The involvement of EU regions and cities in the implementation of the re-newed Lisbon Strategy for Growth and Jobs in 2008: Climate Change and Energy

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It does not represent the official views of the Committee of the Regions.

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Contents

Executive summary

This study deals with the following issues:

- Climate change scientific evidence, impacts, mitigation and adaptation;
- Role of the European Union in achieved international agreements;
- EU leadership role in international agreements to fight climate change and European energy policy;
- Member States main policies with regard to renewable energy promotion;
- Role of local authorities in fighting climate change.

The main research question was how local authorities can contribute to fight climate change and, at the same time, improve competitiveness. This question has been addressed in various ways: through a literature survey regarding climate change evidence and policies to address it, and by reviewing experiences on actions undertaken at the local and regional level to fight climate change. Three case studies have been carried out as illustrations of the possible contribution of local and regional administrations.

General considerations

In general terms, there are a number of considerations that deserve attention when considering the role of local administrations in climate change and energy policy. These include the following:

- Climate change is the 21st Century's most urgent environmental problem.
- The scientific evidence shows that climate change impacts would dramatically increase if the temperature rose beyond 2°C above the pre-industrial temperature.
- Real action is needed if we really want to reduce emissions and avoid global warming to go beyond that threshold.
- The EU has been the major leader in international energy and climate policy, pushing for international action and cooperative agreements to combat climate change.
- The EU has also made increasing efforts to design domestic climate and energy measures aimed to reduce its own emissions by up to 20% (30% if other developed countries assume their own objectives).
- The EU has no competences to implement climate change and energy policies and measures designed at the EU level. Instead, policies need to be applied by national and sub-national institutions in Member States.
- Leadership at a local level is therefore important, as there is much that local authorities can do to reduce emissions and fight climate change.

Experiences in some EU local/ regional governments

A number of local and regional administrations already have some experience in designing actions to fight climate change and improve competitiveness. The three case studies analysed in this study show sound local holistic energy strategies leading to environmental improvement and local economic development.

Case study: Thisted Municipality (Denmark)

Thisted Municipality covers an area of 1,072 km² and has a total population of 45,549 inhabitants (2008). It has a good energy planning and sustainable development strategy that combines well industrial activities with environmental protection and job creation.
Thisted Municipality is a **leading climate-friendly municipality**, with more than 100% production of sustainable energy within electricity and 85% within heating. The renewable energy comes from wind, biogas, biomass, rapeseed oil, geothermal energy, solar energy and waste heat from industry.

Case study: City of Seville (Spain)

Seville is the capital city of the Autonomous Region of Andalusia and has a population of 706,000 inhabitants. It has one of the most successful policies among southern European cities, which tend to have less developed environmental policies than northern Member States.
The strategy Seville has proven successful at promoting renewable energy and fighting climate change.

Case study: City of Gelsenkirchen (Germany)

Gelsenkirchen is a German city with a population of 267,000 inhabitants. It represents a good example of environmental regeneration: in the early 20th century, Gelsenkirchen was the most important coal mining town in Europe (the “city of a thousand fires”); today, the city presents itself as a centre of solar technology (the “city of a thousand suns”).
Based on a renewable energy strategy, Gelsenkirchen has regenerated its old fossil fuels dependent economy and has created a new local economy based on renewable technologies.

Conclusions

The conclusions firstly focus on global warming and the possible impacts of climate change. Next, the role of the three levels of governance that we dis-

tinguished (European, national and local/ regional) in reducing CO_2 emissions and responding to the global challenge of climate change is discussed.

Global warming

According to the Intergovernmental Panel on Climate Change (IPCC), Global Green House Gas (GHG) emissions due to human activities such as the burning of fossil fuels and the destruction of forests have increased 70% since pre-industrial times. As a consequence, global concentrations of GHG and mean temperatures have risen.
The impact of rising temperatures can now be seen in the melting ice in the Arctic and the Alps, rain and snowfall patterns, droughts and heat waves, the intensity of tropical cyclones, etc.
Scientists believe that global warming must be limited to no more than 2°C above the preindustrial temperature if we are to prevent climate change from having irreversible impacts. But current climate change mitigation policies and related sustainable development practices are not enough to reduce global GHG emissions. Further action is needed by all levels of governance, including a renewed international agreement to address climate change after 2012.

EU level

Europe's emission reduction goal needs leadership in securing the implementation of the post-Kyoto international agreements and achieving reductions itself. The EU has been the major leader in international climate policy and has made increasing efforts to reduce its domestic emissions.
The EU-27 as a whole is now likely to meet its Kyoto Protocol 2012 targets, but a 20% emission reduction (30% if other developed countries agree) will require further efforts. Actions planned at the EU level to achieve that goal include:

- EU Emissions Trading Scheme.
- Voluntary environmental initiatives.
- Renewable energy promotion, including bio-fuels.
- Energy efficiency measures.
- Carbon capture and storage development.

Member State level

The EU is responsible to design climate change and energy policies at the EU level. However, The EU has no competences to execute measures. Policies need to be implemented by supranational institutions of the EU and national or sub-national institutions in Member States.

Member States are using a variety of renewable electricity support policies. Main support schemes are feed-in tariffs which are being used in 18 Member States and quotas - often combined with tradable green certificates- which are being used by 7 Member States. Other support policies include tenders, soft loans and investment incentives.

Local level

Local authorities are key players in the climate change challenge. They can reduce their own emissions and encourage their community to reduce their emissions. Local energy strategies and policies may bring about significant environmental benefits, jobs creation and local wealth. Table S.1 shows some estimates from the case studies for greenhouse gas emissions, but there are of course other socio-economic and environmental benefits as well.

	Case one (Thisted municipality)	Case two (Seville city council)	Case three (Gelsenkirchen)
CO_2 reduction (Tn/year)	**90,000**	**34,000**	**200,000**
Main environmental goals achieved	√ 70% of electric power covered by windmills; √ 40% of energy power produced by CHP power plant; √ 82% of heating produced with renewable energy sources	√ 1,280 MWh/year of electric power produced by PH cells; √ 40,000 m^2 of solar-thermal energy panels installed in private buildings; √ increase of the total surface of green areas from 1,680,332 m^2 (1.70 m^2 per in habitant) to 7,243,874 m^2 (9.7 m^2 per inhabitant)	√ 1.14 GWh/year of electricity power produced by PH cells[1]; √ 21,070 m^2 of high efficient houses and buildings constructed; √ conversion of heavy industry in a more environmentally responsible one
Main socio-economic goals achieved	√ average price of heating 50% lower than the national one; √ creation of a strong local compromise for renewable energy development; √ energy self-sufficiency	√ estimating energy saving of € 3,000,000; √ € 110,000 per year of PH cells produced energy sale; √ establishment of a strong local renewable energy industry	√ heating reduction costs of €14,000 per year; √ improvement of residential standard and application of new quality criteria for housing; √ creation of a solar industry cluster

[1] Data refer to the five biggest photo voltaic plants in the city.

1 Introduction

1.1 Background and Context

Climate change is the 21st century's most urgent environmental problem. The promotion of renewable energies and higher energy efficiency to fight climate change is at the heart of the energy policies of the European Union. This will have an impact on European competitiveness and employment, so local and regional administrations will need to understand decisions in order to adapt and take the opportunities that will come.

1.2 Scope of the Study

The main aim of the present study was to introduce climate change and to understand the role of the EU cities and regions in the implementation of climate change and energy policy. This will help to understand the extent to which local policies can be expected to have a real impact on climate change and the degree to which these policies are likely to bring local environmental and socio-economic benefits.
The information needed to answer this question has been collected in various ways. A survey was made of relevant existing documents related to climate change science and policy. In addition, a number of local case studies have been carried out in order to understand how local and regional administrations can adapt and take the opportunities that European climate and energy policies (i.e. the promotion of renewable energies and higher energy efficiency to fight climate change) will bring. For these case studies, market data and expert views from different stakeholder groups were collected.

1.3 Structure of the Study

The present report contains the findings of the study. Section 2 introduces climate change scientific evidence. It also describes the EU leadership role in international agreements to fight climate change, analyses the EU common energy policy and explains how different government levels can act in order to reduce emissions. Section 3 presents the findings from the case studies: Thisted Municipality (Denmark), City of Seville (Spain) and City of Gelsenkirchen (Germany). They show how local and regional administrations can contribute to fight climate change and improve competitiveness. Section 4 concludes.

2 European policies on climate change and energy

2.1 Methodological background

2.1.1 Introduction

The greenhouse effect is the process by which the atmosphere traps some of the sun's energy, warming the earth and moderating our climate. Human activities are increasing 'greenhouse gases' artificially, by (1) **emitting CO_2** by burning fossil fuels and through deforestation, (2) **releasing methane** from agriculture, animals and landfill sites and (3) **emitting nitrous oxide** from agricultural production and chemical activities. As a result, climate change is happening, degrading natural ecosystems (polar ice is disintegrating, permafrost is thawing, coral reefs are dying and sea level is rising, etc.) and impacting our lives.

According to the Intergovernmental Panel on Climate Change (IPCC), the United Nations forum for establishing scientific opinion from all over the world, the world's temperature is expected to increase over the next hundred years by up to 4°C. An average global warming of 2°C can dramatically damage ecosystems and increase risk of hunger, malaria, flooding and water shortages of millions of people. Therefore, the goal of climate policy should be to keep the global mean temperature rise to less than 2°C above pre-industrial levels. This can only be achieved through a rapid reduction in the emission of greenhouse gases into the atmosphere.

This section summarises the main findings of the IPPC Fourth Assessment Report (2007). It reflects the views of more than 2500 scientists who analysed in an exhaustive, objective, open and transparent manner scientific, technical and socio-economical information on climate change[2] risks, adaptation and mitigation.

2.1.2 Working Groups assessment

Summary of Working Group I Report "The Physical Science Basis"

The Working Group I contribution to the IPCC Fourth Assessment Report describes progress in understanding of the human and natural drivers of climate change, observed climate change, climate processes and attribution, and esti-

[2] *Climate change* in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

mates of projected future climate change. It builds upon past IPCC assessments and incorporates new knowledge gained since the Third Assessment. This part summarises the main conclusions of WGI Report.

1. Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased since 1750 and now exceed pre-industrial values. There is *very high confidence* (at least a 9 out of 10 chance of being correct) that this change has happened as a result of human activities: fossil fuel use, land use change and agriculture.

2. Numerous observed long-term changes in climate at continental, regional and ocean basin scales indicate that warming of the climate system is unequivocal. These changes include the following: modifications in arctic temperatures and ice, widespread changes in precipitation amounts and extreme temperatures, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones.

3. Most of the observed increase in global average temperatures since the mid-20th century is *very likely* (90 to 99% probability) due to the observed increase in anthropogenic (i.e. induced by human activity) greenhouse gas concentrations[3]. Warmth of the last half century is unusual in at least the previous 1,300 years.

4. Continued greenhouse gas emissions at or above current rates, would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century. A warming of about 0.2°C per decade is projected for the next two decades for a range of SRES[4] emission scenarios.

5. Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilised.

Summary of Working Group II Report "Impacts, Adaptation and Vulnerability"

The Fourth Assessment of Working Group II of the Intergovernmental Panel on Climate Change (IPCC) shows the current scientific understanding of the impacts of climate change on natural, managed and human systems, the capacity of these systems to adapt and their vulnerability[5]. It builds upon past IPCC assessments and incorporates new knowledge gained since the Third Assessment. This part summarises the main conclusions of WGII Report.

1. Observational evidence and data assessed since 1970 shows that many natural systems are being affected by regional climate changes, particularly

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[3] The Third Assessment Report considered it as *likely* (66% to 90% probability).

[4] SRES refers to the *IPCC Special Report on Emission Scenarios* (2000).

[5] Defined as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

temperature increases. Data has shown that it is *likely* (66% to 90% probability) that anthropogenic warming has had an evident influence on many physical and biological systems (i.e. effects on agricultural and forestry management at Northern Hemisphere higher latitudes such as earlier spring planting of crops; and alterations in disturbance regimes of forests due to fires and pests) as well as on human health (i.e. heat-related mortality in Europe; infectious disease vectors in some areas; and allergenic pollen in Northern Hemisphere high and mid latitudes). Other effects of regional climate changes on natural and human environments are emerging, but the impacts have not yet become established trends (i.e. settlements in mountain regions are at enhanced risk of glacier lake outburst floods caused by melting glaciers).

2. Specific information concerning the nature of future impacts frequently indicates projected changes in precipitation, temperature, sea level and concentrations of atmospheric carbon dioxide. The magnitude of impacts will vary regionally and will depend on issues like the amount and timing of climate change and the capacity to adapt. For example, most European regions will suffer future impacts that will pose challenges to many economic sectors (i.e. increased risk of inland flash floods; more frequent coastal flooding and increased erosion; glacier retreat, reduced snow cover and winter tourism; species losses); in Africa, between 75 million and 250 million people are projected to be exposed to increased water stress due to climate change by 2020; etc.

3. Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions. Some adaptation is occurring now, but more action is needed to reduce vulnerability to future climate change. The limits and costs of adaptation are not fully understood.

Summary of Working Group III Report “Mitigation of Climate Change"

The Working Group III contribution to the IPCC Fourth Assessment Report (AR4) focuses on the scientific, technological, environmental, economic and social aspects of the mitigation of climate change. It builds upon past IPCC assessments and incorporates new literature available since the Third Assessment Report (TAR) was published. This part summarises the main conclusions of WGIII Report.

1. Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004. Carbon dioxide (CO_2) emissions grew by about 80% between in that period, so that global atmospheric concentrations of CO_2 in 2005 (379ppm) exceeded by far the natural range over the last 650,000 years. GHG emissions will continue to grow over the next few decades if no further climate change mitigation policies and related sustainable development practices are developed.

2. The good news is that all sectors (energy supply, transport, buildings, industry, agriculture, forestry and waste management) have substantial economic potential to reduce GHG emissions over the coming decades, but full

use of available mitigation options in not being made in either industrialized or developing countries. New energy infrastructure investments in developing countries, upgrades of energy infrastructure in industrialized countries and policies that promote energy security can, in many cases, create opportunities to achieve GHG emission reductions. Multiple mitigation options exist in the transport sector, although their effect may be counteracted by growth in the sector. Energy efficiency options for new and existing buildings could considerably reduce CO_2 emissions with net economic benefit. The economic potential in the industrial sector is predominantly located in energy intensive industries. Agricultural practices can make a significant contribution at low cost by increasing soil carbon sinks, reducing GHG emission and contributing biomass feedstock for energy use. Forest-related mitigation activities can considerably reduce emissions from sources and increase CO_2 removals by sinks. Post-consumer waste is a small contributor to global GHG emissions, but the waste sector can positively contribute to GHG mitigation at low cost and promote sustainable development. Changes in lifestyle/ behaviour patterns are essential to reduce GHG emissions across all sectors.

3. All mentioned mitigation options have country specific additional co-benefits, including air pollution abatement, balance of trade improvement, provision of modern energy services to rural areas and employment. But they all face barriers, such as consumer preferences and lack of policy frameworks that will need to be addressed through national, local and regional policies and instruments. For example, carbon pricing via economic instruments, government funding and/ or regulation could create incentives for producers and consumers to invest in low-GHG products, technologies and processes. International efforts can help to establish a global response to climate change, stimulate national policies, create an international carbon market and establish new institutional mechanisms that may provide the foundation for future mitigation efforts.

4. In order to stabilize the concentration of GHG in the atmosphere between 710 and 445 parts per million CO_2, emissions would need to peak and decline thereafter. This can be achieved at a global average macro-economic cost between 1% gains to a 5.5% decrease of global GDP, by deploying a portfolio of currently available technologies and those that are expected to be commercialised in coming decades[6]. Costs vary considerably among countries and sectors.

5. Changing development paths can make a major contribution to climate change mitigation, although implementation may require resources to overcome multiple barriers.

[6] See Working Group III Report for an exhaustive list of mitigation options

2.2 Climate and energy policy at the EU level

The United Nations Framework Convention on Climate Change (UNFCCC) binds signatories to avoid "dangerous anthropogenic interference with the climate", but does not specify how this translates to firm goals. The European Union has agreed to avoid that global warming exceeds 2°C above pre-industrial levels.

Europe's ambitious goal implies far lower emissions compared to business as usual. It needs European leadership in achieving reductions itself, that starts with meeting its own commitments under the Kyoto Protocol. That is, reduce emissions up to 8% below 1990 levels for the EU-15 and reduce emissions up to 6% for all of new Member States except Poland and Hungary.

According to UN data published in 2008[7], GHG emissions in the EU have fallen by 2.2% compared to 1990 levels in 2006. The most recent data from the European Environment Agency (EEA)[8] indicates that EU-27 as a whole is likely to meet Kyoto targets between 2008 and 2012, thanks to emissions reductions in Germany, the United Kingdom and the new Member States. Emissions reduction by new Member States is due to reduction of industrial production in the Eastern European countries following the socialist system breakdown. The same data indicates that several countries in the EU-15 are challenged by their EU burden sharing targets[9]. See **Table 2-1** for an overview of GHG emissions in the EU Member States.

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7 United Nations Framework Convention on Climate Change, 'National greenhouse gas inventory data for the period 1990–2006', FCCC/SBI/2008/12, 17 November 2008: http://unfccc.int/resource/docs/2008/sbi/eng/12.pdf

8 'Annual European Community Greenhouse Gas Inventory 1990–2006 and Inventory Report 2008', EEA Technical Report No 6/2008.

9 In June 1998, the EU Council reached political agreement on internal 'burden-sharing' - i.e. the allocation of responsibility to individual Member States for the achievement of the common Kyoto target - as well as on the need for further development of common measures.

Table 2-1 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF[10]) and Kyoto Protocol targets for 2008–12

MEMBER STATE	Kyoto Protocol base year (million tonnes)	2006 (million tonnes)	Change base year 2006 (%)	Targets 2008-2012 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79,0	91,1	15,3	-13,0%
Belgium	145,7	137,0	-6,0	-7,5%
Denmark	69,3	70,5	1,7	-21,0%
Finland	71,0	80,3	13,1	0,0%
France	563,9	541,3	-4,0	0,0%
Germany	1.232,4	1.004,8	-18,5	-21,0%
Greece	107,0	133,1	24,4	25,0%
Ireland	55,6	69,8	25,5	13,0%
Italy	516,9	567,9	9,9	-6,5%
Luxemburg	13,2	13,3	0,8	-28,0%
Netherlands	213,0	207,5	-2,6	-6,0%
Portugal	60,1	83,2	38,4	27,0%
Spain	289,8	433,3	49,5	15,0%
Sweeden	72,2	65,7	-9,0	4,0%
United Kingdom	776,3	652,3	-16,0	-12,5%
EU-15	**4.265,4**	**4.151,1**	**-2,7**	**-8,0%**
Bulgaria	132,6	71,3	-46,2	-8,0%
Cyprus	Not applicable	10	Not applicable	Not applicable
Czech Republic	194,2	148,2	-23,7	-8,0%
Estonia	42,6	18,9	-55,6	-8,0%
Hungary	115,4	78,6	-31,9	-6,0%
Latvia	25,9	11,6	-55,2	-8,0%
Lithuania	49,4	23,2	-53,0	-8,0%
Malta	Not applicable	3,2	Not applicable	Not applicable
Poland	563,4	400,5	-28,9	-6,0%
Romania	278,2	156,7	-43,7	-8,0%
Slovakia	72,1	48,9	-32,2	-8,0%
Slovenia	20,4	20,6	1,0	-8,0%
EU-27	Not applicable	5.142,8	Not applicable	Not applicable

Source: EEA, 2008

EU-27 total emissions fell 0.3% between 2005 and 2006. GHG emissions decreases in that period were due mainly to reductions from households and services (-2.2%), lower industrial emissions excluding iron and steel (-4%), and lower N2O emissions from nitric acid production (-13.1%). Substantial increases came from public electricity and heat production (+1.1%), road transportation (+0.7%), iron and steel production (+4.6%). As a result, 2006 EU-27 CO_2 emissions without land use, land use change, and forestry (LULUCF) were 3.1% below 1990 levels.

In the EU-15, total emissions fell 0.8% between 2005 and 2006. Emissions in 2006 were 2.2% below 1990 levels, but still total EU-15 GHG emissions were 3.7 points above the 2010 target path. As a result, EU-15 CO_2 emissions without LULUCF were 3.4% above 1990 levels. Compared to 2005, CO_2

[10] Land-use, land-use change and forestry

emissions decreased by 0.6% mainly due to lower emissions from households and services (-2.9%), petroleum refining (-4.5%), nitric acid (-16.3%) and adipic acid production (-43.6%). Between 2005 and 2006, GHG emissions increased in the public electricity and heat production sector (+0.6%).
Despite European targets accepted under the Kyoto Protocol already proving a challenge that EU-27 as a whole is likely to meet, it has long been recognised that deeper reductions are needed to avoid a 2°C increase in temperatures. As a consequence, the European Council (March 2007) has committed to a 20% reduction in emissions by 2020 (30% reduction if other developed countries agree). A 30% reduction would require a transition to a low-carbon economy, consistent with keeping global warming under 2 degrees above pre-industrial levels and roughly equates to achieving a 450 parts per million CO_2eq stabilisation target[11].

2.2.1 Leading Role of the EU in Climate and Energy Policy

Since the New Transatlantic Agenda was adopted at the 1995 EU-US summit, the EU has been playing a leading role in global efforts to secure the entry into force and implementation of international agreements. Its efforts – drive for concerns about climate change but also energy security and competitiveness - were essential for the adoption (1997) and the entry into force (2005) of the Kyoto Protocol, intended to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". By October 2008 the Protocol had been ratified by 183 parties, including Annex I parties representing 63.7% of Annex I GHG emissions in 1990. The United States has no intention to ratify the Protocol.
The Protocol obliges industrialized countries and countries of the former Soviet bloc (known as "Annex I Parties") to cut their emissions of GHG by 5.2% for the period 2008-2012 compared with 1990 levels. Developing (non-Annex I) economies were not obliged to join the Protocol and have no GHG emission restrictions. This means that big emitters such as China or India have no obligations under Kyoto.
The EU is now playing a leading role in the international negotiations launched in Bali in December 2007 under the UN Framework Convention on Climate Change. The Conference brought together representatives of over 180 countries, media and observers from intergovernmental and nongovernmental organizations. It aims to reach a global agreement to address climate change after 2012. The date for that is the 2009 Copenhagen climate conference (COP15). Prior to that, the Poznań Climate Change Conference (1 – 12 De-

[11] Emphasis on 'roughly,' as (1) the link between emissions levels, stabilisation and temperature change is determined probabilistically and (2) the impact of Europe's efforts depend on it being part of a total global effort with others taking their own commitments.

cember 2008) provided the opportunity to develop a shared vision for the new global agreement. Although assistants were not able to agree on either a long term goal or targets for emission reductions to avoid dangerous impacts of climate change, Poznan was a useful starting point on the way to the Copenhagen Conference. Although a lot of work and political commitment are still needed to reach a post-2012 agreement.

2.2.2 European Climate Change and Energy policy

The European Union is committed to working for a global agreement to control climate change and is leading the way by taking ambitious action of its own since the early 1990s. In **1997**, the European Commission introduced in the White Paper on Renewables (European Commission, 1997) the objective of fulfilling 12% of the EU-15's total energy demand from renewables by 2010.

In **2000** the Commission launched the first European Climate Change Programme (ECCP I). The second phase of the European Climate Change Programme (ECCP II) was launched in **2005**. The ECCP has led to the adoption of a wide range of policies and measures. As a result, 15 countries that were EU members at the time of the EU's ratification of the Kyoto Protocol in 2002 will reach their Kyoto Protocol target for cutting greenhouse gas emissions.

In **March 2007**, EU leaders made a unilateral political commitment to further cut the Union's aggregate GHG emissions in order to reach a target of -20% (compared to 1990 levels) by 2020. To achieve this commitment, in **January 2008** the European Commission proposed an ambitious package of energy and climate measures (i.e. “Climate and Energy Package”). On 17 **December 2008**, the European Parliament endorsed the energy and climate change package agreed by EU’s 27 leaders at a summit held in Brussels on 12 December. Final agreement was reached after eleven months of difficult negotiations and pressures coming from Member States such as Germany, Italy and Poland that obliged the Council to: (1) hand out free emissions allowances to heavy industry and Member States which rely on coal power or have sectors at risk of “carbon leakage” (for example, Germany, Italy and Poland); (2) allow EU countries to “offset” a substantial (i.e. no more than 50%) part of their carbon reductions by financing climate projects in developing countries (for example, Sweden and Belgium).

The successful implementation of a battery of measures and instruments such as those agreed under the “Climate and Energy Package” is needed if the EU wants to reduce its emissions by 20% and contribute to the goal of avoiding global average temperature beyond 2°C. The instruments include: (1) **EU Emissions Trading Scheme**; (2) **voluntary initiatives** such as the Environmental Management Auditing System (EMAS); (3) the **Covenant of Mayors**

launched by the European Commission to encourage European cities[12] to take actions and develop projects, policies and measures to reduce GHG emissions and favour climate protection; (4) and the deployment of **new energy technologies** to improve energy efficiency, further introduce renewable energy and develop carbon capture and storage (CCS). Initiatives at EU level to improve energy efficiency, promote renewable energy and develop (CCS) are ranging from research (the multi-year framework programmes, of which the new 7th one is an example), to facilitating project and programmes which promote take-up (Intelligent Energy Europe) to policies (renewable energy targets). Here, we focus on the new set of policy documents on energy and climate change endorsed by the European Parliament on 17 December 2008 ("Climate and Energy Package").

EU Emissions Trading Scheme (EU ETS)

The so-called EU Emissions Trading Scheme (European Directive 2003/87/EC) created in January 2005 the single largest market for GHG emissions allowances, which is the most significant measure developed at EU level to cut carbon emissions cost-effectively. The Directive directs Member States to allocate GHG emissions allowances (EUA) for the periods 2005-2007 (first phase) and 2008 – 2012 (second phase) to large fixed sources of CO_2. The 2005 - 2007 period, was seen as a trial that should allow some tinkering for improvement.

The EU ETS applies to specific major point sources of greenhouse gases across the EU, including power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants, and factories making cement, glass, lime, brick, ceramics, pulp and paper. Altogether, it covers some 11,500 installations representing about half of total emissions of CO_2 in the EU. All these installations require a GHG emission permit issued by a competent national authority and must monitor and report their CO_2 emissions. Each installation is allocated an emission cap expressed in a number of allowances (each allowance gives the right to emit one metric tonne of CO_2). These caps are determined by national authorities in accordance with a pre-established National Allocation Plan (NAP), which each Member State must submit to the European Commission for approval. Each Member State must submit one NAP for each trading period (NAP 2005-2007 and NAP 2008-2012).

Each year, the permit holder must surrender a number of allowances corresponding to actual emissions. If these exceed his emission cap, he will have to acquire additional allowances from EU operators who have reduced their emissions below their assigned caps and pay a fine per tonne of unlawfully

[12] Cities and towns are privilege places to deliver new ideas and innovative projects in the field of energy efficiency, development of alternative energy sources, pollution control or citizen's behavioural change.

emitted CO_2[13]. Subject to certain conditions, emission credits from Join Implementation and Clean Development Mechanism projects can also be used to comply with EU ETS obligations. This is explained in a linking directive approved in 2004 by the European Parliament.
Progress to date in the EU ETS has been a story of ups and downs, particularly in the 2005-7 trading period. The main failure to date has been de over-allocation of allowances. This was in part fixed for the second trading period (2008-2012), although many Member States still gave generous allocations. So it remains to be seen whether second period allocations will be low enough to encourage innovation and emission reduction effort.
Voluntary initiatives
The term 'voluntary initiatives' is a general way of referring to different voluntary instruments (e.g. voluntary agreements, programmes, standards, codes of conduct, guidelines, principles, statements, policies etc.) with different levels of compliance. The Commission keeps a positive attitude towards this kind of instrument and it has proposed a few environmental voluntary agreements on the European level. In addition, the European Commission supports a number of programmes, technology platforms, codes of conduct, product labelling and environmental management certification.
Voluntary initiatives introduced by the Commission in the area of energy efficiency include two voluntary **Codes of Conduct** (one for external power supplies and one for digital TV services) and various programmes to give support to partners in the form of **information resources and public recognition**: (1) European Motor Challenge Programme, which focuses on non residential users of compressed air, fan and pump systems, (2) Green Light Programme, a partnership between non-residential electricity consumers and the EC to install energy-efficient lighting technologies in their facilities and (3) Green Building Programme, addressed to owners of non-residential buildings to realise cost-effective measures which enhance the energy efficiency of their buildings.
In the field of the new integrated life-cycle approach to environmental product policy, the recent framework Directive on setting eco-design requirements for energy using products in industrial sectors (Directive 2002/35/EC), gives **priority to self-imposed measures over regulation**. The implementation of this Directive has just begun, so it is not known yet whether in practice self-regulation will prevail over binding standards.
Other voluntary schemes, supported and supervised in various degrees by the EC are (1) **EMAS** (Environmental Management Auditing System) certification for companies or services or (2) the EU **Eco-label for products and Energy Star label for office appliances** (in partnership with the U.S.). For

[13] €20/tonne in the first period and €100/tonne in the current period

EMAS, Member States are responsible for the compliance of the operators, accrediting third parties verifiers and informing the Commission[14].
Some voluntary agreements at the EU level **have been successful** (e.g. industry self commitments on energy savings targets for washing machines, the Energy Star programme and Green Light initiative), while **others have failed**. Among the later, we can find the ACEA (European Automobile Manufacturers' Association) voluntary agreement to deliver to CO_2 targets by car companies. Its non-success has obliged the Commission to propose legislation setting binding targets.

Renewable energy: increase the share of renewable energy in EU primary energy consumption

The promotion of renewable energies is at the heart of the energy policies of the European Union. On the EU level, targets have been set for the share of renewable electricity and bio-fuels to be achieved by 2010. These shall help in meeting the overall objective for achieving a 12% share of renewables in total energy consumption by 2010. Additional targets for 2020 form part of the recent proposal to promote the use of energy from renewable sources (European Commission, 2008a).
In 1997, the White Paper on renewables introduced the objective of fulfilling 12% of the EU-15 total energy demand from renewables by 2010 (European Commission, 1997). The White Paper formed the basis for the current two cornerstones of the EU legislation on the issue:

- The directive on the promotion of electricity from renewable energy sources (2001/77/EC), which sets a target of 22.1% of gross electricity consumption to be met by renewables in the EU-15 in 2010. Complemented by national targets for the new EU Member States, included in the Accession Treaties, the EU-27 target for 2010 became 21%. Although the contribution of renewables has increased by 55% since 1997, the EU will probably fall short of the renewable target established in the directive.
- The bio-fuels directive (2003/30/EC), which sets 'reference values' of 2% and 5.75% for the share of bio-fuels in transport diesel and gasoline consumption to be met by the end of 2005 and 2010, respectively. The directive obliges Member States to formulate national indicative targets, taking into account the proposed reference values.

On 23 January 2008, the European Commission published a proposal for a new directive on the promotion of the use of energy from renewable sources (European Commission, 2008a). Te proposal builds on the Conclusions of the European Council from March 2007 (European Council, 2007). On December 17 2008, the European Parliament voted in favour of a directive on the pro-

[14] 3,658 organizations and 5,380 sites in the EU were certified EMAS in 2007.

motion of the use of energy from renewable sources. Member States must present National Renewable Energy Action Plans to the Commission by 30 June 2010 at the latest. The national plans shall set out Member States' national targets for the shares of energy from renewable sources in transport, electricity and heating and cooling in 2020.
The directive extends the EU's policy on renewable energies to the year 2020. It establishes a legally binding 20% target for the share of renewable energy (covering renewable heat, electricity and transport fuel) in the final energy mix by 2020. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. All Member States shall achieve a uniform binding minimum bio-fuel share of 10% in transport diesel and petrol demand, but EU countries are free to decide their preferred renewable 'mix' in order to take account of their different potentials, current deployment of renewable technology, local conditions and Member State's GDP[15]. The directive gives the opportunity to trade 'guarantees of origin', allowing those over-complying to sell certificates to those needing them.

Use of bio-fuels

Bio-fuels are regarded by the Commission as a key measure not only to reduce greenhouse gases from the problematic transport sector, but also to reduce the EU's heavy dependence on imported oil from politically unstable countries. Security of supply and, with the possibility of oil prices remaining high more or less permanently, the balance of payments are also key issues.
The bio-fuels directive (2003/30/EC) sets "reference values" of 2% and 5.75% for the share of bio-fuels in transport diesel and gasoline consumption to be met by the end of 2005 and 2010, respectively. The directive obliges Member States to formulate national indicative targets, taking into account the proposed reference values. Since the bio-fuels directive was approved, uptake of bio-fuels has been very uneven. Only Germany and Sweden have reached Directive 2003/30/EC's 'reference value' of 2% of all fuels in 2005 and the directive's target of 5.75% cent bio-fuel in 2010 is unlikely to be achieved.
As part of the new overall 20% renewable target indicated in the new directive, the directive has established a minimum binding target of 10% for the use of bio-diesel in transport by 2020. Bio-fuels shall be taken into account for that purpose only if they fulfil the **sustainability criteria** ensuring that bio-fuels and other bio-liquids do not originate from raw material obtained from land with high biodiversity value and/ or land high carbon stock and/ or land that was peat-land in January 2008 (European Parliament, 2009).

[15] National targets range from 10% in Malta to 49% in Sweden.

Increase energy efficiency

Energy efficiency and demand side management have been recognized by the EU as priority means to comply with the energy security of supply and climate change agendas. The Green Paper on Energy Efficiency (COM (2005) 265) identified over 20% estimated savings potential in EU annual primary energy consumption by 2020. The potential for energy saving in the EU per sector being: households (residential) 27%; tertiary 30%; transport 26%; manufacturing industry 25%.

A number of **Directives** exist in various sectors **to promote energy efficiency**. They include: (1) the **energy labelling of households equipment Directive** (92/75/EEC) has been regarded as a great success in moving the market towards more efficient appliances; (2) the **energy performance of buildings** d**irective** (2002/91/EC) demands Member States set minimum standards for the energy performance of new buildings; (3) the **energy end-use efficiency and energy services** d**irective** (2006/32/EC) requires Member States to adopt a national indicative energy savings target of 9 % within 9 years (by 2016) and to provide a series of three reports on their Energy Efficiency Action Plans to outline the progress achieved in their implementation; (4) the **directive on the promotion of cogeneration** (2004/8/EC) provides harmonisation of definitions of efficient CHP, establishes a framework for a scheme for a guaranty of origin of CHP electricity, and sets the general target of having electricity production from cogeneration increased to 18%.

Moreover, the Commission recently proposed an **energy efficiency action plan** (COM (2006) 545), endorsed by EU leaders at the Spring Council meeting (8-9 March 2007) Implementing the plan should mean that energy consumption will be 20% lower by 2020 than it would have been without intervention. This should translate into savings of €100 billion a year and a reduction of CO_2 emissions of 780m tonnes[16]. The proposed Action Plan pushes the above measures forward and contains over 70 proposed measures aim at improving energy efficiency in buildings, transport and manufacturing that can be summarised as follows:

- **Labelling and eco-design requirements**: the Commission will legislate on appliances and other energy using equipment (i.e. motors, computers, street and office lighting, televisions, air conditioning and refrigeration) with particular focus on standby loss reduction. In particular, EU leaders called for increased energy efficiency requirements on office and street lighting to be adopted by 2008 and on incandescent lamps and other forms of lighting in private households by 2009.

[16] Double the 2012 EU Kyoto target

- **Energy efficiency in buildings**: by 2009 the Commission will propose expanding the scope of the energy performance of buildings Directive (2002/91/EC), which will include the first EU-level minimum energy requirements for new and renovated buildings.
- **Microgeneration**: in 2007 the Commission will put forward a proposal for a new regulatory framework to promote the connection of decentralised generation and minimum efficiency requirements for new electricity, heating and cooling plants capacity lower than 20 MW.
- **Fuel efficiency of cars**: the Commission has proposed legislation to ensure the EU meets its target level for average new vehicle emissions of 120g CO_2/km by 2012, which will not be achieved through the existing ACEA voluntary agreement.
- **Energy taxes**: in a review of the EU energy tax directive in 2008 the Commission will 'consider the costs and benefits' of using tax credits as incentives for firms to produce and consumers to buy more energy efficient products.

The Commission has recently announced that it would make a proposal for an international agreement (with OECD and key developing countries such as China, India and Brazil) on energy efficiency.

Promote fossil Fuel and Carbon Capture and Storage

Carbon Capture and Storage (CCS) is a **greenhouse gas emissions mitigation approach** consisting of capturing CO_2 from large sources (such as coal or gas fired power plants) transporting it to a storage site and injecting it into a suitable geological formation where it should remain indefinitely. Over the last few years this technology has been gaining attention, pressing the EU to considering its use and to set up a Working Group on CCS under the Second European Climate Change Programme (ECCP II).
The Working Group on CCS published a report in June 2006 stressing the need for developing the policy and regulatory framework for CCS. The Communication from the Commission "Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal after 2020"[17] adopted on 10 January 2007, set out the EU strategy with respect to CCS. This strategy identifies two major tasks for deployment - (1) Developing an enabling legal framework and economic incentives for CCS within the EU and (2) Encouraging a network of demonstration plants across Europe and in key third countries – which are addressed by a directive proposed as part of the climate and energy package in January 2008.

[17] COM (2006) 843 final

That proposed directive outlines establishing a legal framework for CCS, covering site selection and exploration permits, and specifies detailed criteria for the requirements on site characterisation and risk assessment. In addition, it clarifies that it is up to Member States to determine the areas to be made available for storage and the conditions for site use. Although the Commission will provide an opinion on storage permits, permitting decisions will be reviewed by a national competent authority. Impact assessment and public consultation will be ensured under Directive 85/337/EEC on Environmental Impact Assessment which will apply to CO_2 storage sites. Furthermore, the directive covers closure and post-closure obligations, including monitoring and reporting obligations, inspections, measures in case of irregularities and/or leakage and provision of a financial security.

Nuclear power: a controversial issue

The Commission's policy position about nuclear energy is generally cautious, given the different views from Member States[18]. The communication published as part of the energy package (COM (2006) 844), focuses on safety and security of nuclear power. The communication expresses that "nuclear energy generation has a role to play in security of supply, competitiveness and sustainability". In this sense, the latest EU R&D programme (7FP) allocates €1,947 million to research into fusion energy and €287 million for nuclear fission and radiation protection. €517 million are reserved for nuclear activities of the EU Joint Research Centre.

2.2.3 Member States (EU-27) climate change and energy policies

The **EU has no explicit competence in the area of energy policy**, except for certain aspects of nuclear energy (including common radiation protection standards) and a limited number of EU legislative issues on particular aspects of energy policy: (1) legislation to liberalise the market for electricity and natural gas was passed in the mid-1990s using the EU's powers to establish a single market; and (2) legislation to promote energy efficiency and renewables was adopted under the environmental provisions of the Treaty.
That means that the EU has no powers to implement climate change and energy policies and measures designed at EU level. Instead, they **need to be implemented by supranational institutions of the EU and national** (and, in

[18] While France and the Czech Republic agree on the role of nuclear in the fight against climate change, countries like Austria, Belgium, Germany, Iceland, Ireland, Norway and Sweden oppose to nuclear power. And 61% of EU population thinks that nuclear energy should be reduced (CEC, 2008 Attitudes of European Citizens Towards the Environment, Eurobarometer Special Report 295 Wave 68.2TNS Opinion and Social, European Commission, Brussels).

some cases also sub-national) **institutions** in 27 Member States. Although a political consensus has developed recently between the Member States to establish a stronger role for the EU in energy policy, the real action is still at national level. For example, Germany and Spain's growth in wind energy is the result of guaranteed high tariffs paid by spreading the subsidy over the whole rate base.

This is just one example out of a variety of policies in place around the EU-27. **Table 2-2** provides an overview of the support policies for electricity from renewable (RES) across Member States. **Three types of support models** on the supply side of electricity seem to have sprung up: **feed-in tariffs**, **green certificates** and **tenders**. Feed-in tariffs (FIT) are being applied by 18 Member States. Quotas, often combined with Tradable Green Certificates (TGC), are being applied in 7 Member States. Tenders are used in 3 Member States particularly for large renewable plants. Additional policies such as soft loans and investment incentives complement the main renewable support policies.

Table 2-2 Support policies for electricity from renewables across Member States

Country	Feed-In Tariff (FIT), or Quota system (Q) with TGC (+TGC)	Additional support schemes:	2005 share of RES-E	2010 target for RES-E
Austria	FIT (full FIT for 10 years; declining afterwards; annual adjustments)	Regional investment incentives	57.4%	78.1%
Belgium	Q + TGC (Flanders and Wallonia)	Minimum prices for electricity from Renewables from the Federal government ('fall-back prices') Investment support	2.8%	6.0%
Bulgaria	FIT (premium prices)	Tax incentives, purchase obligation	11.8%	11.0%
Cyprus	FIT (15 years support)	Investment grant scheme (30-55%)	0.0%	6.0%
Czech Republic	FIT (15 years support; FIT levels announced annually)	Investment grants Selection possible between FIT and premium	4.5%	8.0%
Denmark	Premium & FIT (for biomass & -gas; technology dependent support 10-20 years)	Offshore wind: tender Photovoltaic: net metering	28.2%	29.0%
Estonia	FIT (7-12 years, not beyond 2015; single FIT for all technologies)		1.1%	5.1%
Finland		Energy tax exemption Investment incentives (40% for wind; 30% other RES-E)	26.9%	31.5%

Country	Feed-In Tariff (FIT), or Quota system (Q) with TGC (+TGC)	Additional support schemes:	2005 share of RES-E	2010 target for RES-E
France	FIT (15 or 20 years depending on technology)	Tenders for plants > 12 MW (except wind)	11.3%	21.0%
Germany	FIT (20 years)	Soft loans	10.5%	12.5%
Greece	FIT (12 years; possible extension to 20 years)	Investment incentives	10.0%	20.1%
Hungary	FIT (no time limit defined)	Grants; Purchase obligation A green certificate scheme was prepared but no start data of implementation is fixed.	4.6%	3.6%
Ireland	FIT (15 years support)	FIT for biomass, hydropower and wind	6.8%	13.2%
Italy	Q + TGC	FIT for photovoltaic (20 years)	14.1%	25.0%
Latvia	Q	Tender for wind	48.4%	49.3%
Lithuania	FIT (10 years)	Purchase obligation	3.9%	7.0%
Luxembourg	FIT (10 years; 20 years for Photovoltaic)	Investment Incentive	3.2%	5.7%
Malta	FIT	Lower VAT rate	0.0%	5.0%
Netherlands	Premiums payments (abruptly abolished in August 2006)		7.5%	9.0%
Poland	Q +TGC	Exemption from excise tax	2.9%	7.5%

Country	Feed-In Tariff (FIT), or Quota system (Q) with TGC (+TGC)	Additional support schemes:	2005 share of RES-E	2010 target for RES-E
Portugal	FIT (15 years)	Investment incentives (up to 40%) Tender for wind and biomass installations	16.0%	39.0%
Romania	Q + TGC	Annual minimum and maximum values of TGC set at 24-42 Euro per certificate (2005-12)	35.8%	33.0%
Slovakia	FIT	Tax incentives; Investment subsidies	16.5%	31.0%
Slovenia	FIT (Full FIT for 5 years, reduced after 5 and 10 years)	Selection possible between FIT and premium Investment funds (40%)	24.2%	33.6%
Spain	FIT (full FIT for 15, 20, 25 years; afterwards reduced FIT)	Selection possible between FIT and premium; Soft loans Tax incentives; Regional investment incentives	15.0%	29.4%
Sweden	Q + TGC	Wind energy: Investment incentives Offshore wind: premium tariff (transitory)	54.3%	60.0%
UK	Q + TGC	Exemption from the Climate Change Levy; Investment Grants; UK is currently considering introducing differentiated certificates for different RES-E technologies.	4.3%	10.0%

Source: Saveyn et al. (2008)

Feed-in Tariff

Feed-in tariffs are **a price-based policy which set the price to be paid for renewable energy per kWh generated** (in the form of guaranteed premium prices). This is usually combined with other policy measures, generally purchase obligation (i.e. the obligation to purchase the renewable electricity by the grid operator), but also low-interest loans (i.e. the feed-in tariffs of wind technology are complemented with low-interest loans in Spain), capital grants, spatial planning, exemption of balancing costs and support for manufacturing of turbines.
Feed-in tariffs (and premiums) form a backbone of the renewable policies in **18 Member States**. They are used across various EU countries for different types of renewable power generation, including biomass, photovoltaic solar, thermal solar, geothermal, small hydro, tidal, onshore wind, and offshore wind (European Commission, 2007c; 2008c). In 2000 more than 80% of the new wind power installed in the EU was put in countries with guaranteed prices, notably Denmark, Germany and Spain. Typically the costs are borne either by consumers or by the public budget.

Tradable Green Certificate

Tradable Green Certificates (TGC) is **a flexible market instrument for environmental policy**. In the TGC scheme, each electricity company gets a quota for the amount of electricity derived from renewables. For each unit renewable electricity delivered to the grid the company receives a green certificate in addition to the electricity price. Companies that do not generate enough energy to fulfil their quota from renewables can buy the certificates from companies that have certificates in excess. RES-E investors receive an extra allowance for their investment, in addition to the market price of the produced electricity, namely the market price of the certificate. This way, RES technologies are at least partly compensated for the environmental benefits they provide. This generates more supply of renewable-generated electricity, favouring competition between the lower-cost suppliers (and technologies). The TGC schemes may stimulate the development of green power if the imposed shares of green power in total sales are significant and if the fine level of non-compliance is high enough to enforce the quota.
In the EU, national or regional TGC markets are used in **7 Member States**: the Netherlands, Sweden, Italy, Belgium, Poland, Romania and the UK (see Table 2-2). The establishment of these national/regional TGC markets is very much in line with the fixed targets for renewables adopted by the Member States under the EU renewable electricity directive (2001/77/EC).

Tender system

Tender is an **incentive on production**. Companies interested in renewable energy projects are invited by the government to bid for developing specific projects. Winning bids receive a long term contract with fixed price for each unit of renewable electricity generated. In addition to achieving environmental targets, the tender system principally aims to establish relevant renewable industries by encouraging "in-house" manufacturing.
Tenders are used in **4 Member States**: Denmark (offshore wind), France (large renewable projects, except for wind), Latvia (wind) and Portugal (wind and biomass installations) for different types of renewable power generation. For example, the Portuguese government issued in 2005 an invitation to bid for grid connection concessions to the public grid totalling 1500 MW. The invitation was limited to the wind power sector and was, at the time, the largest tender of its kind in Europe to date.

2.3 Climate change and energy policy at the regional and local level

To achieve national and international climate saving goals, all mentioned measures and initiatives will need to be implemented at the national level. But Climate change is not simply a matter that can be left at a national level. Action is needed at **all levels of governance, from the local level upwards**. Local authorities are, therefore, key players in the climate change challenge. They play an important part with their regional programs and the realisation of concrete measures.
Local authorities are very important to reduce emissions and fight climate change. Local authorities are responsible for delivering on a range of policies that have a real impact on energy policy and climate change. Their use of energy – for instance in transport systems, local industry, heating and cooling - is a major source of greenhouse gases. They can mitigate climate change through **spatial planning and regulation**, reducing **emissions from their own operations** (including schools and their private sector service providers) or **creating behavioural change** of their wider community, as they can directly approach various relevant actors and are best placed to speak with their citizens and to show how local level changes can contribute to facing challenges.
The way in which spatial planning planned/ built and the way in which resources are used can greatly affect emissions. By re-evaluating how and where we build, we can reduce emissions (mitigating climate change) and help adapt to potential impacts. Through the **planning system**, local authorities can introduce and implement policies which reduce the threat of climate

change by: (1) promoting the highest standards of resource and energy efficiency in new development so as to reduce CO_2 emissions arising from construction and use, (2) requiring land-use patterns that reduce the need to travel by car, (3) promoting renewable energy and low-carbon energy projects, (4) restricting development which has a major negative impact on CO_2 emissions, (5) adapting to the harmful impacts of climate change

The way the local authority run its **own operations** can also have an impact on GHG emissions. This will be to the benefit of public services, residents and businesses both economically and socially. Own CO_2 equivalent emissions can be reduced by (1) using energy more carefully in their own operations, (2) using alternative sources (including bio-fuels for public transport), (3) creating more effective heating in public buildings, (4) introducing changes in the was waste is treated in the municipality[19] and (5) setting targets for green public procurement and applying sustainability criteria when purchasing goods and services.

By communicating with residents and creating wider knowledge of climate change and sustainability through education and publicity, local authorities can help understand climate change. This will **create behavioural change** and will make it easier to achieve the necessary changes to encourage both mitigation and adaptation measures. This can be achieved by (1) making everyone aware and encouraging people to do their bit, (2) informing to the public of the potential local impacts of climate change and to explain the local authority' plans to reduce CO_2 emissions (i.e. promotion of what the authority is doing) and (3) educating to individual residents, community groups and scholars. Encouraging local businesses to become more sustainable is also important in order to reduce local CO_2 emissions.

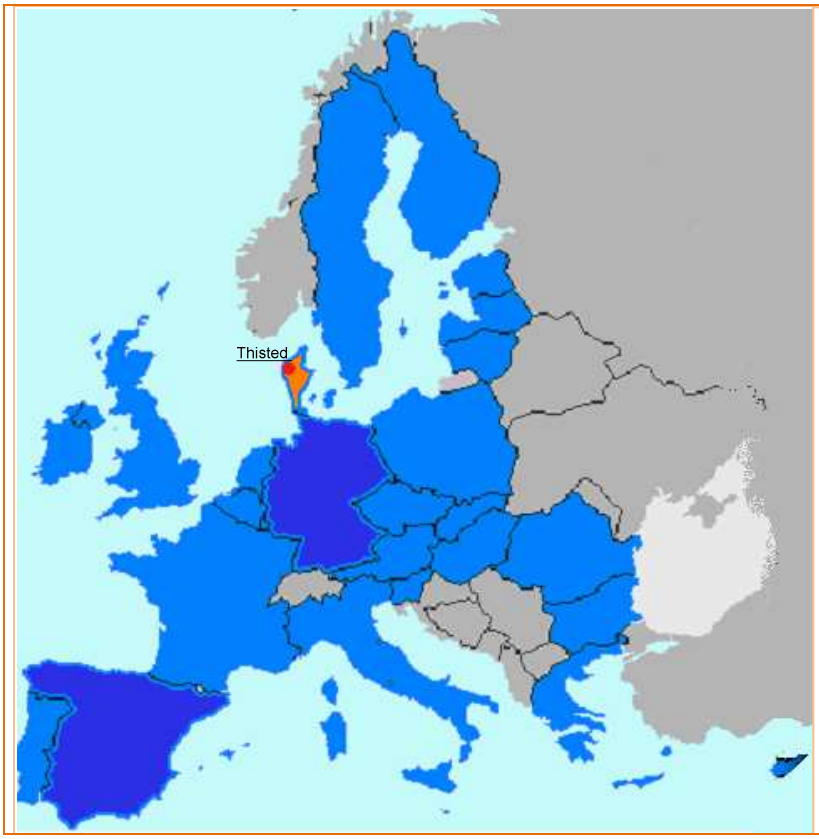
A range of EU mechanisms is available to support local efforts. These include the Structural Funds, the Intelligent Energy programme, the LIFE+ fund and the Civitas initiative on sustainable urban transport.

[19] Waste has an impact on climate change through methane emissions

3 Experiences in some local/ regional administrations with sound initiatives to fight climate change

This section presents three case studies that provide a critical insight into **how local and regional areas are acting in a climate change and new energy policies context**. The selection of the cases has been made in agreement with the LMP and guided by factors such as relevance to study (i.e. innovative nature, participative character, community involvement or affected population) and information availability.

3.1 Case study: Thisted Municipality (Denmark)



Thisted Municipality is a municipality in Region Nordjylland, Denmark. The municipality covers an area of 1,072 km² and has a total population of 45,549 inhabitants (2008). It is a rural costal area characterized by its nature and landscapes that contains Denmark's first national park, which is home to a variety of rare species.

The Municipality represents a useful example for good energy planning and sustainable development strategy in a coastal area. It combines well industrial activities with environmental protection and job creation.

3.1.1 General Context

Thisted Municipality is a **leading climate-friendly municipality** in Denmark. Over 100% of its electricity demands and 85% of its heating demands are produced without using fossil fuels, reducing CO_2 emissions by almost 90,000 tons per year.

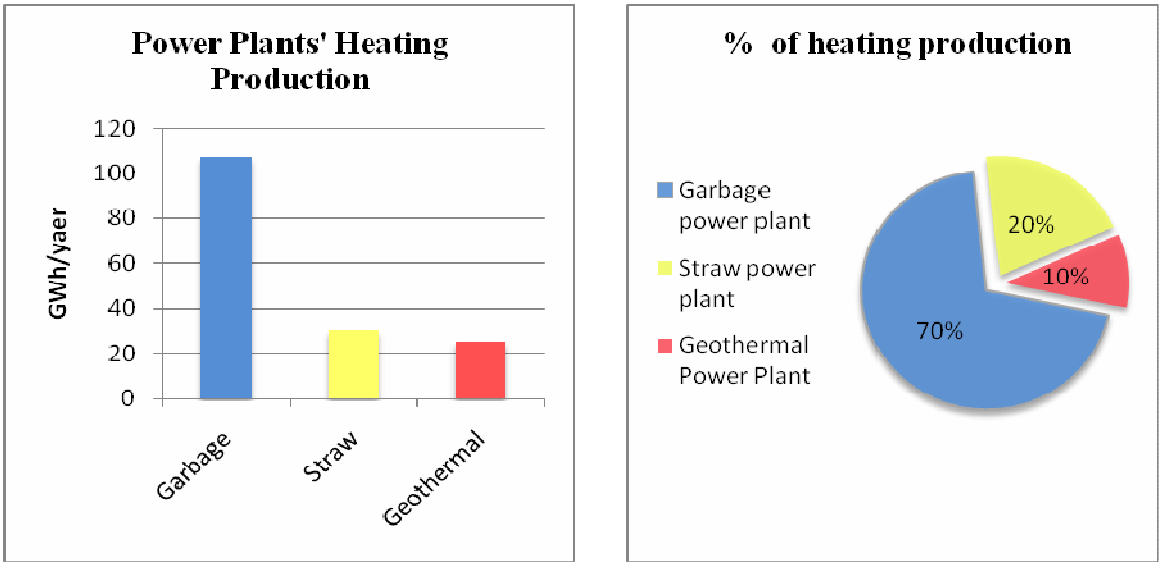
The renewable energy comes from wind, biogas, biomass, rapeseed oil, geothermal power, sun and waste heat from industry. Wind power is present throughout the municipality and contributes to a large amount of energy production within the region. There are several combined heating and power plants that makes the municipality self-supplying with electricity. The major towns in the municipality are all covered by local heating suppliers, which use renewable energy sources.
Locals give support to Renewable Energy. This can be proved by the many locals owning windmills and the several farmers operating biogas plants. The use and development of renewable energy, has attracted new companies to Thisted and created new jobs.

3.1.2 Main projects/ initiatives undertaken

Thisted began its sustainable path in 1982, when the Nordic Centre for Renewable Energy was established in the territory. The Nordic Centre for Renewable Energy is a non-profit, independent organization that provides research, development of technology, training and information for the manufacture, industrial innovation and implementation of renewable energy technologies and energy savings. It aims to achieve measurable increases in the utilization of renewable energy technologies and thereby significant reductions in environmental pollution associated with energy use in Denmark and elsewhere. It obtains support from local authorities, national and international agencies, and the industry. Currently, it is one of the biggest eco-sites within the European Union.
Thisted and the other smaller towns in the municipality have 100% district heating using biomass. The major towns in the municipality are all covered by local heating suppliers, which use renewable energy sources. In total, as much as 82% of the heating comes from renewable energy: a geothermal power plant, a straw power plant and a garbage power plant (see figure 3-1).
The municipality is a leader in the use of geothermal heating. **A geothermal plant** was constructed in the municipality in 1984. The plant, the first of its kind in Denmark, was a co-operative effort between the engineering company *Houe and Olsen* and *DONG A/S*. The geothermal power plant produces 25 GWh of heat/year (10% of total heating production), enough to supply heat to 2000 households a year.
An incineration plant was built in 1991. The facility covers the heating demand for the largest city of the municipality, Thisted. It consists of a combined heat and power plant (CHP) that also uses other forms of renewable energy, such as straw, wood pellets, wood chips and waste material as biomass fuels. The straw power plant manages 800 tons of straw/year and produces 30 GWh of heat/year (i.e. 10% of all heating production).

A garbage power plant also exists. It handles 52000 tons of waste/year and produces 107 GWh of heat/year (70% of heating production) and 25GWh of electricity/year.

Figure 3-1 Heating coming from renewable sources



Source: Thisted commune (www.thisted.dk)

There is also biomass district heating in the local communities of Hurup, Vestervig, Øsløs/Vesløs and Bedsted. They are all 100% heat self-sufficient, with heating coming from biomass, woodchips, pellets, waste and waste heat as heating sources in the district heating network. Five local CHP power plants exist in Hanstholm (4Mw), Klitmølle (2Mw), Vorupør (2Mw), Snedsted (3Mw) and Dragsbaed (8Mw). All CHP plants are not-for-profit consumer owned and are prepared to use bio-fuels.

The municipality is electrically self-supplying. Together with several combined heating and power plants running with renewable sources (e.g. biomass such as straw, wood pellets, wood chips and waste material) and biogas plants, wind power makes the municipality self-supplying with electricity.

Thisted municipality has 252 windmills with an installed capacity of 103 GW. Each windmill is in average at 409 kW. The total production from the 252 windmills was in 2006 at 212 GWh which covers 68% of the electricity consumed in Thisted municipality. Since 1997 the Sydthy municipality, which is now part of Thisted municipality, has been more than 100% self-sufficient with electricity from windmills. All windmills are locally owned, thus the economic benefits are kept in the local community, and they help to sustain and stimulate the local economy. Renewables give jobs to a considerable number of people and provide local acceptance of wind power; in the region no NIMBY (*not in my back yard*) effect has been registered.

There are four large biogas plants, located in Boddum (265Kw), Brund (95Kw), Hunstrup (300Kw) and Bedsted (220Kw), with a total production of 7 GWh/year of electric power. A series of smaller biogas suppliers participate into the sustainable electricity production network.
Finally, there are five combined heat and power plants: Hanstholm (4 MW), Klitmøller (2 MW), Vorupør (2 MW), Snedsted (3 MW) and Dragsbaedmalt (8 MW). They are all prepared for using bio-fuels.
Future developments include a plan for integrating all the local autonomous energy plants in Thisted municipality into one integrated autonomous system. One advantage of such a network would be that the local biogas plants could be connected to the system in a way that they could deliver their surplus of energy (heat) to the entire system. That would enable a reduction of energy costs. This plan also suggests that additional wind power capacity peaks will be used for district heating. Further development of wind power will make wind power the primary source of electricity and heating.
When a local surplus of wind electricity will occur, this will be used in combined heating and power plants, in order to reduce the use biomass and natural gas. Biomass will in this way be back-up storage when wind-and solar energy is not sufficient to cover the need for electricity and heating.
The new wind turbine plan introduces new kind of mechanism for the development of a new and more efficient turbine project and the proposal of 26 new projects involving around 80 wind turbines.
An ambitious transport plan is under construction, with the massive substitution of electric cars in place of conventional ones.

3.1.3 Agents involved

Thisted energy policy is a case of bottom-up development strategy. Main projects start from local people initiatives. The role of the Municipality is to coordinate the local development in accordance with the regional planning. It provides a link between the private sector and public policies on energy and development.
Thisted's strategy is based on three basic parameters:
local action, that implies citizen participation;
local economy support, that implies the use of local companies;
a mix of new and developed technologies in order to guarantee innovation paths and profitable business for local people.

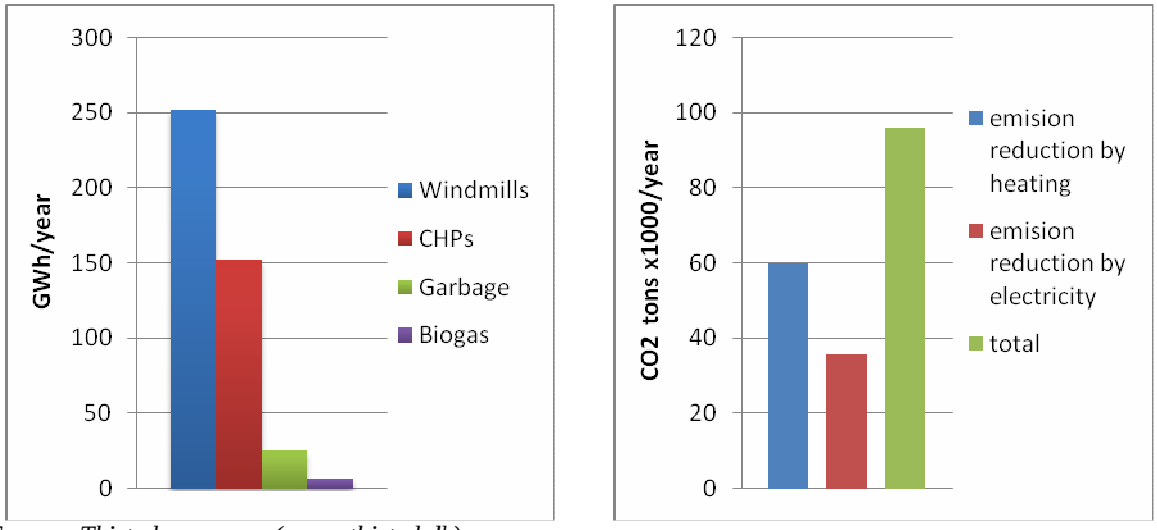
The Central Government gets involved by incentivising and subsidising the production of renewable energy and establishing tax exemptions (i.e. Tax free hydrogen and electric cars).
The Nordic Centre for Renewable Energy plays a key role, especially in the early stage of the renewable energy development. It contributes to local eco-

nomic development by canalizing the origins of funds and allocating the spending in an efficient way.
Recently, the Municipality has made an agreement with the Nature Conservation and Environmental Organization in order to reduce CO_2 emissions by up to 3% each year until 2025.

3.1.4 Environmental and energy impacts

The municipality has reached the energy auto sufficiency in the electric energy supply side: 68% of the electricity consumption is covered by windmills and more than 40% of the energy power is produced by CHP power plants. At the same time, the municipality is trying to be self sufficient in heating production. Today, about 4/5th of heating production is covered by renewable energy sources, and the municipality is working to create an interchange net in order to redistribute the heat surplus coming from the biomass plant within the region. The total renewable energy production permits the saving of more than 90.000 tons of CO_2 per year, which is equivalent to 40,000 barrels of oil (see figure 3-2).

Figure 3-2 CO_2 emissions saved

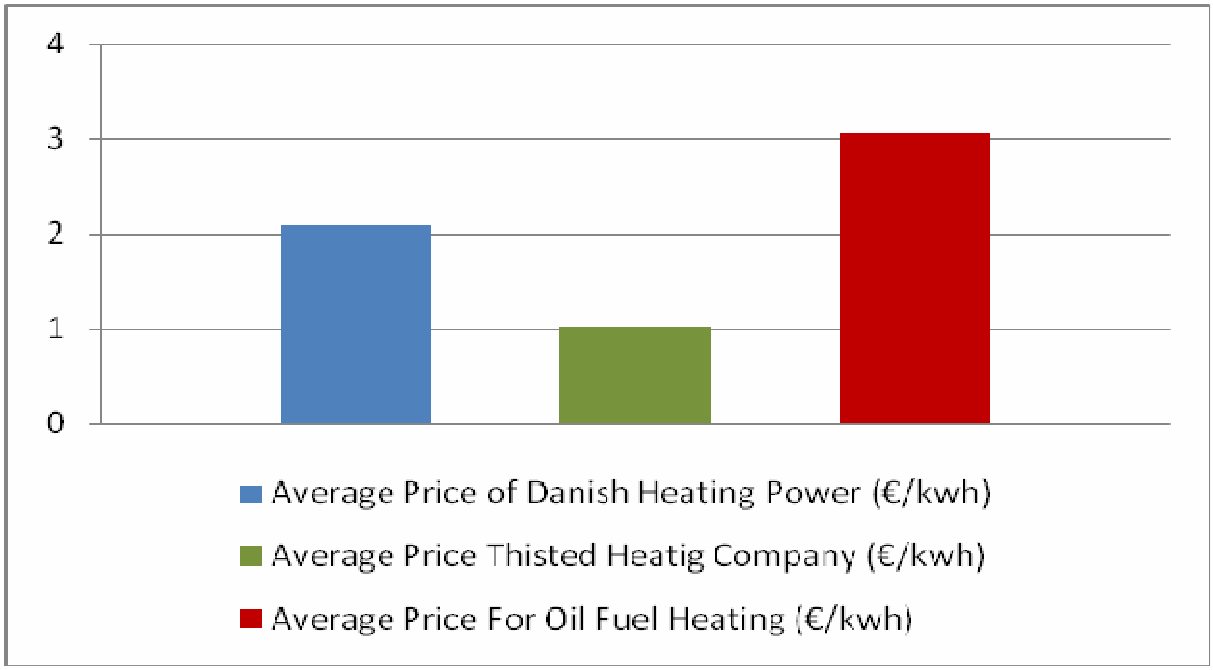


Source: Thisted commune (www.thisted.dk)

3.1.5 Socio-economic benefits

Socio-economic results are very significant. The price of heating from the combined plants is 1/3 of what it would be if oils were used instead, and 1/2 of Denmark's average prices. This saves money for both local authorities and citizens.

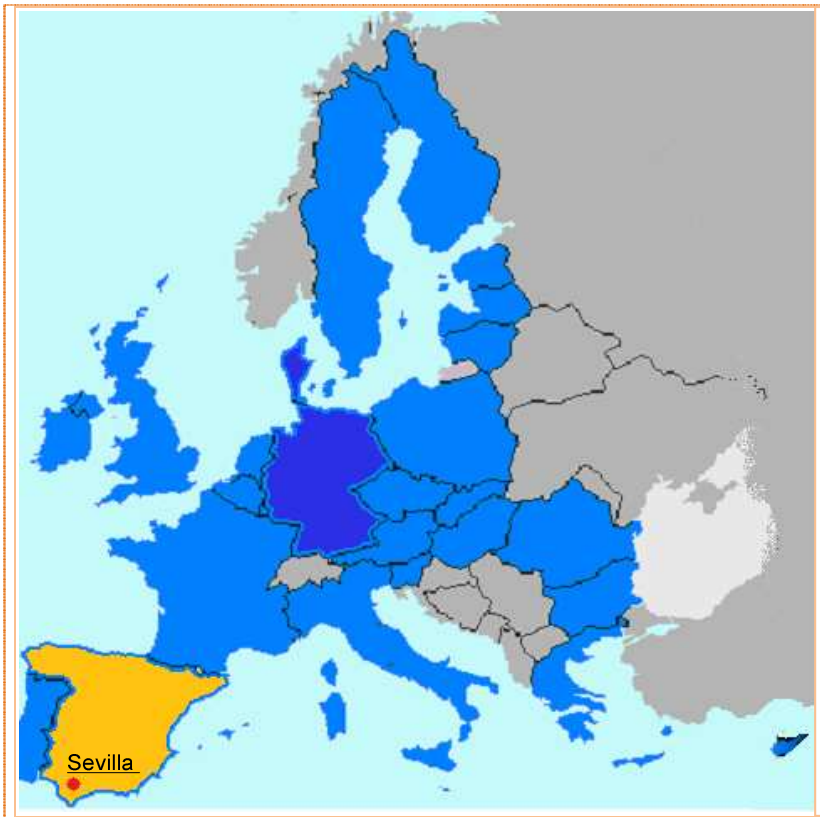
Figure 3-3 Average price of heating



Source: Thisted commune (www.thisted.dk)

Biomasses, particularly straws, used in CPH plants come from farmers that are able to sell something that would otherwise be considered a waste product.
The local compromise for the support of renewable energy is demonstrated by the local ownership of wind turbines and by the fact that that several farmers have their own biogas facilities.
The transformation to renewable energy had another impact on the local economy. New industries have come to the area and created new jobs. These include the main supplier of nacelles for Vestas, several sub-suppliers for wind turbine components as well as a leading producer of equipment for pressing seed oil (CimbriaSKET).
Energy self-sufficiency is a guarantee of competitiveness for the 1,700 businesses that are currently operating in the municipality; it avoids fuel price volatility and minimizes external costs associated with environmental degradation.

3.2 Case study: City of Seville (Spain)



Located in south western Spain, **Seville** is the capital city of the Autonomous Region of Andalucía. The population is 706,000 inhabitants occupying a surface area of 142.44 km2. Its consumption of primary energy is around 1,400,000 tep/year.

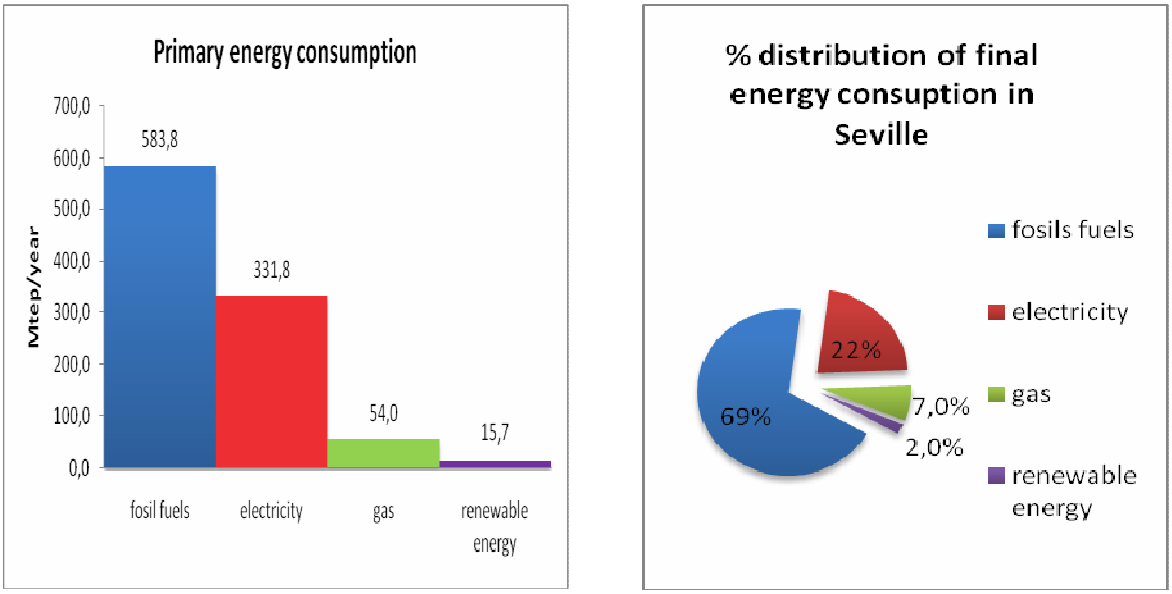
Seville has one of the most successful policies among southern European cities, which tend to have less developed environmental policies than northern Member States. Seville strategy has proved successful at promoting renewable energy and fighting climate change.

3.2.1 General Context

From an energy point of view, the city of Seville is characterised as being a big centre of energy consumption. The City requires a great amount of final energy in order to deal with the energy needs of its transportation, heating and lighting system.

A big amount of the incoming energy is degraded into heat. Therefore, a primary energy consumption of 1,161.5 Mtep/year (total energy loss is 398.6 Mtep/year) is needed in order to face off the given final energy consumption.

Figure 3-4 Primary energy consumption and distribution of final energy consumption in Seville



Source: Ayuntamiento de Sevilla, Agencia de la energía de Sevilla (www.agencia-energia-sevilla.com)

The final consumption of the city of Seville represents 38, 2% of the total province consumption and 7% of the total Autonomous Region energy consumption. This means that the energy consumption per unit area in the City (5.41 tep/km^2) is much higher than the energy consumption per unit in the province of Seville (0.14 tep/km^2) and the Autonomous Region (see table 3-1).

Table 3-1 Energy consumption per unit area

Territory	Energy consumption per unity area (tep/km^2)
City of Seville	5.41
Province of Seville	0.14
Autonomous Region of Andalucía	0.15

Source: Ayuntamiento de Sevilla, Agencia de la energía de Sevilla (www.agencia-energia-sevilla.com)

The Energy Consumption per Capita (tep/inhabitant/year) of Seville (1.09 tep/inhabitant/year) is similar to other cities with similar climate and residential conditions. It is lower than the mean provincial consumption (1.20 tep/inhabitant/year) and higher than the regional consumption (0.98 tep/inhabitant/year). The explanation can be found in the strong influence of the transport and residential sectors, but not in the energy consumption of the industrial sector that tends to be rather low within urban contexts.

3.2.2 Main projects/ initiatives undertaken

During the last few years, the city of Seville has taken action to reduce its energy consumption and its emissions. The consolidation of the Energy Agency of Seville, created in 1997 with the EU support, has represented the key instrument within this process. The Energy Agency of Seville is an administrative body of the Seville City Council created in order to improve city's energy management.
Prior to the creation of the Energy Agency of Seville, there was no model of energy management. However, there was a political and social will to improve the energy model of the city that made it possible to start working on an energy strategy that included measures and policies aimed at saving energy, improving energy efficiency and promoting renewable energy.
Since its creation, the Agency has designed and implemented two main management tools: (1) Ordinance for Local Energy Management; (2) Energy Plan of Seville, which specifies the actions that should be undertaken, both in the city as well as in the City Hall itself, in order to save energy and improve energy efficiency.
In 2000, the Agency elaborated the 1st Energy Plan of Seville 2000-2002. It followed by the1st Ordinance for the Management of Local Energy of Seville, which formed the basis for the elaboration of 2nd Energetic Plan of Seville 2002-2006. The agency is working on the 3rd Plan 2007-2011, which should have been finished by now.
Main actions proposed in the Ordinance and in the Plans are:

- Improvement of communication and education in energy related issues by:
  - developing activities for non-experts on energy and energy efficiency issues: congresses and seminaries, information and education campaigns;
  - organising technical meetings for experts;
  - writing and editing reports and essays in specialised magazines;
  - creating the **Local Energy Bureau (OFAEM)** to give information and support to all socio-economic agents of the city on issues such as efficient use of energy and the possibilities given to allow reduction on energy costs;
  - creating the **Local Intelligent Energy Forum,** in which politicians, planners, developers, market actors and citizens have the possibility to cooperate in the application of energy efficiency measures in all sectors (BELIEF project).

- Support energy efficiency measures by:
  - developing Optimization Energy Plans (OEP) aimed to reduce the municipal consumption of energy;
  - implementing Optimisation Energy Plans in public buildings;
  - updating the energetic diagnosis of the city hall of Seville and its local installations;

- Promote renewable energy by:
  - developing an ordinance for local energy management of Seville;
  - installing 500 photovoltaic kw in municipal buildings connected to the network (phase three concluded with the installations of 415 kw);
  - promoting sustainable illumination in the rural areas;
  - designing an integral policy of tax bonuses to promote energy efficiency;
  - introducing the obligation of installing solar thermal heat in new and renovated buildings.

- Good management of energy within the urban context by:
  - signing the collaboration agreement;
  - subsidizing projects: Fifth European Conference on Sustainable Cities and Towns, Intelligent Energy for Europe (Project FINANCE), Intelligent Energy for Europe (Project COLUMBUS);
  - designing the local strategy to fight climate change, Seville's local strategy against climate change;
  - participating in international networks.

The city is acting against climate change through the Local Agenda 21. The Local Agenda 21 Action Plan of Seville (2006) outlines 15 strategic lines of action in different fields of the local processes. One action line refers to "energy consumption control, energy efficiency and development of renewable energies". This action line defines the role of the Energy Agency of Seville within the Action Plan and stresses the importance of local policies aimed to increase energy saving and efficiency in local building. The following actions can be underlined:

- give support to the 'Seville Solar City' project, aim to improve and manage the installation of photo voltaic panels in municipal buildings;
- optimise historical building illumination;
- establish bioclimatic criteria for new buildings.

The Local Agenda 21 Action Plan of Seville integrates several energy actions aimed at changing the composition of the final energy consumption structure and fighting climate change. The most relevant are (1) policy actions aimed to support the incorporation of renewable energies in heating and (2) urban mobility strategy to promote the use of public transport and encourage the bicycle use thought the development of an urban cycle track network.
The project Seville Green City started in 1995. It aims to increase and rationalise green spaces in the city. The intervention has entailed investments in rehabilitation, cleaning, gardening and reforestation accounting for 35 million Euros, of which the City Government and the Structural Funds contributed 11 million and 24 million respectively.

The project has made it possible to increase the total surface of green areas from 1,680,332 m^2 (1.70 m^2 per inhabitant) in 1995 to 7,243,874 m^2 in 2000(9.7 m^2 per inhabitant). There are nine big parks within the urban area (2,073,477m^2), four historic gardens (814,252 m^2), two plantations (134 000m^2) and other parks and gardens. The new Urban Plan envisaged an investment of 112 € millions aimed to create 10,000,000 m^2 of new public green spaces within the city. The final aim is to achieve the European standard of 25 m^2 of green space per inhabitant.

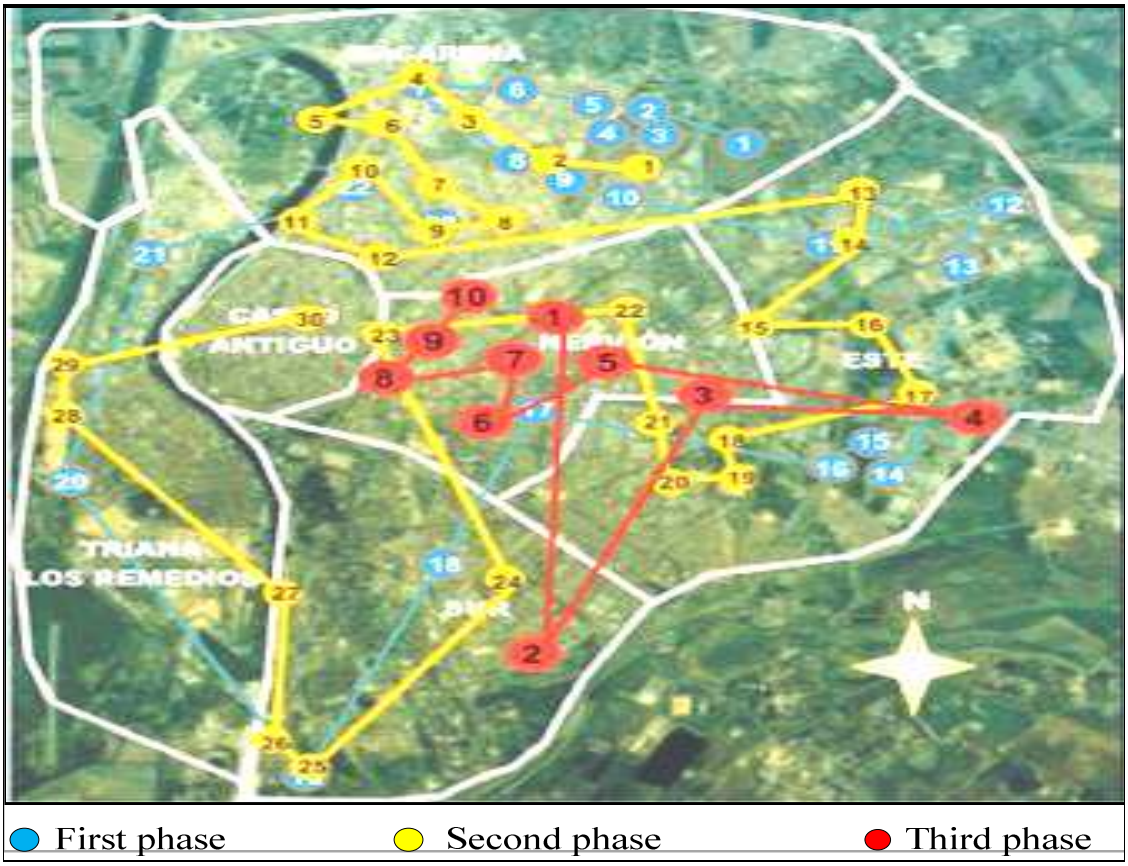
3.2.3 Involved agents

The city council is the main actor involved in the processes. The city council has financed the projects and facilitated technical assistance. The European Union, the Spanish Government, the Spanish Institute for Energy Diversification and Saving (IDEA), the Autonomous Region of Andalusia and the private sector are also involved. The private sector has provided 150,000 € in the last 3 years and has been involved in more than 30 projects. Socio-economic agents have helped design the Ordinance for Local Energy Management, the Energy Plan of Seville and the Local Agenda 21.

3.2.4 Environmental and energy impacts

Main policies have brought a series of environmental and energy benefits. The estimated annual production of electricity produced by the installed photo voltaic panels is around 812MWh/year.The city council currently owns and manages 53 photovoltaic installations, with a global power generation of 265 kw that avoids the emission of 225 tons of CO_2 per year. Electricity is sold to the grid at a subsidized price (0, 44€cent or 0, 34 €cent/kWh). In the short period, ten other projects will be launched, with a global capacity of 235 kW.
A part of the municipal buildings provide a electricity production trough photo voltaic cells, for the self consumption, that accounts for 464 MWh/year and avoids the emission an estimated quantity of 1105 tons of CO_2 per year.

Figure 3-5 Phases of 'Seville Solar City'



Source:www.agencia-energia-sevilla.com

Table 3-2 Annual production, annual revenue, total investment and emission reduction of 'Seville Solar City'

	annual production* (kWh/year)	annual revenue** (€)	total investment (€)	emission reduction*** (Tm CO_2 /year)
1st Phase, 23 facilities	218,066	95,949	1,150,000	108
2nd Phase, 30 facilities	246,390	108,412	1,384,000	117
3rd Phase, 10 facilities	285,544	125,639	1,713,000	138
Total	**750.000**	**330,000**	**4,247,000**	**363**

*estimated with 3000 hours of sun per year
** estimated at a subsidized price of 0.44 €cent per kWh
*** estimated as avoided emissions

Source: Ayuntamiento de Sevilla, Agencia de la energía de Sevilla (www.agencia-energia-sevilla.com)

Since the introduction of the 'Solar thermal Heat Obligation' for new and renovated buildings, more than 10,000 solar heaters (40,000 m2 of solar-thermal energy panels) have been installed in houses and buildings. This avoids the emission of 26,000 tons of CO_2 a year.
Within the Optimization Energy Plans (OEP):

- 365 municipal buildings have been better insulated and made more efficient in terms of energy use;

- for 1,385 electric contracts of public lighting, 56,850 high-consumption lamps have been replaced with low-consumption ones ;
- LEDs have replaced old bulbs in 430 crossings with traffic lights (10,800 lamps);
- Improving energy efficiency in sport facilities and buildings.

CO_2 reduction for OEP measures is estimated to 5,612 Tm per year.
In the case of green space policies, and defining the 'net carbon dioxide reduction' as the difference between CO_2 reductions and releases in metric tonnes[20], estimating an average tree life for the selected species of 80 years, and taking into consideration the latitude of the city and the average growth rate of trees, it possible to estimate that each tree can avoid 200kg of CO_2 in its life. This means that the plantation of more than 6,000 trees can avoid the emission of 15 tons of CO_2 every year.

3.2.5 Socio-economic benefits

Economic benefits come from both energy savings and power sales.
Efficiency policies are estimating to generate energy saving of 3 million Euros per year.

Table 3-3 energy saving of implemented policies in energy efficiency

Implemented policies on energy efficiency	Energy's cost saving
Optimization of electricity bills	543,663
Improvement in lighting efficiency	511,109
Stabilisers	1,149,244
LEDs in traffic lights	773,227
Sport facilities and buildings[21]	605,000
Total	3,582,243

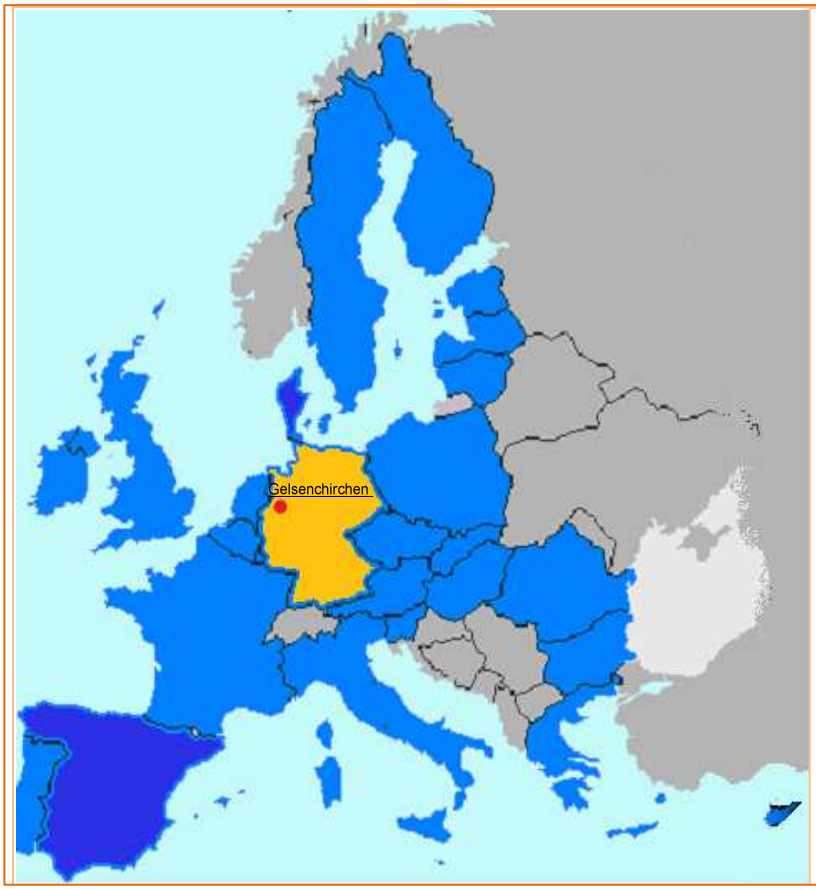
Source: Ayuntamiento de Sevilla, Agencia de la energía de Sevilla (www.agencia-energia-sevilla.com)

Revenues coming from photovoltaic energy sales have been estimated at 110,000 Euros per year for phase one and two.
New green areas have increased the citizens' perception of Seville as a comfortable place to live, while the effort made in education and information has brought to the creation of environmental social networks within the city border. The main target achieved has been the wide distribution of the energy problem

[20] The release of CO_2 is offset by CO_2 sequestered as woody biomass and CO_2 emissions avoided due to savings in space heating and cooling.
[21] Sport facilities and buildings represent 3.5 % of the total energetic cost of the city hall of Seville.

and its awareness that overtakes the future of the City as it is now, the sustainability problem that it means and its main solutions in hand.
Other social gains have come from the establishment of a strong renewable energy industry that allows worldwide leadership in some renewable technologies such as thermoelectric and photovoltaic systems.

3.3 Case study: City of Gelsenkirchen (Germany)



Gelsenkirchen is a city in North Rhine-Westphalia, Germany. It is located in the northern part of the Ruhr area. Its population is c. 267,000. In the early 20th century Gelsenkirchen was the most important coal mining town in Europe.

Gelsenkirchen represents a good example of environmental regeneration. As a former mining and steel industry location (the 'city of a thousand furnaces'), the city has set itself the aim of playing an active role in shaping the transition from the coal age to the solar age, and becoming a 'city of a thousand suns'.

3.3.1 General Context

The city of Gelsenkirchen was for many years a prosperous centre of heavy industry. Coal mining and the iron and steel industries attracted workforce and lead to a sharp rise in its population. The city grew into an advanced industrial metropolis strongly dependent on heavy industry and fossils fuels, but the coal crisis in the late 1950s brought about a depression.

In the 1980s local authorities started a structural change away from coal and steel towards service industries and new technologies such as solar power. As a result, the economic structure has become more diversified in recent years resulting in job opportunities in a variety of pioneering sectors. In late 1999, for instance, Shell opened Europe's largest and the world's most modern solar cell production plant. Gelsenkirchen boasts advanced infrastructure, attractive housing and a large number of green spaces and recreation areas. In addition, there's a wealth of cultural, sporting and leisure activities on offer.

The withdrawal of heavy industry from the city proved that renewable energy technologies could strengthen the economy and create new and sustainable local

employment. Research and development of solar technologies were promoted vigorously through joint projects between industry, crafts, science and solar associations.
Today, Gelsenkirchen presents itself as a centre of solar technology. With a renewable energy strategy based on solar resources, the city has created a regional network of solar energy. As a result, a new and sustainable industry cluster and new jobs in emerging sectors have been created. The overall image of the region has also improved. The 'Solar Housing Project' has created efficient living space and developed the sustainable architecture sector.
The strategy followed by the city has created a link between climate friendly renewable energies and the social agenda.

3.3.2 Main projects/ initiatives undertaken

The Emscher Park International Building Exhibition (IBE), a regional government regeneration initiative run between 1989 and 1999, tried to demonstrate how land no longer needed by heavy industry could be revitalised. The programme began in 1989 and was successfully completed in 1999. The IBE has cooperated in collaboration with the 17 cities of the Emscher region, which include Gelsenkirchen. In order to give a strong impulse to socio-economic and environmental recovery, the IBE has implemented several projects. The most significant goals of these projects were, between others, as follows[22]:

- the preservation and re-use of the industrial legacy;
- the ecological upgrading of derelict urban-industrial sites through the development of an urban structure of high economic potential and high architectural quality, and which is complementary to landscape planning (Working in the Park);
- the implementation of the principle of a recycling economy;
- the rehabilitation of workers' settlements and the extension of residential areas;
- a "holistic" approach to economic, social, and cultural transformation;
- the development of a modern and sustainable infrastructure for future economic growth.

One of the most prominent projects arising from the Emscher Park International Building Exhibition has been the Gelsenkirchen Science Park. In 1995, it was home to the largest roof-mounted solar PV plant (210 kW) existing at the time.
Since then, the park has been transformed into a Base for Local Production and Research and Development for Clean Energy Technologies (Institute of Applied Photovoltaic), with more than 11,000m^2 of offices and labs, 25 companies and 400 jobs.

[22] www.eaue.de

Thanks to these impulses the city has developed a solar cluster, which begun with the production facilities for photovoltaic modules set up by the Flabeg Solar International Company (formerly Pilkington). In 2000, the city was chosen by Shell Solar for the construction of a factory for solar cell production by the company, able to produce almost 13 million cells annually with a total capacity of 25 megawatts. Today, the solar cluster includes several companies and institutions focusing on solar energy.
A solar power plant has recently been inaugurated. At the current stage of expansion, the plant generates about 320,000 kWh power per year with a peak output of 355 kWp/a. It is located on an ore and coal bunker of the former steel works "Schalker Verein".
As part of this strategy, and in order to respond to the requirements of the statewide initiative for forward-looking energy sources launched by the government of the German regional state of North-Rhine/Westphalia, the city started the implementation of innovative projects in the fields of energy conservation, efficient energy use and exploitation of inexhaustible energy sources focusing on housing estates.
Several projects have been developed in order to improve the energy efficiency of new buildings through passive isolation and carbon free energy production.
Solar housing estates are characterized by high thermal insulation standards and solar-supported energy supply systems (solar heating and photo voltaic cells). The table above shows all solar housing estate projects undertaken.

Table 3-4 Housing state projects undertaken

Solar Housing Estate "Sonnenhof" (72 houses newly built 1999-2001);	Warm water through solar collectors(470 m^2): 60–65%	Electricity through photovoltaic: 25% (installed capacity: 80 kWp)	CO_2-reduction compared to conventional housing: 55%
Housing Estate "Lindenhof" (2003);	Warm water through solar collectors(600 m^2: 60%	Energy for room heating reduced from 300 to 65 kWh/m^2 (-80%)	CO_2-reduction compared to conventional housing: 55%
Graf Bismarck – Brownfield a project currently in progress.	50 ha free space (forest/water)	Solar Architecture: direction/height of buildings, generous plot sizes, roofs & facades suitable for PV & solar collectors, low energy construction	Sustainable energy supply

Source: Energie-Cités, Die Landesregierung Nordrhein-Westfalen-NRW (www.energieland.nrw.de)

3.3.3 Agents involved

Actions have been supported by several institutions at the EU, National, Regional and Local level. The **Science Park Gelsenkirchen** has been co-founding through the European RECORE programme (Regenerating Europe Coalfield Regions), an initiative of the Association of European Coal Mining Regions (EURACOM).
The federal government participates and funds several Research and Development projects:

- The “SolarBau: Monitor”, funded by the German Federal Ministry for Economics;
- The “Photovoltaic Technology Evaluation Centre”, financed by the German Federal Ministry for the Environment (BMU).

Main institutions involved at the regional level, especially for the Solar Housing Estate projects, are:

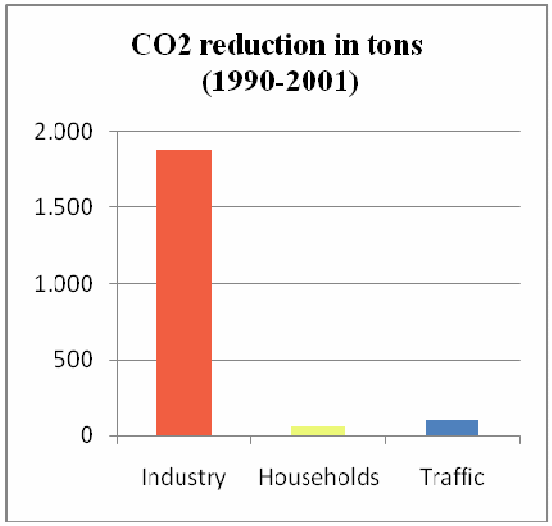
- The Regional Ministry of Housing and Urban Development (Bauministerium des Landes Nordrhein-Westfalen)
- The Regional Ministry of Energy Development (Energienministerium des Landes Nordrhein-Westfalen)
- The Regional Ministry of Science (Wissenschaftsministerium des Landes Nordrhein-Westfalen)

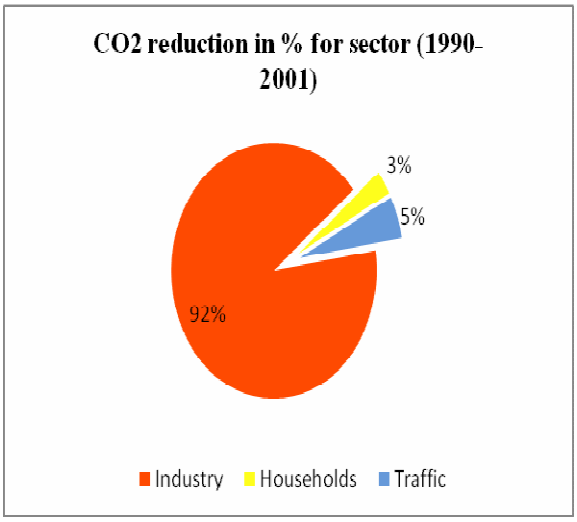
Local Authorities have been leading projects planning and execution. Several city departments (i.e. planning, education, and housing) guarantee projects’ coordination and provide information.
The supporting association "Solarstadt Gelsenkirchen e.V.", founded in 2004, is an information and cooperation platform for all participants of the Solar City: The association bundles all activities to implement the concept of the "Solar City Gelsenkirchen". Furthermore, its goal is to raise awareness and international cooperation concerning energy and climate protection.

3.3.4 Environmental and energy impacts

The reconversion of the industrial area has determined a great reduction in CO_2 emission. During the first 10 years of the reconversion project, CO_2 emissions reduction amounted more than 2 million tons, of which more than 1.8 million concerns the industrial sector.

Figure 3-6 CO_2 reduction (total and per sector)





Source: www.gelsenkirchen.de

Taking into account CO_2 emissions that new and renovated buildings have with respect to the older ones, Solar Housing Estate projects contribute to a reduction of more than 660 tons/year (emissions reduction for m^2: from 227kg/year to 31,4Kg/year as calculated for new edification standards),
The five biggest photo voltaic plants in the city (361 kWp, 355 kWp, 250 kWp, 210 kWp and 84 kWp) have an estimated production of 1.14 GWh/year.

3.3.5 Socio-economic benefits

The heating cost reductions made available by Solar Housing Estate projects are estimated at 14,000 € per year.

Table 3-5 Estimation of Heating costs saving for Solar Housing Estate projects buildings

Heating cost's per m^2 in old houses	€ 1.25
Heating cost's per m^2 in new or renovated houses (standard)	€ 0.53
Variation	€ 0.6625
m2 of Solar Housing Estate projects built	21,070
Heating costs saving	€ 13,958.875

Source: Die Landesregierung Nordrhein-Westfalen-NRW (www.energieland.nrw.de)

The improvement of residential standard and quality criteria for architecture, buildings and energy supply are attracting new investors and energy service companies into the city.

The solar industry cluster is in continuous growth and is creating jobs in emerging sectors. International companies like Scheuten Solar, Abakus Solar and Vaillant, employ several hundred people. Additionally, there are jobs in small trade, education, consultancy and science.
R&D activities have been lunched through the cluster. The University for Applied Sciences Gelsenkirchen is investigating and testing facilities for PV-modules and for solar thermal applications (including cooling).
The FhG ISE – Fraunhofer Institute for Solar Energy Systems- Laboratory and Service Centre Gelsenkirchen is focused on production orientated research, with in-line solar cell processing lines and Energy efficiency.
In 2006 the “Photovoltaic Technology Evaluation Centre” (PV-TEC) was inaugurated. It is a production-based evaluation and service centre for the silicon solar cell wafer technology.

4 Findings and conclusions

The main question addressed in this study was how three levels of governance (European, national and local/ regional) can act to reduce CO_2 emissions, responding to the global challenge of fighting climate change and contributing towards European competitiveness and employment. The conclusions will therefore focus on each group separately (sections 4.2 – 4.4). Prior to that, global warming and the possible impacts of climate change are discussed (section 4-1).

4.1 Global warming

Global GHG emissions due to human activities have increased 70% since pre-industrial times (1970 – 2004). Carbon dioxide (CO_2) emissions grew by about 80% in that period, so that global atmospheric concentrations of CO_2 in 2005 (379ppm) exceeded by far the natural range over the last 650,000 years (IPCC, 2007).

Increase in observed global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations related primarily to fossil fuel use and, to a lesser extent, land-use change and agriculture. Apart from temperature rise, human action has contributed to sea level rise, changes in wind patterns affecting extra-tropical storm tracks and temperature patterns, extreme temperatures, extreme weather events and changes in many physical and biological systems. Other effects of human induced climate change on natural and human environments are emerging, including (1) effects on agricultural and forestry management at Northern Hemisphere higher latitudes, (2) earlier spring planting of crops, (3) alterations in disturbance regimes of forests due to fires, (4) heat-related mortality in Europe, (5) changes in infectious disease vectors and allergenic pollen in some areas, (6) hunting and travel over snow and ice in the Arctic or mountain sports in lower-elevation alpine areas, etc.

Current climate change mitigation policies and related sustainable development practices are not be enough to reduce global GHG emissions. If further policies are not implemented, emissions will continue to grow over the next few decades. This would cause further warming of 0.2°C per decade for the next twenty years and induce severe changes in the global climate system during the 21st century that would affect systems, sectors and regions[23]. Substantial economic potential exist for offsetting the projected growth of emissions or reducing them below

[23] Some systems (tundra; boreal forest and mountain regions; Mediterranean-type ecosystems; tropical rainforests; mangroves and salt marshes, coral reefs; sea ice biome; low-lying coastal systems), sectors (water resources in some dry regions at mid-latitudes and in the dry tropics; agriculture in low latitudes; human health in populations with low adaptive capacity) and regions (Arctic; Africa; small islands; Asian and African mega-deltas) are *likely* to be more affected than others.

current levels, but adequate policies need to be designed and implemented at all levels of governance. A renewed international agreement to address climate change after 2012 is also needed. The agreement should be reached in 2009 at the UN Copenhagen Conference.

4.2 EU level

Europe's emission reduction goal needs leadership in securing the implementation of the post-Kyoto international agreements and achieving reductions itself. The EU started taking action to reduce its own emissions in the early 1990s. As a result, the EU-27 as a whole is now likely to meet its Kyoto Protocol 2012 targets. A 20% emission reduction (30% if no other developed countries agree) will require further action and the successful introduction of the different actions and initiatives planned at the EU level, including:

- **EU Emissions Trading Scheme**. It remains to be seen whether emissions trading encourages innovation and emission reduction.
- **Voluntary initiatives**. The Commission has proposed a few European environmental voluntary agreements (some have worked and others failed) and supports programmes, technology platforms, product labelling, etc.
- **Promote renewable energy, including bio-fuels**. Various EU directives exist to further develop renewable energy within Member States: directive on the promotion of electricity from renewable energy sources (2001/77/EC), biofuels directive (2003/30/EC), proposal for a new directive on the promotion of the use of energy from renewable sources (COM (2008) 19 final).
- **Improve energy efficiency**. A number of Directives exist to promote energy efficiency: energy labelling of households equipment Directive (92/75/EEC), energy performance of buildings Directive (2002/91/EC), energy end-use efficiency and energy services Directive (2006/32/EC), Directive on the promotion of cogeneration (2004/8/EC). The Commission recently proposed an energy efficiency Action Plan (COM (2006) 545) that contains over 70 proposed measures aim at improving energy efficiency in buildings, transport and manufacturing.
- **Develop carbon capture and storage**. The Commission has recently proposed a Directive for establishing a legal framework for CCS.
-

4.3 Member State level

The EU is responsible to design climate change and energy policies at the EU level, but has no competences to implement measures (except for the common radiation protection standards and a number of legislative issues). They need to be implemented by supranational institutions of the EU and national or subnational institutions in Member States.

This report has focused on renewable electricity support policies:

- **Feed-in tariffs are being used by 18 Member States**: Austria, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Lithuania, Luxemburg, Malta, Portugal, Slovakia, Slovenia and Spain.
- **Quotas are being used in 7 Member States**: Belgium (combined with TGC), Italy (combined with TGC), Latvia, Poland (combined with TGC), Romania (combined with TGC), Sweden (combined with TGC) and United Kingdom (combined with TGC).
- **A tender system is being used in 4 Member States**: Denmark, France, Latvia and Portugal.

The main support schemes are feed-in tariffs (or premiums) and quotas - often combined with tradable green certificates. Tenders, soft loans and investment incentives complement the main renewable support policies.

4.4 Local level

Local authorities are key players in the climate change challenge, so climate change action to the local level is also needed. They can reduce emissions by: introducing sustainability criteria when designing their planning system and policies; improving energy management of both own and non-public operations; creating behavioural change of their community.

Introducing sustainability criteria (i.e. energy efficiency, etc.) when designing their planning system and policies.

Through the planning system, local authorities can (1) promote the highest standards of resource and energy efficiency in new development so as to reduce CO_2 emissions arising from construction and use, (2) require land-use patterns that reduce the need to travel by car, (3) promote renewable energy and low-carbon energy projects, (4) restrict development which has a major negative impact on CO_2 emissions, (5) adapt to the harmful impacts of climate change. All this policies and measures can reduce emissions and help fight climate change.

Improving energy management of both own operations (i.e. public buildings) and non-public installations (i.e. local industry, heating and cooling).

Own CO_2 emissions can be reduced by (1) using energy more carefully in their own operations, (2) using alternative sources (including bio-fuels for public transport), (3) creating more effective heating in public buildings, (4) introducing changes in the way waste is treated in the municipality and (5) setting targets

for green public procurement and applying sustainability criteria when purchasing goods and services.

Creating behavioural change of their community, helping reduce non-public emissions.

By communicating with residents and creating wider knowledge of climate change and sustainability through education and publicity, local authorities can help understand climate change. This will create behavioural change and will make it easier to achieve the necessary changes to encourage both mitigation and adaptation measures.
This can be achieved by (1) making everyone aware and encouraging people to do their bit, (2) informing to the public of the potential local impacts of climate change and to explain the local authority' plans to reduce CO_2 emissions (i.e. promotion of what the authority is doing) and (3) educating to individual residents, community groups and scholars. Encouraging local businesses to become more sustainable is also important in order to reduce local CO_2 emissions.

Local case studies show some practical examples that prove how local and regional governments can contribute to fight climate change and create employment.

A range of projects have been developed by different governments that prove how local and regional governments can contribute to deal with climate change and bring wealth to their territories. The report has analysed three particular case studies in which energy strategies and policies have been used in order to deal with climate change and improve their economies. Because of the extent of the policies pursued and the achieved objectives, the three cases can be seen as paradigms of climate change policies at the regional and local level.
The first case - the **Municipality of Thisted**- represents a useful example for good energy planning and sustainable development strategy in a coastal area. It combines industrial activities with environmental protection and job creation. The main characteristic of the Thisted case lies in the bottom-up implementation and in the establishment of a integrated energy plan for the municipality which involves all local players and which aims to halt CO2 emissions to the greatest possible extent. As result of these premises, the municipality has created a net of energy interchange within the municipality itself and it has succeeded in creating an entrepreneurial substrate oriented towards sustainability and renewable energy. Due to the success of its energy and climate change strategies, Thisted has been chosen to be a full-scale demonstration municipality for renewable energy for the forthcoming Climate Summit in Copenhagen in November 2009.

CO_2 emissions have been reduced by almost 90,000 tons each year and a big number of new companies and workplaces have been established on the basis of this renewable energy. The Municipality will now focus on:

- Developing a new and integrated energy plan for the municipality which involves all local players and which aims to halt CO_2 emissions to the greatest possible extent;
- Being a free of fossil fuels municipality;
- Becoming a full-scale demonstration municipality of renewable energy for the forthcoming Climate Summit in Copenhagen in November 2009.

The **Seville city council** case study can be seen as representative of one of the most successful policies among Southern European cities, which tend to have less developed environmental policies than Northern Member States. The Seville strategy has proved successful at promoting renewable energy, improving energy management and fighting climate change. CO2 emissions have been reduced by 7,000 tons in the last five years (it is the Spanish city with the biggest reduction of CO2 emissions in that period). **Main projects and actions developed** since "The Energy Agency of Seville" was created in 1997 include:

- Ordinance for Local Energy Management;
- Energy Plan for Seville;
- Metropolitan Transport Plan for the area of Seville;
- Seville Solar City: Photovoltaic Network in Municipal Buildings;
- Regulation for the Local Energy Management in Seville.

Several reasons explain Seville's strategy success: the correct identification of energy needs within the local context; the correct identification of the most efficient local energy sources available; the collaboration with national and international authorities; and the stress put on education and awareness on energetic and environmental questions.

Finally, the case of **Gelsenkirchen** represents an example of a successful environmental regeneration strategy. As part of an area formally dominated by mining and steel industry, the city has set itself the aim of playing an active role in shaping the transition from the heavy industry to a more sustainable industrial sector. The regeneration program has helped the creation of a new local economy based on renewable, and more particularly, on solar resources.

The city is currently the centre of a regional network of solar energy; **research, development and application of solar technologies are being promoted** vigorously through joint projects with partners in industry, crafts, science, solar associations and other groups in the society. Gelsenkirchen will join 'Climate Alliance' this year. **Main projects developed** include:

- 'Science Park Gelsenkirchen'. Inaugurated in 1995 with an investment of 44M Euros, the Science Park houses 25 companies that employ 400 people;

- Solar Industry Cluster. The cluster is the German leader in producing and commercializing Solar panels and projects;
- Solar Housing Estate. Several projects have been developed in order to improve the energy efficiency of new buildings through passive isolation and carbon free energy production.

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