are also applicable to this Directive.

The Commission Communication of 7 December 2005 "The support of electricity from renewable energy sources" [COM(2005) 627 final - Official Journal C 49 of 28 February 2006] reports on the progress made in achieving the objectives set by the MS in the field of renewable energies, as stipulated by the previous 2001 directive. It focuses specifically on public support allocated to assist the market penetration of RES-E.

■ **The share of renewable energy in the EU**

The Communication from the Commission to the Council and the European Parliament - The share of renewable energy in the EU - Commission Report in accordance with Article 3 of Directive 2001/77/EC, evaluates the effect of legislative instruments and other Community policies on the development of the contribution of RES in the EU and proposals for concrete actions [COM(2004) 366 final - not published in the Official Journal]. This Communication assesses the development of renewable energy in the EU. It serves three purposes:

- To implement the provisions of Directive 2001/77/EC under which the Commission is required to make a formal report evaluating the progress made by EU-15 towards achieving national targets for 2010 for RES.
- To assess the prospects for achieving the target of 12% of overall energy consumption being produced from renewable energy in EU15 by 2010.
- To put forward proposals for concrete actions at national and Community level to ensure the EU's renewable energy targets are achieved by 2010.
■ **Biomass Action Plan**

■ **EU strategy for biofuels**
  - The Commission Communication of 8 February 2006 entitled "An EU Strategy for Biofuels" [COM(2006) 34 final - Official Journal C 67 of 18 March 2006]. The Strategy complements the Biomass Action Plan adopted at the end of 2005 and responds to a threefold objective: further promotion of biofuels in the EU and in developing countries, preparation for the large-scale use of biofuels, and heightened cooperation with developing countries in the sustainable production of biofuels. This threefold objective breaks down into seven policy areas, which encompass the priorities envisaged by the Commission.

**Energy efficiency**
  
■ **General scheme**

In order to meet the objectives of the renewed Lisbon strategy, and thus stimulate growth and employment in Europe, a Competitiveness and Innovation Framework Programme CIP was adopted for the period 2007-2013. The programme supports measures to strengthen competitiveness and innovation capacity in the EU. It particularly encourages the use of information technologies, environmental technologies and RES. One of the specific subprogrammes that was developed in this framework was the Intelligent Energy - Europe Programme, which, as mentioned before, helps speed up efforts to achieve the objectives in the field of sustainable energy.

The Action Plan on Energy Efficiency was published in October 2006. The Action Plan, which will be implemented over the next six years, is in response to
the urgent call from Heads of State and Government at the Spring European Council this year for a realistic Energy Efficiency strategy. The Plan underlines the importance of minimum energy performance standards for a wide range of appliances and equipment (from household goods such as fridges and air conditioners to industrial pumps and fans), and for buildings and energy services. In combination with performance ratings and labelling schemes, minimum performance standards represent a powerful tool for removing inefficient products from the market, informing consumers of the most efficient products and transforming the market to make it more energy efficient. Minimum performance requirements for new and renovated buildings will be developed. Very low energy consumption buildings (or passive houses) will also be promoted.

More information on the "Action Plan for Energy Efficiency" is available on its website:
http://ec.europa.eu/energy/action_plan_energy_efficiency/index_en.htm

■ Energy efficiency legislation
The Green Paper on the safety of energy supply highlighted that, if no action is taken, the EU’s dependence on external energy sources will increase from 50% to 70% by 2030 according to current estimates.

In 2006, the EU adopted the Directive 2006/32/EC on energy end-use efficiency and energy services. The purpose of the Directive is to make the end use of energy more economic and efficient by:

- establishing indicative targets, incentives and the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent efficient end use of energy;
- creating the conditions for the development and promotion of a market for energy services and for the delivery of energy-saving programmes and other measures aimed at improving end-use energy efficiency.

This directive requires Member States to adopt and achieve an indicative target for saving energy of 9% by 2015. The target has been set and calculated in accordance with the method set out in Annex I to the Directive. Member States must also set themselves an intermediate national indicative target to be achieved by 2009.

in one process) in order to save energy and combat climate change.

Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings [Official Journal L 001 of 04.01.2003] creates a common framework to promote the improvement of the energy performance of buildings. The Directive concerns the residential sector and the tertiary sector (offices, public buildings, etc.). The scope of the provisions on certification does not, however, include some buildings, such as historic buildings, industrial sites, etc. It covers all aspects of energy efficiency in buildings in an attempt to establish a truly integrated approach.

Efficiency in energy-using products.
A directive concerning household appliances is the Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances [Official Journal L 297 of 13.10.1992]. It aims at harmonising national measures relating to the publication of information on the consumption of energy and of other essential resources by household appliances, thereby allowing consumers to choose appliances on the basis of their energy efficiency.

The detailed arrangements for implementing the Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficient labelling programs for office equipment at Community level have been put forward in Regulation (EC) No 2422/2001 of the European Parliament and of the Council of 6 November 2001 on a Community energy-efficient labelling programme for office equipment [Official Journal L 332, 15.12.2001] This regulation is designed to coordinate the labelling of energy-efficient office equipment using the ENERGY STAR logo.
European Parliament and Council Directive 2000/55/EC of the 18 September 2000, on energy efficiency requirements for ballasts for fluorescent lighting [Official Journal L 279 of 01.11.2000] aims at achieving cost-effective energy savings in fluorescent lighting, which would not otherwise be achieved with other measures. This directive only covers newly produced ballasts, which are responsible for high energy consumption and offer considerable potential for energy savings.

Directive 92/42/EEC of 21 May 1992 on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels comes under the SAVE Programme concerning the promotion of energy efficiency in the Community. It determines the objectives or "essential requirements" which must be met, during manufacture and before being placed on the market, by hot-water boilers fired with liquid or gaseous fuels with a rated output of no less than 4 kW and no more than 400 kW:

- Standard boilers
- Low-temperature boilers
- Gas condensing boilers

### 4.3. Voluntary Agreements

In this subsection, different voluntary agreements to improve energy efficiency and promote renewable energies are summarised.

<table>
<thead>
<tr>
<th>Programme</th>
<th>Description</th>
<th>Website</th>
<th>Logo</th>
</tr>
</thead>
<tbody>
<tr>
<td>The GreenLight Programme</td>
<td>Initiative encouraging non-residential electricity consumers to install energy-efficient lighting technologies in their</td>
<td><a href="http://www.eu-greenlight.org/">http://www.eu-greenlight.org/</a></td>
<td><img src="#" alt="Logo" /></td>
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### 4.4. Compilation of Best Practice Cases

As indicated above, it may be useful during the preparatory work and planning of a project to gather information and study previous similar projects. In this sub-section, the main case study compilations are summarised.

<table>
<thead>
<tr>
<th>Database</th>
<th>Type Info</th>
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<tbody>
<tr>
<td>FP6 Demonstration Projects</td>
<td>Compilation of projects that have been carried out under the EC 6th Framework Programme</td>
<td><a href="http://ec.europa.eu/energy/res/fp6_projects/concerto_en.htm">http://ec.europa.eu/energy/res/fp6_projects/concerto_en.htm</a></td>
</tr>
<tr>
<td>Project RUSE Database</td>
<td>Successful stories in the field of sustainable energy in Europe.</td>
<td><a href="http://www.ruse-europe.org/-RUSE-Database-">http://www.ruse-europe.org/-RUSE-Database-</a></td>
</tr>
<tr>
<td>DEEP project</td>
<td>Green Public Procurement</td>
<td><a href="http://www.iclei-europe.org/leap">www.iclei-europe.org/leap</a></td>
</tr>
<tr>
<td>Network/Database</td>
<td>Description</td>
<td>Website/URL</td>
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<tr>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Procura+</td>
<td>Good practice examples (in pdf) of sustainable procurement from across Europe, grouped by subject area</td>
<td><a href="http://www.procuraplus.org">www.procuraplus.org</a></td>
</tr>
<tr>
<td>BioMatNet</td>
<td>Network &amp; database of FP2 - FP7 non-food use of crops projects (including biomass &amp; bioenergy)</td>
<td><a href="http://www.biomatnet.org/">http://www.biomatnet.org/</a></td>
</tr>
<tr>
<td>CADDET Technical Brochures</td>
<td>Database of 400+ case studies on energy efficiency and renewable energy</td>
<td><a href="http://www.caddet.org/brochures/index.php">http://www.caddet.org/brochures/index.php</a></td>
</tr>
<tr>
<td>CREATE</td>
<td>Case studies on local community education</td>
<td><a href="http://www.create.org.uk/localcommunities/education.asp">http://www.create.org.uk/localcommunities/education.asp</a></td>
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<tr>
<td>ELTIS</td>
<td>Database of case studies on mobility and transport</td>
<td></td>
</tr>
<tr>
<td>Energie-Cités</td>
<td>Database of good practice of sustainable energy policies</td>
<td><a href="http://www.energie-cites.org">http://www.energie-cites.org</a></td>
</tr>
<tr>
<td>ENTHUSE</td>
<td>Creating Local Government Enthusiasm for Renewable Energies</td>
<td><a href="http://www.enthuse.info/">http://www.enthuse.info/</a></td>
</tr>
<tr>
<td>EPOMM</td>
<td>European Platform on Mobility Management</td>
<td><a href="http://www.epomm.org/">http://www.epomm.org/</a></td>
</tr>
<tr>
<td>European Environment Agency (EEA)</td>
<td>Reports and publications about Europe’s environment published by the EEA</td>
<td><a href="http://reports.eea.europa.eu/">http://reports.eea.europa.eu/</a></td>
</tr>
<tr>
<td>ICLEI Information Clearinghouse - Europe</td>
<td>Publications, case studies, newsletters and a variety of technical manuals about Local Governments for Sustainability</td>
<td><a href="http://wwwICLEI-Europe.org/">http://wwwICLEI-Europe.org/</a></td>
</tr>
<tr>
<td>INFORSE - Europe</td>
<td>Collection of Sustainable Energy Successes in Europe</td>
<td><a href="http://www.inforse.org/europe/contents.htm">http://www.inforse.org/europe/contents.htm</a></td>
</tr>
<tr>
<td>IntellEbase</td>
<td>Database of ALTENER</td>
<td><a href="http://ec.europa.eu/energy/iebase">http://ec.europa.eu/energy/iebase</a></td>
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### ANNEXES

<table>
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<tbody>
<tr>
<td>ManagEnergy</td>
<td>Case Studies and other documents detailing projects, publications, events and websites</td>
<td><a href="http://www.managenergy.net/submenu/Scs.htm">http://www.managenergy.net/submenu/Scs.htm</a></td>
</tr>
<tr>
<td>OPET</td>
<td>Database of good practice</td>
<td><a href="http://www.opet-network.net">http://www.opet-network.net</a></td>
</tr>
<tr>
<td>Practical Help</td>
<td>The Energy Saving Trust’s service for Local Authorities (UK)</td>
<td><a href="http://www.est.org.uk/housingbuildings/localauthorities/">http://www.est.org.uk/housingbuildings/localauthorities/</a></td>
</tr>
<tr>
<td>SURBAN</td>
<td>Database on sustainable urban development in Europe</td>
<td><a href="http://www.eaue.de/">http://www.eaue.de/</a></td>
</tr>
<tr>
<td>The Carbon Trust (UK)</td>
<td>Database of research, development and demonstration projects</td>
<td><a href="http://www.carbontrust.co.uk/default.htm">http://www.carbontrust.co.uk/default.htm</a></td>
</tr>
</tbody>
</table>

4.5. **Key Players in the Field of Renewable Energy Sources and Energy Efficiency**

**Renewable Energy- European Associations**

<table>
<thead>
<tr>
<th>Association</th>
<th>Website</th>
<th>Contact Information</th>
</tr>
</thead>
</table>

280
| Association (EWFA) | Belgium          | Tel: +32 2 546 1940  
Fax: +32 2 546 1944  
E-mail: ewfa(at)ewea.org |
|-------------------|------------------|------------------|
| European PV Industry Association (EPIA) | Renewable Energy House  
Rue d'Arlon 63-65  
1040 Brussels  
Belgium  
Tel: +32-2-465.38.84  
Fax: +32-2-400.10.10  
E-mail: epia(epia.org) |
| European Small Hydropower Association (ESHA) | Renewable Energy House  
Rue d'Arlon 63-65, 1040  
Brussels - Belgium  
Telephone: 32 2  
546.19.45 Fax: 32 2  
546.19.47  
E-mail Secretariat:  
info(at)esha.be |
| European Biomass Association (AEBIOM) | AEBIOM  
Croix du Sud 2 bte 11  
1348 Louvain-la-Neuve  
BELGIUM  
Tel: + 32 10 47 34 55  
Fax: + 32 10 47 34 55  
E-mail: jossart@aebiom.org |
| European Biomass Industry Association (EUBIA) | Rue d'Arlon 63-65  
B-1040 Brussels  
Phone: +32 2 400 10 20  
Fax: +32 2 400 10 21  
eubia@eubia.org |
| European Geothermal Energy Council (EGEC) | 63-65, rue d'Arlon  
B-1040 BRUSSELS  
Tel: + 32 2 400 10 24  
Fax: + 32 2 400 10 10  
Contact:  
info@egec.org |
| European Solar Thermal Industry Federation (ESTIF) | Renewable Energy House  
Rue d'Arlon 63-65  
B-1040 Bruxelles  
BELGIUM |
<table>
<thead>
<tr>
<th>Association</th>
<th>Website</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Renewable Energy Centres Agency (EUREC)</td>
<td><a href="http://www.eurec.be">http://www.eurec.be</a></td>
<td>Tel: +32-2-54 619 38 Fax: +32-2-54 619 39 Email: <a href="mailto:info@estif.org">info@estif.org</a></td>
</tr>
<tr>
<td>European Forum for Renewable Energy Sources (EUFORES)</td>
<td><a href="http://www.eufores.org">http://www.eufores.org</a></td>
<td>Renewable Energy House Rue d'Arlon 63-65, B-1040 Brussels <a href="mailto:info@eurec.be">info@eurec.be</a>, Phone: +32 2 546 1930, Fax: +32 2 546 1934</td>
</tr>
<tr>
<td>Internationales Wirtschaftsforum Regenerative Energien (IWR)</td>
<td><a href="http://www.iwr.de">http://www.iwr.de</a></td>
<td>Grevener Str. 75 D-48159 Münster Tel.: ++ 49 - (0) 251 / 23 946 - 0 Fax: ++ 49 - (0) 251 / 23 946 - 10 E-Mail: <a href="mailto:info@iwr.de">info@iwr.de</a></td>
</tr>
</tbody>
</table>

**European Networks**

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<thead>
<tr>
<th>Association</th>
<th>Website</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnR network (Agencias Europeas de Energía)</td>
<td><a href="http://www.enr-network.org">http://www.enr-network.org</a></td>
<td>E-mail: <a href="mailto:elena@cres.gr">elena@cres.gr</a></td>
</tr>
<tr>
<td>The European renewable energies federation</td>
<td><a href="http://www.eref-europe.org/">http://www.eref-europe.org/</a></td>
<td><a href="mailto:info@eref-europe.org">info@eref-europe.org</a></td>
</tr>
<tr>
<td>Black Sea Regional</td>
<td><a href="http://www.bsrec.bg/">http://www.bsrec.bg/</a></td>
<td>8, Triaditza Str., 1000 Sofia, Bulgaria, Tel.: +359</td>
</tr>
<tr>
<td>Organisation</td>
<td>Website/Contact Information</td>
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</tr>
<tr>
<td>------------------------------------------</td>
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</tr>
<tr>
<td>Energy Centre</td>
<td>2 980 6854, Fax: +359 2 980 6855 <a href="mailto:office@bsrec.bg">office@bsrec.bg</a></td>
<td></td>
</tr>
<tr>
<td>ENER The European Network for Energy Economics Research</td>
<td><a href="http://www.isi.fhg.de/e/departm.htm">http://www.isi.fhg.de/e/departm.htm</a> Hansastrasse 27c 80686 München Phone: +49 (0) 89 / 12 05-0 Fax: +49 (0) 89 / 12 05-75 31</td>
<td></td>
</tr>
<tr>
<td>Energie-Cités (Energie-Cités is the association of European local authorities for the promotion of local sustainable energy policies.)</td>
<td><a href="http://www.energie-cites.org/">http://www.energie-cites.org/</a> 157, avenue Brugmann - BE-1190 Bruxelles - Tel. : +32 2 544 09 21 - Fax : +32 2 544 15 81</td>
<td></td>
</tr>
<tr>
<td>IEPE (Institut d'Economie et de Politique de l'Energie)</td>
<td><a href="http://www.upmf-grenoble.fr/iepe/aindex.html">http://www.upmf-grenoble.fr/iepe/aindex.html</a> 1221-1241, rue des Résidences, 2e étage, domaine universitaire, Saint-Martin d'Hères Postal address : LEPII-IEPE , BP 47, 38040 Grenoble, France Tel: +33 (0)4 56 52 85 70 Fax: +33 (0)4 56 52 85 71</td>
<td></td>
</tr>
<tr>
<td>International Network FOR Sustainable Energy -</td>
<td><a href="http://www.inforse.org/">http://www.inforse.org/</a> Gl. Kirkevej 82 DK-8530 Hjortshøj Denmark Phone: +45 86 22 70 00</td>
<td></td>
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</table>
## ANNEXES

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Website</th>
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</table>
| INFORSE      | Phone/Fax: +45 86 22 70 96  
E-mail: inforse@inforse.org |
| EUGENE (European Green Electricity Network) | http://www.eugenestandard.org |
| FEDARENE     | 11 rue du Beau-Site  
B-1000 Bruxelles  
Tel.+32 2 646 82 10  
Fax.+32 2 646 89 75  
E-mail: fedarene@fedarene.org |

### National Energy Agencies (alphabetical order?)

<table>
<thead>
<tr>
<th>Country</th>
<th>Organisation</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>PTJ - Forschungszentrum Jülich GmbH (research center)</td>
<td><a href="http://www.fz-juelich.de">http://www.fz-juelich.de</a></td>
</tr>
</tbody>
</table>
|         | Deutsche Energie-Agentur GmbH (dena)  
German Energy Agency | www.dena.de |
<p>| Austria | Österreichische Energieagentur (Austrian Energy Agency) | <a href="http://www.eva.wsr.ac.at/(en)/">http://www.eva.wsr.ac.at/(en)/</a> |
|         | Oberösterreichischer Energiesparverband (Upper-Austria) | <a href="http://www.esv.or.at/esv/index.php?id=1&amp;L=1">http://www.esv.or.at/esv/index.php?id=1&amp;L=1</a> |
| Belgium | VITO (Vlaamse instelling voor technologisch onderzoek) | <a href="http://www.vito.be/english/index.htm">http://www.vito.be/english/index.htm</a> |
|         | ERBE - Agence Régionale Biomasse Energie asbl | <a href="http://users.skynet.be/erbe/">http://users.skynet.be/erbe/</a> |</p>
<table>
<thead>
<tr>
<th>Country</th>
<th>Organization</th>
<th>Website</th>
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</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>DEA - Danish Energy Authority</td>
<td><a href="http://www.ens.dk">http://www.ens.dk</a></td>
</tr>
<tr>
<td></td>
<td>Energie Center Denmark</td>
<td><a href="http://www.uk.teknologisk.dk/">http://www.uk.teknologisk.dk/</a></td>
</tr>
<tr>
<td>Spain</td>
<td>IDAE - Instituto para la Diversificación y Ahorro de la Energía</td>
<td><a href="http://www.idae.es">http://www.idae.es</a></td>
</tr>
<tr>
<td>Finland</td>
<td>MOTIVA - Energy Information Centre</td>
<td><a href="http://www.motiva.fi">http://www.motiva.fi</a></td>
</tr>
<tr>
<td></td>
<td>TEKES Technology Development Centre (Finland)</td>
<td><a href="http://www.tekes.fi">http://www.tekes.fi</a></td>
</tr>
<tr>
<td>France</td>
<td>ADEME Agence de l'Environnement et de la Maîtrise de l'Energie (France)</td>
<td><a href="http://www.ademe.fr">http://www.ademe.fr</a></td>
</tr>
<tr>
<td>Greece</td>
<td>GRECIA CRES Centre for Renewable Energy Sources</td>
<td><a href="http://www.cres.gr/kape/default_uk.htm">http://www.cres.gr/kape/default_uk.htm</a></td>
</tr>
<tr>
<td></td>
<td>SenterNovem Netherlands Agency for Innovation, Energy and Environment</td>
<td><a href="http://www.senternovem.nl">www.senternovem.nl</a></td>
</tr>
<tr>
<td></td>
<td>NOVEM - Nederlandse Organisatie voor Energie en Milieu (The Netherlands Agency for Energy and the Environment)</td>
<td><a href="http://www.novem.nl">http://www.novem.nl</a></td>
</tr>
<tr>
<td>Country</td>
<td>Organization</td>
<td>Website</td>
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<tr>
<td>Ireland</td>
<td>Energy Research Group - University College Dublin</td>
<td><a href="http://erg.ucd.ie/">http://erg.ucd.ie/</a></td>
</tr>
<tr>
<td></td>
<td>Sustainable Energy Ireland</td>
<td><a href="http://www.sei.ie">http://www.sei.ie</a></td>
</tr>
<tr>
<td>Italy</td>
<td>ENEA - Ente per le Nuove Tecnologie l'Energia e l'Ambiente</td>
<td><a href="http://www.ena.it">http://www.ena.it</a></td>
</tr>
<tr>
<td>Portugal</td>
<td>ADENE - Agencia para la Energía</td>
<td><a href="http://www.adene.pt">http://www.adene.pt</a></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Energy Saving Trust</td>
<td><a href="http://www.est.co.uk">http://www.est.co.uk</a></td>
</tr>
<tr>
<td>Sweden</td>
<td>STEM Swedish National Energy Administration</td>
<td><a href="http://www.nutek.se">http://www.nutek.se</a></td>
</tr>
<tr>
<td>Lithuania</td>
<td>SC Energy Agency, Lithuania</td>
<td><a href="http://www.ena.lt">www.ena.lt</a></td>
</tr>
<tr>
<td>Poland</td>
<td>NAPE - National Energy Conservation Agency</td>
<td><a href="http://www.nape.pl">www.nape.pl</a></td>
</tr>
<tr>
<td></td>
<td>Narodowa Agencja Poszanowania Energii</td>
<td></td>
</tr>
<tr>
<td></td>
<td>KAPE SA - The Polish National Energy Conservation Agency</td>
<td><a href="http://www.kape.gov.pl">www.kape.gov.pl</a></td>
</tr>
<tr>
<td></td>
<td>Krajowa Agencja Poszanowania Energii SA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EC BREC/IEO - Institute for Renewable Energy Association of Polish Energy</td>
<td><a href="http://www.ieo.pl">www.ieo.pl</a></td>
</tr>
<tr>
<td></td>
<td>Actors at Local and Regional Level</td>
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</tr>
<tr>
<td>Czech</td>
<td>CEA - Česká</td>
<td><a href="http://www.ceacr.cz">www.ceacr.cz</a></td>
</tr>
<tr>
<td>Republic</td>
<td>Energetická agentura</td>
<td>The Czech Energy Agency</td>
</tr>
<tr>
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</tr>
<tr>
<td>Hungary</td>
<td>Energy Centre Hungary</td>
<td><a href="http://www.energycentre.hu">www.energycentre.hu</a></td>
</tr>
<tr>
<td>Romania</td>
<td>ARCE - Agentia Romana pentru Conservarea Energiei Romanian Agency for Energy Conservation</td>
<td><a href="http://www.arceonline.ro">www.arceonline.ro</a></td>
</tr>
<tr>
<td>Cyprus</td>
<td>CIE - Cyprus Institute of Energy</td>
<td><a href="http://www.cie.org.cy">www.cie.org.cy</a></td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>SEA - Slovak Energy Agency</td>
<td><a href="http://www.sea.gov.sk">www.sea.gov.sk</a></td>
</tr>
<tr>
<td>Luxembourg</td>
<td>AEL - Agence de l'Energie du Luxembourg</td>
<td><a href="http://www.ael.lu">www.ael.lu</a></td>
</tr>
</tbody>
</table>

**Local/Regional Energy Agencies**

Local and regional energy agencies support the transition to more sustainable energy systems. They spread management practices, provide information guidance, and offer a range of services based on specific local needs. More than 50 new energy agencies have been set up with the support of Intelligent Energy - Europe since 2004. They add to about 200 agencies set up under SAVE II, the predecessor of the IEE programme. The ManagEnergy website (http://www.managenergy.net/energyagencies.html)
provides more details on Europe's local and regional energy agencies (location, contacts, weblinks).

FEDARENE is the premier European network of regional and local organisations which implement, co-ordinate and facilitate energy and environment policies. Regional and local agencies, ministries and departments working in these fields, are represented in FEDARENE. For more information on this network, see the table above about European networks.

4.6. Funding

There are different grant programmes at European level for the funding of projects carried out at regional and local level related to renewable energies and energy efficiency. The national energy agencies can also facilitate and fund this type of project to a different extent depending on the country.

- Intelligent Energy - Europe Programme
  As mentioned before, the objective of the Intelligent Energy - Europe Programme is to contribute to secure, sustainable and competitively priced energy for Europe, by providing for action:
  - To foster energy efficiency and the rational use of energy resources.
  - To promote new and renewable energy sources and to support energy diversification.
  - To promote energy efficiency and the use of new and renewable energy sources in transport.

The Programme contributes to the Commission's proposed integrated energy and climate change package including the action plan for energy-efficiency and the renewable energy road map.
The different actions promoted by the programme can take the form of projects or the establishment of new local and regional energy management agencies. The programmes provide grants to this end. A new call for proposals was recently launched. Approximately €52 million are available and the deadline for submitting proposals was 28 September 2007.

The majority of grants will be awarded to projects. It is expected that this call for proposals will result in about 65 grants for projects and about 12 new energy management agencies.
For more information in this regard:
http://ec.europa.eu/energy/intelligent/call_for_proposals/index_en.htm

- EU Structural Funds (SF) for renewable energy
EU SF are the EU’s basic instruments for supporting social and economic development in EU MS. They account for over a third of the EU budget and
play an important role in fostering local and regional restructuring across the Union. In addition to the cohesion fund, which supports large infrastructure projects in the field of environment and transport, there are four structural funds: the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Financial Instrument for Fisheries Guidance (FIFG) and the guidance section of the European Agricultural Guidance and Guarantee Fund (EAGGF).

The new structural fund programmes will run from 2007 to 2013. A clear focus on measures promoting energy efficiency and RES is planned. In principle, renewable energy and energy efficiency projects will be eligible under each of the three new structural funds objectives – convergence, regional competitiveness and employment as well as territorial cooperation.

SF can co-finance a broad variety of initiatives, from environmentally-sound public procurement to improving the energy performance of buildings; from sustainable urban transport systems to awareness-raising and support activities for businesses or public authorities. The level of co-financing varies, depending on regions and objectives, from 50% under the regional competitiveness objective to a maximum of 85% of cohesion fund support to the EU’s outermost regions and islands.

For more information in this regard:
http://www.eugrants.org/frametemplate.html

■ JASPERS

The EC, the European Investment Bank (EIB) and the European Bank for Reconstruction and Development signed the Memorandum of Understanding on JASPERS (Joint Assistance to Support Projects in European Regions), the technical assistance vehicle that will help national and regional authorities to prepare projects, including sustainable energy projects, for funding by the EU budget. JASPERS will provide assistance at any stage of the project cycle from initial conception through to the final application for EU funding or the decision to provide EU funding by national authorities. The assistance may cover technical, economic and financial aspects and any other preparatory work needed to deliver a fully developed project.

For more information: http://www.jaspers.europa.eu/

■ EIB

The EIB has significantly increased targets for renewable energy lending since its introduction in 2002. The EIB has adopted new targets in the areas of renewable energy, energy efficiency and GHG emissions reduction.

In line with the “Action Plan for EU energy policy 2007-2009” adopted in March 2007 by the European Council, the EIB has reinforced its contribution in the areas of renewable energy (RE) and energy efficiency (EE):
• New annual target of EUR 800 million (minimum) lending to RE projects
• 50% of EIB lending to electricity generation associated with RE technologies
• EIB financing share of total costs for RE projects increased from 50% to 75%, in particular for “emerging RE technologies” and investments contributing significantly to EE
• Update of the selection criteria for RE technologies
• Development of financial instruments, including framework facilities, for smaller-scale investments and use of structured finance and investment funds
• Introduction of a systematic review of EE issues when assessing projects to be supported by the Bank

For more information:
Annex 5: Questionnaire for Renewable Energy Projects

- Introduction

Objective
This document provides a brief background to the study entitled "The use of renewable energy sources and measures to boost energy efficiency - significant contributions by the local and regional levels to combating climate change", which is currently been carried out by BIO Intelligence Service for the European Union Committee of the Regions (http://www.cor.europa.eu/). This document also contains a list of questions to supplement our understanding and additional data request about the project (title of the specific project), in which your agency/organisation participated actively.

In particular, we are seeking information on the following aspects:
- Role and responsibilities of the bodies involved in the project
- Decision-making progress
- Problems and obstacles
- Citizens’ attitude towards the project
- Technical aspects
- Project’s lifespan
- Key factors of its success
- Project cost
- Project funding mechanism
- Socio/economic impacts/benefits
- Environmental impacts/benefits (e.g. reduction of greenhouse gas emissions, energy consumption reduction, air pollution reduction, etc.).
- Ongoing applications of the project
- The potential to replicate a similar project by other local/regional authorities.

Background
Local and regional authorities in Europe are playing a very important role in the production and use of renewable energies and in increasing energy efficiency. Therefore, the active involvement of local and regional governments is necessary in order to achieve the targets of the European Union’s energy policy. Indeed, many of them give priority to sustainable energy solutions and they set targets for themselves that sometimes are even more ambitious than those at the national or European level. Thus, some of the local and regional plans for reducing energy consumption and the emission of greenhouse gases are successful examples that can be repeated elsewhere.

In this context, the European Union Committee of the Regions launched this study on the contribution by local and regional levels to combating climate
change through the use of renewable energy sources and measures to boost energy efficiency.

The main goal of this study is to analyse successful cases of local and regional authorities promoting renewable energy and energy efficiency in different EU Member States in order to identify key factors contributing to the success of these projects. In other words, this work aims at identifying the patterns of best practice in planning and implementing projects relating to renewable energy and energy efficiency.

■ General Information

Contact details
- Organisation
- Address
- Name
- Position/Department
- Telephone
- E-mail

Organisation
- Please specify the kind of organisation you work in?
  - Local authority (e.g. municipality, prefecture)
  - Regional authority (e.g. county, region, province)
  - National government
  - Other public bodies (e.g. energy agency)
  - Private company (e.g. consultancy/engineering company, industry)
- Please describe briefly the main activities of your organisation

- How many people are employed in your organisation?
  - Less than 20
  - 20-100
  - 101-500

■ Project Objectives and Description

Context of the project
- Geographic location
- Scope (e.g. regional or local)
- Is the project framed within another project/programme?
  - Yes
  - No
- If yes, please specify.
• Can you please provide information on the climatic, economic, topographic and demographic conditions in the area where the project was implemented (e.g. number of inhabitants, main economic activities in the area, etc.)?

Objectives of the project
• What was the main goal of the project?

• What were the specific objectives of the project?

Involved organisations and their role and responsibility
• Name of the promoter/leading partner of this project
• Please specify how the leading partner contributed to the promotion of the project (e.g. funding, advertising, establishment of a private-public partnership, planning, etc.)

• Please list other public organisations that participated in the project and explain their role.

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<thead>
<tr>
<th>Organisation</th>
<th>Role in the project</th>
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</tbody>
</table>

• Was a public-private partnership established for this project?
Yes [ ] No [ ]
• Please specify the name of the private companies and their contribution to the project here:

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Role in the project</th>
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</table>
Beneficiaries

• Who was the targeted audience of the project?
  - Citizens
  - Decision makers
  - Schools and universities
  - Households
  - Professionals of the energy sector (e.g. engineers and architects)
  - Transport companies
  - Financial institutions
  - Other

• What was the area of focus for the project?
  - New buildings
  - Building refurbishment
  - Industry
  - Financial instruments
  - User behaviour
  - Education
  - Transport and mobility
  - Legal initiatives
  - Planning issues
  - Other

• If pertinent, please provide more detailed information in this regard (e.g. number of families involved, number of inhabitants implicated, number of public workers that participated in the awareness campaigns, etc.)

Technical aspects

• Type of renewable energy source and technologies implemented within the project.
  - Solar energy (photovoltaic and solar thermal)
  - Biomass
  - Wind
  - Geothermal
  - Hydropower
☐ Tide and wave
☐ Other

• What is the use of the obtained energy?
  ☐ Heating
  ☐ Cooling
  ☐ Electricity
  ☐ Transport
  ☐ Other

• Please describe in detail the technical aspects of the project, the methods and technologies that were used, the technical performance, the capacity, etc. An explanation on the reasons behind making choices, (e.g. feasibility cost/benefits) would be welcome.

  

**NOTE:** Feel free to send us any complementary technical data.

• What it is the current share of overall renewable energy production in your municipality/region?

  

**Project’s Process and Time Plan**

*Implementation and Project’s lifespan*

• Starting date
• Date of completion
• If not finalised, what it is the provisional date of completion?
• Please describe in detail the main phases of the project (e.g. design, implementation, operation, monitoring, etc.), indicating how they were carried out, the different actors that participated, the output of each phase, and the obstacles that were encountered.

  

• Please specify the starting and ending date for each phase of the project.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Start date</th>
<th>End date</th>
<th>If delayed, please indicate the cause</th>
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<tbody>
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</table>
• Did the project include the promotion of the use of renewable energy, via, for instance, information campaigns/training programmes?
  Yes [ ]  No [ ]
If yes, please provide details.

[ ]

*Decision making process*
This is a very relevant aspect in identifying best practices.
• What were the socio-economic and technical reasons for conducting this project?

[ ]

• Which actors were involved in the decision-making of the project?

• Which actor(s) took the final decision?

[ ]

• Did a public consultation take place during the project?
  Yes [ ]  No [ ]
If yes, please elaborate your answer, specifying what kind of consultation was carried out, how many people/stakeholders were involved, the reasons for public consultation, etc.

[ ]

• Did the outcome of the public consultation have any effects on the decision making process?
  Yes [ ]  No [ ]
If yes, please specify.

___

- What was the role of the public authorities in the decision-making process during the planning and implementation of the project?

___

**The citizen’s attitude towards the project**
The acceptance of a project by the affected citizens plays a very important role in the success of such projects.

- What was the citizen’s general attitude towards this specific project? Please, indicate the reactions that were observed during the different phases of the project.

___

- Please list reactions of local/ regional interest groups (e.g. NGOs, consumer organisations, associations, etc.) towards the project, if any.

___

- In your opinion, what were the factors that contributed to the acceptance of the project?

___

- If there were difficulties concerning the acceptance of the project, which were the reasons for that?

___

**Problems and obstacles**
The analysis of the problems and obstacles during the project planning and implementation process would help to determine weakness and the aspects that could be improved or considered when implementing similar projects at the local and regional level.

- Please fill in the following table indicating the problems that were
encountered and how they were overcome.

<table>
<thead>
<tr>
<th>Barrier/Problems(^{76})</th>
<th>Solution</th>
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<tbody>
<tr>
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</table>

- **Cost and Funding**
  - What was the total capital cost of the project? (Note: If not finalised, please indicate the planned budget). _____
  - What was the cost of the planning phase of the project? _____
  - What was the building cost of the project? _____
  - What payback period is expected? _____
  - If known, please specify the cost of each phase of the project.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Cost (€)</th>
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</tbody>
</table>

- What were the sources of funding for the project?

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Total funding (€)</th>
<th>Programme</th>
</tr>
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<tbody>
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</tbody>
</table>

- Was the final total cost higher that initially estimated?
  Yes ☐          No ☐

If yes, please explain what the causes were.

---

\(^{76}\) Including technical, political, administrative, economical, social or environmental problems.
Results

General results of the project

- To what extent the objectives cited in section 3.2 were realised?

- Please indicate the total energy produced by the implemented renewable energy source (kWh)

- Please describe in detail how the produced energy is being used (e.g. the installation covers 60% of the electricity requirements of the building or community).

Note: If available, please provide quantitative data, e.g. percentage of market targeted and reached, meetings held, persons contacted, students taught, etc.

Socio-economic impacts/benefits

The objective of this section is to identify the different social and economic impacts that have resulted from the implementation of the project. Also, the questions in this section aim to determine ongoing implications of the project (e.g. energy costs saved, running costs, maintenance costs, etc.).

- If available, please indicate the number of jobs created.

- Please describe the project results in terms of population awareness and behavioural change.

- If known, please indicate the results of the project in terms of technological innovation (e.g. the project using a new technology or methodology).

- Please indicate the annual energy cost saved (€/kWh)

- What are the operation and maintenance costs of the installed technologies?
• How did the project affect the energy consumption of the beneficiaries of the project?


• Please indicate the average energy price in the area where the project was implemented. (€/kWh) __
• Did the project have an effect on the consumers’ energy expenditure?
  Yes ☐ No ☐
  If yes, please provide details.


*Environmental impacts/benefits*
The objective of this section is to identify both positive and negative impacts on the environment during and after the implementation of the project, especially in the territory of the authority responsible for the project.
• Please indicate the annual reduction of CO2 emissions (tonnes) resulting from the implementation of the project
• Please indicate the cost per tonne of CO2 avoided resulting from the implementation of the project
• If available, please provide information on the annual emission reductions of other pollutants such as sulphur oxides (SOx) and nitrogen oxides (NOx).


• Please provide information on any other environmental consequence (positive or negative) related to the project (e.g. visual impacts of the implemented renewable technology, reuse of waste, noise, etc.)


**NOTE:** If available, feel free to send us any information and complementary data on the environmental benefits/impacts related to the project.

■ Lessons learnt and repeatability
One of the main objectives of this study is to determine why the specific project has been successful and if it constitutes a best practice project. The main
objective of this section is to identify those factors that are independent on the particular local conditions and that can be considered for replication of the project by regional and local authorities in other parts of the country or in other Member States.

- In your opinion, what were the factors that contributed to the success of the project (e.g. strong support from stakeholders, public participation, funding, the planning process, etc.)?

  

- What experiences were gained and lessons learnt through this project?

  

- In your opinion, how your initiative could be replicated by other parties elsewhere in Europe?

  

- Please describe what you would do differently or avoid doing if you were to help others in replicating your experience.

  

END OF THE QUESTIONNAIRE
# Annex 6: Abbreviations and Acronyms used in the Report

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHP</td>
<td>Combined heat and power</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>CO</td>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>CSC</td>
<td>Cost of saved carbon</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EPC</td>
<td>Energy performance contract</td>
</tr>
<tr>
<td>ESCO</td>
<td>Energy service company</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EU-15</td>
<td>Member States in the European Union prior to the accession of 10 candidate countries on 1 May 2004</td>
</tr>
<tr>
<td>ERDF</td>
<td>European regional development fund</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GDP(PuPP)</td>
<td>GDP at purchasing power parity</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse gases</td>
</tr>
<tr>
<td>GSHP</td>
<td>Ground source heat pumps</td>
</tr>
<tr>
<td>HVAC</td>
<td>Heating, Air Ventilation and Cooling</td>
</tr>
<tr>
<td>HQE</td>
<td>Haute qualité environnementale (High environmental quality)</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>kWh</td>
<td>Kilowatt-hour</td>
</tr>
<tr>
<td>LRAs</td>
<td>Local and regional authorities</td>
</tr>
<tr>
<td>Mtoe</td>
<td>Millions of tonnes of oil equivalent</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>MWth</td>
<td>Megawatt thermal</td>
</tr>
<tr>
<td>MWp</td>
<td>Megawatt peak</td>
</tr>
<tr>
<td>MS</td>
<td>Member States</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-governmental organisation</td>
</tr>
<tr>
<td>NHER</td>
<td>National home energy rating</td>
</tr>
<tr>
<td>PC</td>
<td>Performance contracting</td>
</tr>
<tr>
<td>PV</td>
<td>Photovoltaic</td>
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<tr>
<td>PPP</td>
<td>Public-private partnership</td>
</tr>
<tr>
<td>RES</td>
<td>Renewable energy sources</td>
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<tr>
<td>RES-E</td>
<td>Electricity produced from renewable energy sources</td>
</tr>
<tr>
<td>SF</td>
<td>Structural funds</td>
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<tr>
<td>TWh</td>
<td>Terawatt-hour</td>
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<tr>
<td>TPF</td>
<td>Third party financing</td>
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<tr>
<td>TPES</td>
<td>Total primary energy supply</td>
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<tr>
<td>toe</td>
<td>Tonne of oil equivalent</td>
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<tr>
<td>Wp</td>
<td>Watt peak</td>
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