Municipal energy and climate planning

– a guide to the process

Guidebook - International version | Enova SF | 2010

Table of Contents

"The sole responsibility for the content of this text lies withthe authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that maybe made of the information contained therein."

Enova is not responsible for further translations of the English guidebook into other languages.

Preface

The municipalities play an important role in the international, national, regional and local efforts to reduce greenhouse gas emissions through improving energy efficiency and increasing the use of renewable energy. Developing an energy and climate plan is an effective and important first step in this process.

This guidebook "Municipal energy and climate planning" is meant to be a tool for municipalities that aim to establish their own Sustainable Energy Action Plan (SEAP). This guidebook was initially prepared prepared by Enova in collaboration with the Norwegian Association of Local and Regional Authorities (KS), the Norwegian Pollution Control Authority, Institute for Energy Technology (IFE) and New Energy Performance AS (NEPAS). The purpose was to guide Norwegian municipalities in their energy and climate efforts, and the guidebook is now an integral part of ENOVA's program for municipalities.

Although the guidebook initially was prepared in a Norwegian context, the methodologies and topics are general and thus also relevant for municipalities in other countries. The intention is therefore that national initiatives are taken to translate this somewhat simplified, English version of the guidebook into more languages and at the same time include specific national issues. In this way, the guidebook can be made locally available and support energy and climate initiatives at local level all over Europe. In January 2008, the European Commission launched the initiative "The Covenant of Mayors", and a typical target group for this guidebook could be the partner cities and municipalities of this European Commission initiative.

The guidebook is based on certain national and international methodologies related to local energy and climate planning. One project funded by the Intelligent Energy for Europe Programme - "A three fold approach to sustainable energy planning at local level" (3-NITY) has developed three integrated elements for this specific purpose - namely; Sustainable Planning, Sustainable Measures and Activities and finally Sustainable Excellence. These three elements involve specific tools and methodologies that provide detailed discussions of all relevant topics needed to establish a useful energy and climate plan. The guidebook is in fact the publishable report of the 3-NITY project.

The guidebook "Municipal energy and climate planning" is a practical tool for use once the decision has been made and the municipalities are ready to start the actual planning process. The objective is to put in place a long-term strategy including an action plan with a clear focus on practical implementation of measures and activities at the local level. This guidebook explains more of the details of the planning process, and provides a practical introduction to the different steps in the process.

A SEAP has three main parts:

Executive Summary
Part 1: Factual basis and scenarios
Part 2: Planning and implementing measures

The Executive summary is in fact the document to be politically adopted by the municipal council, and should cover the main results from Part 1 and 2. Part 1 will require substantial efforts the first time the planning process is carried out. However, if done properly, regular future updates will be relatively easy to implement.

Part 2 is based on the scenarios and potentials identified in Part 1, and is the most important part of the plan. It involves practical measures and activities for continuous implementation, and should be frequently updated and supplemented.

The SEAP must have quantitative targets for energy efficiency improvement in relevant sectors, starting with municipal buildings and installations; targets for heat and power generation based on local renewable energy sources; and targets for reduction of greenhouse gas emissions. Moreover, the plan must describe the municipalities' organisational capabilities to actually implement the plan. This is in fact the most critical factor, and where many municipalities face challenges in moving from planning to implementation.

Most Norwegian municipalities have already started planning for the consequences of climate change. More extreme weather conditions and heavy rainfall will present new challenges related to land use and infrastructure. This guidebook focuses on measures that can reduce the negative effects of climate change; however, municipalities may decide also to include a specific chapter discussing local vulnerability and the impact of climate change.

Good luck with the important work of energy and climate planning in your municipality!

Nils Kristian Nakstad
Executive Director, Enova SF

1 Introduction

Developing an energy and climate plan is only one of several processes that are necessary for a municipality to achieve its targets for energy efficiency, renewable energy and reduction of greenhouse gas emissions. These targets should be both quantitative in nature, e.g. kWh saved and reduced CO_2 emissions, as well as qualitative, such as increased competence and awareness related to climate challenges.

The main processes are:

History
Many municipalities have already developed their plans, implemented specific measures, improved competence and achieved good results. Typically, these municipalities want to achieve even more! Other municipalities have ambitions but have not yet really got started.

Energy and climate planning
The energy and climate plan itself is really only the documentation of a publicly initiated process where all relevant sectors in the municipal administration and their stakeholders have been involved. An agreed distribution of roles, responsibilities, priorities and tasks is one important outcome of the process. The very fact that people work on the plan contributes positively to increasing knowledge at the local level. The plan should be adopted politically and become an integral part of the municipal planning hierarchy.

Implementation
This is by far the most important process, and typically where many municipalities fall short by not being able to take the process from plan to action. The plan must include a manageable action plan with agreed roles and responsibilities for the identified measures and activities. The easiest measures and activities should be implemented first, gradually increasing the complexity of the measures as competence and experience is built up. However, all new developments should be planned for a long term perspective where the intensity of energy consumption and greenhouse gas emissions become sustainable over time.

The figure below illustrates these processes, and shows the role played by the energy and climate plan in a long term perspective that can span several decades.

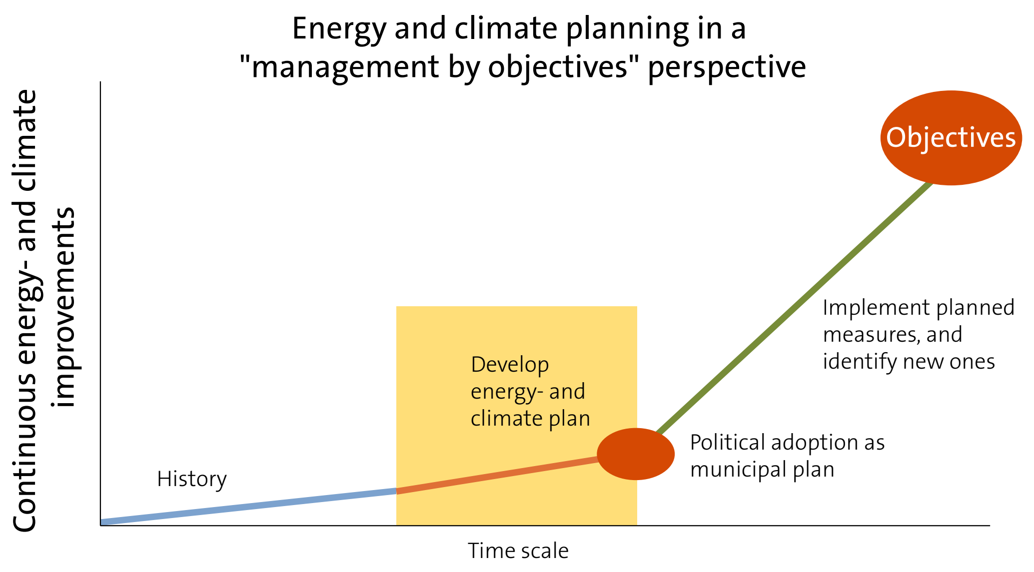


Figure 1: Energy and climate planning in a "management by objectives" perspective

2 Organising the energy and climate plan work

2.1 Organising the energy and climate plan work

Political mandate
A policy decision must be made to develop a plan. In this connection, the existing municipal plan should be reviewed in order to identify items that can support the political mandate. Stronger wording can be proposed in the plan text, if applicable.

Critical success factors, local drivers and organisational commitment
What are the critical success factors for an energy and climate plan - and what is the real motivation for municipalities to draw up their own energy and climate plan?

Critical success factors can include:
- The municipality's political willingness to pass and follow up resolutions dealing with energy and climate
- The municipality's organizational/financial capacity to implement the measures entailed in an energy and climate plan

Potential local drivers (motivation)
- Large local/regional potential for renewable energy
- Local environmental considerations
- Local jobs
- Substantial growth
- Direct financial savings and a desire to profile the municipality/local stakeholders as environmentally friendly
- Implementation of EU and National legislation

Organization and foundation of the work
All relevant municipal sectors must be involved in areas where it is natural that they contribute and share partial responsibility. The general responsibility for coordinating the process should, however, be assigned to the section or department that has the greatest vested interest in the plan (ref. drivers). If the initial motivation is purely political in nature, the mayor or chair of a committee may be assigned the primary responsibility for driving the process from the political aspect.

If planning purposes are the main motivation, the municipal planning department (e.g. the planning manager) should take on this responsibility, while if the main focus is on energy consumption in the municipality's own buildings, then the building/property manager should manage the process. Placing the administrative responsibility in a single location is an advantage, and preferably with a single person who can be expected to assign high priority to the process. Experience indicates that a good plan process requires intense concentration, both politically and administratively.

There are various models for how the municipality can organize its efforts aimed at energy and climate, as well as how this work can be rooted in the existing organization. It is important to find the model that is best suited to your municipality: large/small municipality, urban/rural, more/less developed. It is also important to ensure that different segments within the municipality can cooperate in the planning process in order to achieve greater momentum, improved climate effects and better profitability for the measures.

Example: development of industry and commerce linked to renewable energy resources, coordinated land use and transportation planning.

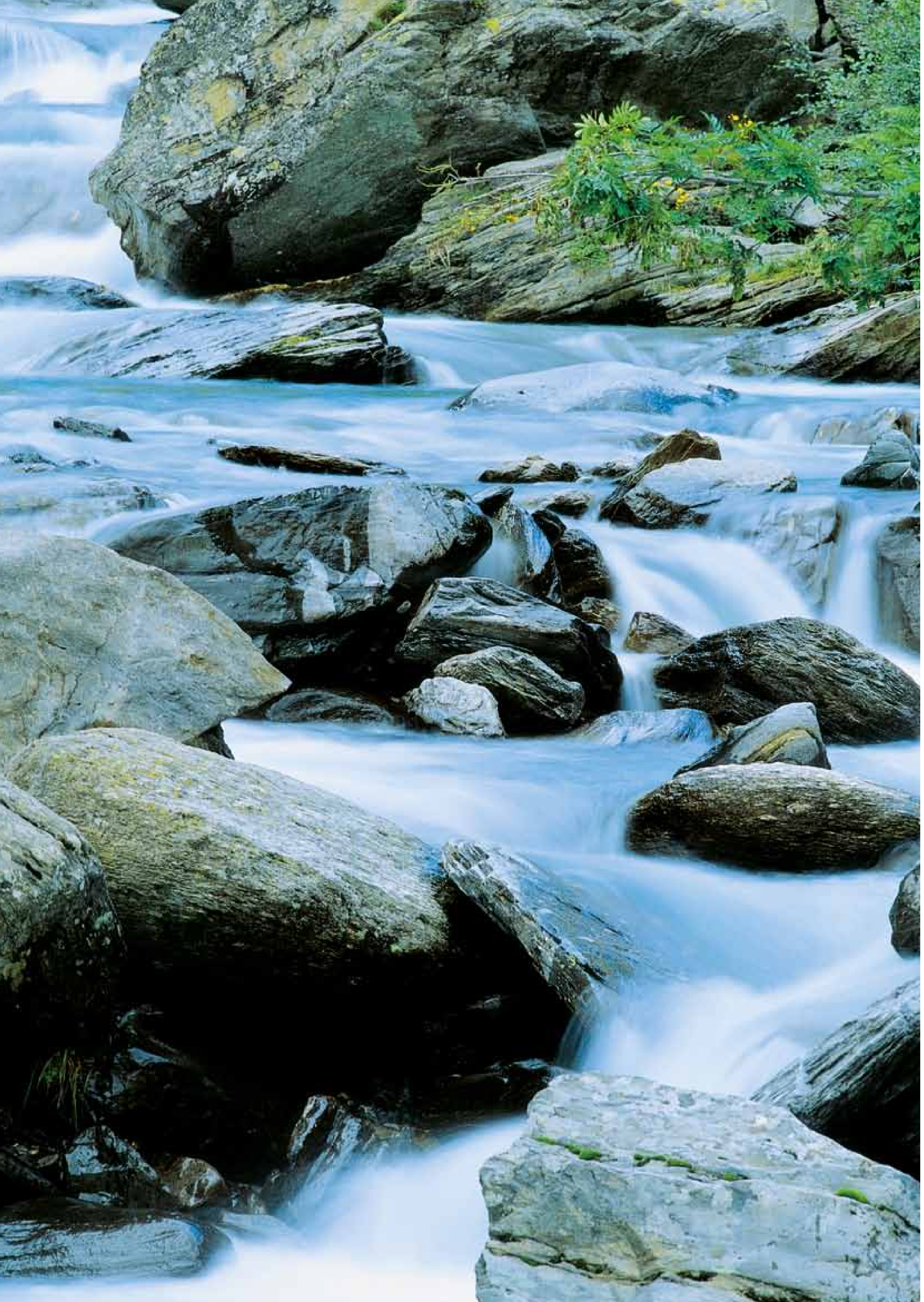
As mentioned, broad participation is important, as is a good, orderly system for the planning process. Good organization entails different ways of achieving this - e.g. through establishing a steering committee composed of the most key stakeholders along with a broader reference group who meet at the beginning and towards the end of the process. A working group should also be set up, with a basis in the municipal organization that coordinates the actual work. In smaller municipalities, it will often be possible to involve the relevant stakeholders using simpler processes and management models. From the very start, it is important to clarify the purpose of the planning work. As many as possible of the key municipal players should be assigned responsible roles to ensure strong ownership of the process in the organisation. Also, clarify where the various municipal players have tasks to perform, and how they can influence the actual implementation of the measures proposed in the plan. To achieve the greatest possible results, private sector stakeholders that cannot be ordered to act should also be motivated to take action. A good energy and climate planning process should result in agreements where stakeholders other than the municipality itself commit to implementing measures. How and when the plan will be processed administratively and politically must also be clarified.

It is important to point out that an energy and climate plan will contain activities and measures where the municipality does not assume responsibility for the results, but is merely a central facilitator and instigator.

Energy and climate plan group

The municipality's own employees, local stakeholders (forest owners, housing cooperatives, business and industry, residents and external consultants, if applicable) and interested parties must work together in the process and take responsibility!

The area licensee or power grid company, as well as gas grid companies and district heating companies, should also be included in the energy and climate plan work.



3 Gathering information

Access to up-to-date statistics about factors such as energy consumption, resource base and greenhouse gas emissions for the municipality is important when commencing the work on an energy and climate plan. National energy agencies, national statistics offices and pollution control authorities may be able to provide relevant information. In some countries, local energy producers and grid owners may have more reliable information.

However, when gathering data and information, it is important to know what this information actually describes. Energy sources are often converted into energy carriers, which are in turn transported to the consumer. The energy may change form several times along the way, and part of the energy may be lost. Some energy can also be lost at the point of consumption. Therefore, statistics often differentiate between "end use" and "net energy". When electricity is converted into heat, 100 per cent of the end use is utilised. If bioenergy is converted in the same way, often only 70-85 per cent is fully utilised - the rest is lost with the flue gas. For this purpose, the word "utilised" should be understood to mean fully utilised/put to its intended use.

3.1 The energy system

Energy consumers do not demand energy per se, but rather the services that the energy can provide, such as transportation, lighting, heating, cooling or power. Energy is also used to power industrial processes. The energy resources at our disposal are often in a different form than what we need, and they are often found in another location. Conversion and distribution of energy are often associated with both loss of energy and greenhouse gas emissions.

The amount of energy obtained from a forest in the form of biomass is not the same as the amount of heat that comes from the pellet stove further out in the energy chain. Therefore, it is important to be aware when using statistical figures that the user must differentiate between primary energy sources (e.g. 1 m3 biomass) and service provided by that energy (e.g. 1 kWh of heating). Society does not demand electricity or fuel; it demands warm rooms and transportation services.

Schematic overviews of stationary energy systems are provided in Figures 2a and 2b. The figures show how various energy sources are converted into energy carriers which are ultimately turned into energy services for the end user.

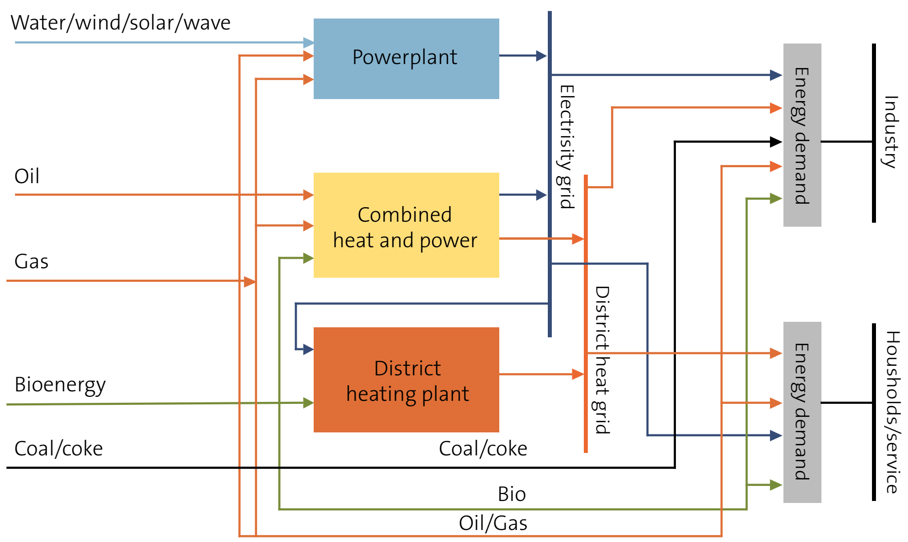


Figure 2a: Example of a schematic overview of a stationary energy system

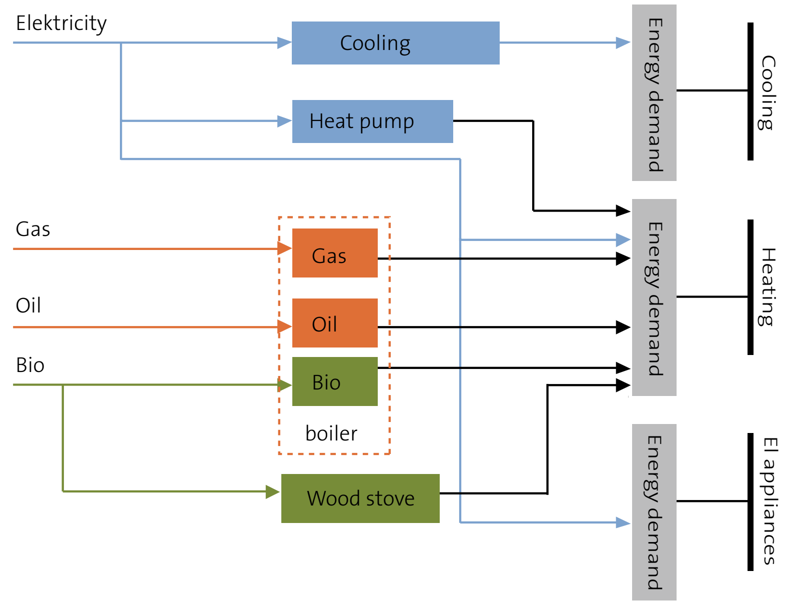


Figure 2b: Example of a schematic overview of a stationary energy system

3.2 Potential for local energy efficiency

Municipal buildings

Potential energy reduction depends on the number/volume of buildings and their condition.

Bottom-up gathered data from all of the municipalities' building area should include schools, health-related buildings, administration and cultural/sports-related buildings. Some municipalities also want this work to include municipal housing projects. The figure that is needed is the total gross heated area, and these statistics should be updated annually due to the major changes that occur through changed usage, remodelling, additions, etc. Empirical figures from Norway show that the municipal building area is equivalent to 5-8 m^2 per resident of the municipality, but this may differ from country to country.

Energy consumption includes all energy input to the buildings, and it is quite a challenge to stay up-to-date here. The challenges lie in the fact that electricity, fuel oil, biofuel and district heating are all measured differently and cover different areas, thus making it difficult to maintain access to good energy statistics. The grid companies are a good source of assistance for the municipalities. The Norwegian national energy agency, Enova, recommends establishing energy monitoring systems in all municipalities. A person should be designated as an energy coordinator, with responsibility for working on energy monitoring, preparing reports and actual reporting to management and operations personnel in the buildings.

The potential for energy reduction emerges through comparing actual measured consumption and normative figures. The actual consumption and the normative figures are developed as kWh per m^2 of floor space per year. In Norway, school buildings normally use 150-250 kWh/m^2/year, while health-related buildings use 200-300 kWh/m^2/year. Consumption varies with the age of the buildings, intensity of use, building standard and outdoor climate. Therefore, it is quite a difficult task to quantify the savings potential for the municipality's buildings.

Other buildings in the municipality

Corresponding calculations can be made for the remaining sectors, revealing an estimated potential for local energy reduction. Calculations made for individual buildings in Norway show an extensive spread here, but are normally in the range of 10-30 per cent.

In the absence of good statistical material and good methods for calculating energy efficiency potential, a figure of about 20 per cent of current energy consumption can be used as a realistic average for the municipality. However, this does not apply to the municipality's own buildings and facilities. A detailed study is required for these items, with reference to specific energy reduction measures and associated costs.

4 Practical development of the plan and how to prepare reports

4.1 Part 1 - Factual basis and scenarios

4.1.1 Summary of the factual basis

A brief summary of the status of the municipality's energy and climate situation is to be prepared. Based on an overall evaluation of this summary, the municipality can set energy and climate targets, draw up a reasonable strategy and promote the measures necessary to achieve them.

Framework conditions
A brief account shall be prepared of the framework conditions that apply to the work on energy and climate, both nationally, regionally and locally/on the municipal level, with particular focus on the latter.

4.1.2 Description of the current status

This describes the current situation in the municipality in an energy and climate perspective, in relation to the population, residence patterns, business and industry, environment and other factors. A short description should be prepared of special factors in the municipality that are of significance for the composition and size of energy consumption and greenhouse gas emissions, such as large industrial facilities, power production etc. This can also reflect important industrial and commercial interests. Earlier political decisions that bind the municipality should also be discussed. The heading can be "Where do we stand, and what brought us here."

4.1.3 Status and development of energy consumption and related greenhouse gas emissions

The energy consumption pattern determines both the development and the dimensioning of the municipality's energy system. Energy consumption will largely guide the need for distribution networks and determine how much energy must either be produced locally or brought in from outside. Documentation of the historical development in energy consumption is therefore a key issue in connection with future planning.

Format
The presentation of the consumption data will depend on the format utilised in the most important sources of data. Consumption is divided by energy carriers and consuming sectors. As discussed in Chapter 3, consumer data may largely be obtained from the national statistics office, power grid and gas companies and any district heating companies that have a licence in the municipality.

The national statistics offices keeps statistics for all energy carriers, although the format differs somewhat between electricity and other energy carriers. The consumption statistics for electricity are more roughly categorised into sectors as compared with other energy carriers, and it may therefore be beneficial to use the consumption figures provided by the power grid companies. The power grid and district heating companies will normally have relatively detailed sector categories for consumption data, but this does vary. The national statistics office has a more coarse sector categorisation of its consumption statistics for the other energy carriers. As the coarsest categorisation will be the determining factor when the data is summarised, electricity consumption (as well as district heating, if this is obtained directly from the district heating company) will have to be adjusted with respect to the other energy carriers.

We recommend that consumption be sorted according to national's statistics, e.g. by the following sectors and energy carriers:

Sectors

Sectors	
- Primary industries	Stationary combustion
- Industry	Stationary combustion
- Services	Stationary combustion
- Households	Stationary combustion
- Road traffic	Mobile combustion
- Aircraft	Mobile combustion
- Ships	Mobile combustion
- Other transportation	Mobile combustion

Energy carriers
- Electricity
- Coal, coal coke and petroleum coke
- Wood, wood waste, waste liquor
- Gas
- Petrol, kerosene
- Diesel, gas oil and light fuel oil
- Heavy oil, waste oil
- Waste

The value stated for all types of fuel is the net calorific value, or the energy content, prior to combustion and conversion into heat. As regards electricity and district heating, the energy supplied to the consumer is reported prior to loss incurred through conversion/heat exchange on the part of the end user. The tables also contain a forecast

Green house gas emissions should be sorted according to the following sources:

Stationary combustion	Mobile combustion	Process emissions1
Oil and gas production	Light vehicles	Oil and gas production
Industry and mining	Heavy vehicles	Industry and mining
Other industries	Motorcycles and mopeds	Agriculture
Households	Domestic aviation	Landfill gas
Combustion of waste and landfill gas	Ships and boats	Other process emissions
	Other mobile combustion	

[1] Process emissions are emissions that originate from processes other than combustion, e.g. industrial processes. Therefore, some sectors are listed two places in those cases where a differentiation between combustion emissions and process emissions is required.

for the development of energy demand in the municipality for the next 20 years. Here it is important to take into account a possible realisation of the energy conservation potential in all sectors, as well as the fact that new development must take place in accordance with more stringent energy requirements. Municipalities that host large, dominant industrial companies are encouraged to prepare a separate table for the applicable company/companies. This makes it easier to compare the municipality with other municipalities that do not have energy-intensive industry.

A template to be used for tables can be found in Appendix (2).

Status - stationary consumption
Because temperatures vary from year to year and from place to place, energy consumption must be corrected for degree-days. This is done in order to allow a comparison of consumption over a period of time in different geographical areas. All energy that is used for heating must be corrected for degree-days. The percentage of energy used for heating varies from sector to sector, as well as between energy carriers. The degree-day correction is accomplished by using a correction factor which can be calculated on the basis of a normal degree figure and a degree figure for each year.

Future development - stationary consumption
Even at this early stage of the planning work, it is important to quantify potential energy savings, i.e. to make an assessment of the possibilities for reducing energy demand on the part of the end user. A rough estimate of energy savings alternatives is made during the survey phase. This is done by using a benchmark or a reasonable level for specific energy consumption in households and in various types of service buildings, and comparing this with the actual level in the municipality. Climate and the mix of building types in the relevant municipality must also be taken into account.

Comments should also be provided to the extent that dispersion coefficients are available for some of the building categories. The municipality should have dispersion coefficients for its buildings. The grid owner may also be able to produce these figures for more/other buildings. On this basis, potential energy savings can be estimated, particularly for entities that have a high specific consumption. It has been proven that this dispersion coefficient is extremely stabile, both among households and enterprises that have relatively similar buildings, in technical terms. Data regarding energy consumption in various categories of nmunicipal buildings can be found in the SEC-BENCH database. www.sec-bench.eu.

As regards industry, it is important that larger companies be contacted in order to map both approved energy conservation projects and to evaluate future possibilities. The IEE/EU-funded project "BESS" has energy statistics and benchmark-figures for various SMEs sectors in several European countries available online. www.bess-project.info

Information about relevant energy efficiency projects and assessments from major private service enterprises, as well as from the municipality itself, should be part of the basis for drawing up a forecast for future energy demand trends in the municipality. The factors that are examined and discussed in this section will form an important basis for the work on projections and scenario development as discussed in Chapter 4.1.9, and obviously also during the work on goals and measures.

Status - mobile consumption
In contrast to stationary consumption, it is difficult to divide the fuel consumed in the transportation sector among geographical areas. As illustrated, national's statistics for mobile energy consumption are often divided between road traffic, air and ship traffic, as well as other mobile consumption.

In many municipalities that are small in terms of population but large in area, most of the traffic will be on highways or county roads, and much of this will be transit traffic. Other sources of mobile combustion include aviation, shipping,

railway and machinery used in agriculture and forestry activities and building and construction activities. Regarding aviation and shipping, a general rule should be that only consumption that occurs less than 100 m above ground, or 0,5 nautical miles off the shore, is allocated to the municipalities. Consumption from railway may be provided by the national railway companies. Consumption from machinery in agriculture, forestry and construction may be diffcult to encounter, however estimates should be made.

Future development - mobile consumption

National studies and forecasts are the best available basis for making assessments regarding future changes in mobile consumption in the municipality. Based on these studies and forecasts, as well as figures showing recent years' developments in the respective municipality, it should be possible to indicate what the future traffic pattern in the municipality will look like. It is reasonable to assume that the need for transportation will increase somewhat, but that vehicles and boats/ferries will consume less fuel per kilometre. The municipality itself has considerable opportunities to facilitate a reduction in the need for local transportation, while there are fewer options as regards affecting transit traffic. Therefore, municipalities are recommended to prepare a separate table for traffic on the network of trunk roads in the municipality. The factors that are studied and discussed in this section will form an important basis for the work on projections and scenario developments discussed in Chapter 4.1.9, and obviously also for the work on goals and measures.

Related greenhouse gas emissions

A necessary precondition for reducing greenhouse gas emissions is knowledge about how much is currently being emitted, and where these emissions come from. Only few countries yet have statistics for all emissions on the municipal level, sorted by source and component (type of emission). The municipal distribution is based on national calculations, broken down to the municipal level. There will be some uncertainty associated with the distribution formula used here. The greenhouse gases can either be examined separately (CO2, CH4 and N2O account for 97 per cent of the greenhouse gas emissions), or together in CO2 equivalents. Presenting the emissions distributed by components should be recommended, so as to clarify their origin. Source distribution is divided between stationary and mobile combustion and process emissions, and then further divided by sectors.

Process emissions will be discussed in more detail in Chapter 4.1.4.
Emissions related to production of electricity must reflect the fuel mix of the total generation system, including imports and exports. The national and European fuel-mfix data can be found at Eurostat.

Templates for tables can be found in Appendix [2].

4.1.4 Status of greenhouse gas emissions from processes, agriculture and landfills

Calculating greenhouse gas emissions

Calculation of greenhouse gas emissions (as well as emissions of other substances) takes place using figures for activities that are multiplied by an emission factor. Only certain types of emissions are determined through measurements and/or what is self-reported.

- Examples of activities: amount of waste handled in different ways, amount of Nitrogen in spread fertilizers number of hectares of cultivated soil
- Examples of emission factors: tonnes of methane per tonne of deposited waste, kg. of methane per cow, etc.

Considerable uncertainty is linked both to activities and, in particular, emission factors. This can result in significant errors in the calculated greenhouse gas emissions. In many cases, therefore, the calculated emissions may deviate substantially from the actual emissions. Furthermore, the calculation method is simplified in such a way that a number of measures that reduce emissions, for example within agriculture, cannot be credited using the current calculation methodology.

4.1.5 Resource surveys

Mapping the energy resources will clarify the latitude the municipality has with regard to development of the energy system, and it will also constitute an important part of the decision basis for potential measures. It can also be useful to look at the resource base in context with current production and consumption. Some municipalities which currently have a net import of energy could possibly take steps to become exporters of energy. An overview to illustrate this point could be a crucial determining factor. The potential for improved energy efficiency can also be said to be an energy resource, as it frees up energy that is already being used. In a planning context, this potential is normally included under potential end user measures, in other words, when projecting energy demand in the municipality.

Hydro power

Future development of new large hydro power stations will be rather limited in most areas of Europe, even though a potential still exists. However, there is a large and realistic potential for developing the many smaller watercourses found all across Europe. This can also provide extra income for landowners, and may be interesting for municipalities that see the possibility of becoming self-supporting in terms of energy. Hydro power plants are classified into two main categories according to size: small-scale and large-scale. Small-scale hydro power plants have an output of less than 10 MW, while large-scale hydro power plants have an output of more than 10 MW.

Small-scale hydro power

Small-scale hydro power plants can be further divided into three categories: micro power plants (<100 kW), mini power plants (100-1000 kW) and small power plants (1-10 MW). Some countries have developed digital resource mapping of small power plants from 50-10,000 kW. The GIS method (Geographic Information System) is based on digital maps, digitally accessible hydrologic material and costs of various parts of facilities. In some cases there will be limitations in the overlying power grid. Therefore, area licensees should be consulted to help determine which projects are best suited as regards costs, power grid connection, etc.

Large-scale hydro power

As mentioned, there is reason to believe that there will not be any large-scale hydro power development in Europe in the future. However, a potential for large-scale hydro power still exists in several places and this should be included in the survey. Evaluating the possibility of rehabilitating existing power plants is also recommended, to reduce losses and thus increase production capacity.

Wind power

Many places in Europe, particularly along the coast lines, have annual average wind speeds of 7-9 metres per second. Theoretically, this provides good conditions for exploiting wind energy. Building windmill parks is, however, often limited by local aesthetical considerations, and such issues have often generated a great deal of involvement by the community. Economic considerations will also be decisive, as wind energy has yielded a higher power price than the market average in recent years. Mapping wind power potential is done using wind measurements over an extended period of time. Data from weather stations will be a good point of departure as they often have wind gauges installed. However, wind speed is often determined by local conditions and may vary considerably even between places that are geographically close together. A number of European countries are in the process of developing national wind atlases, and this will provide valuable information. Inland municipalities may want to look to Sweden for the time being. Several wind power projects have been initiated in central areas of Sweden, and the wind measurements there could provide an indication of the conditions in parts of the inland areas. It is, however, extremely important to take local variations into account. Many coastal municipalities have already considered applications from power companies for development of windmill parks. In most cases it would be a good idea to hire external consultants to develop a realistic picture of the potential for wind power in the municipality.

Bioenergy

Bioenergy is a term that encompasses all energy that can be extracted from organic material, or so-called biomass. Biomass is available in many different forms with varying energy content. The most important bioenergy resources are forest fuels, residuals from the forestry industry, straw, energy crops, livestock fertilizer, combustible waste, wet organic waste and landfill gas. Unexploited forest growth, which could be extracted in a realistic and ecologically prudent manner, in municipalities where there is significant forestry.

Trees growing outside of actual forest areas can also be a source of fuel.

Compared with the data that can be obtained from national statistics, more in-depth assessments of available bioenergy resources have been made in many countries (including both ecological and competing financial considerations). If the municipality itself does not have its own forestry manager or equivalent position, the chief county forester/county forester will be able to provide important information. Dedicated bioenergy projects are now underway in several countries, including participation by county governors, county administrations and industry actors. It would be natural for the municipalities to contact their county governor regarding these activities.

Generally speaking, it can be difficult to obtain good figures for the biomass potential in a municipality. The local forestry industry/forest owner association should normally have figures for annual forest felling, as well as estimates for regions showing the sustained yield that may be useful background information. In many cases, it will be interesting to look at the resource base in a larger region, such as in connection with plans to build large incinerators or pellet factories.

Resources such as livestock fertilizer may be available from agriculture for biogas production, and possibly also areas that can grow straw and energy crops. As regards bioenergy from agriculture, the municipality's own agriculture manager may have some overviews that can be supplemented by representatives of the industry. Refuse collection companies have an overview of waste used for energy recovery, as well as landfill gas. The municipality's resource base for bioenergy can be calculated using energy content values for the various types of biomass.

Solar energy

Solar energy is of interest for both electricity and heating, however depending on the location. Energy production can take place in several different ways, from exploiting passive solar radiation when designing new buildings and their placement on building lots, to installing solar collectors or photo voltaic cells that convert solar energy into domestic hot water or water-based heating to heat rooms, and electricity. The sunniest parts of the world receive solar radiation equivalent to 2500 kWh/year per m2. Metrological data can be used to calculate the local potential for heat and/or electricity production from solar energy. Regarding solar collectors, the energy requirement for domestic hot water in the summer months can be used as a rough estimate. As the annual requirement for an average family is approximately 4000 kWh, about half of this can be provided by solar collectors in the existing dwellings. With new construction of dwellings, however, there are greater opportunities to integrate solar collectors in a way that can cover up to about 40 per cent of the total heat requirement with reasonable profitability, based on today's energy prices.

In addition comes the possibilities of building larger facilities that could be connected to local or district heating plants. It is difficult to estimate this potential, and in the current situation, this should not be included in the resource overview.

Heat pumps

Most municipalities have one or more heat sources available that allow the use of heat pumps. In this context we are primarily thinking of grid solutions with distribution of heat to multiple end users. Small units in individual dwellings are considered to be end user measures, and will not be discussed further here. When designing grid heat pump solutions, it is an advantage to have a nearby, temperature-stabile heat source in order to achieve maximum efficiency.

Examples of such sources include:

- Background heating with boreholes
- Sea/lake/river water
- Waste heat
- Sewers

If the plan includes using lake or river water, it is important to make sure that the source does not freeze solid during winter. This may be a challenge in some municipalities.

With regard to waste heat, it is primarily low-grade waste heat that is a potential heat source for heat pumps. High-grade waste heat in the form of steam or flue gas can be used directly for heating. Waste heat can, as such, be considered to be a separate energy resource and, where this is applicable, it is listed separately in the overview.

Fossil gas and petroleum products

Some municipalities host exploitation of oil and gas. Positive climate effects will result in those cases where use of fossil gas is substituted for the use of oil or coal. This use is often limited by the lack of an infrastructure for gas.

General information: References to the websites of authorities/institutions/organisations that present statistics and other relevant information such as national policies and support programmes can be found in Appendix.

4.1.6 Energy conversion: generation and distribution

In this connection, energy generation means the percentage of the resource potential that is extracted and utilised/sold in the market.

The overviews should contain:

- Power generation from water, wind, biomass, gas, coal and nuclear
- Bioenergy in the form of wood (also self-cut), wood chips, pellets, etc.
- District heating generation from various energy carriers (also larger heat pump facilities)

All generation and distribution of energy should be clearly and thoroughly mapped. Generation can be sorted according to the same categories as the resource survey; that is, small and large-scale hydro power, wind power, bioenergy, solar energy, heat pumps, gas and coal power. Biomass can be used to generate both heat and electricity, however, when producing electricity, heat and electricity will normally be generated simultaneously in order to better exploit the energy in the biomass or the natural gas in cogeneration. Processes are also being developed for production of biofuel from biomass, but some technological development remains before so-called second generation biofuel can be produced economically. Nevertheless, smaller quantities of biofuel can be produced from sources such as fish waste, offal, fat used for deep frying, as well as other types of fat.

With regard to distribution, electricity and district heating are the primary topics, as well as gas in certain locations. It is important to take account of future challenges associated with the distribution network, such as any bottlenecks and planned revisions. Information about this can be found in the local energy studies. Transporting fuel oil, fuel, wood, chips, pellets and combustible waste fractions can also be categorised as energy distribution. This often takes place in bulk lots on roads and railways, and is then not normally included as part of the fixed infrastructure in the energy system. However, such transport must be included in the assessment of the overall energy system in the municipality, as it both entails costs, requires energy, burdens the road and rail network and often entails greenhouse gas emissions.

Normally, few calculations are required for documentation of generation and distribution. Most of this information is available from the energy producers and the power grid companies. This applies particularly to electricity, district heating and gas.

It is important that the municipality has insight into and knowledge about the topics discussed here, but it is as facilitator and instigator vis-à-vis other stakeholders that the municipality can most efficiently achieve results. This applies throughout the entire value chain - from enhancing exploitation of local energy sources to increased flexibility on the user side. However, many municipalities have ownership interests in the local energy company, and can thereby exert influence on the development of the energy system. The municipality is, not least, a significant building owner and purchaser of goods and services, and can therefore set a good example for other stakeholders.

4.1.7 The energy system

An energy balance sheet should be set up for the municipality, with graphical presentations of the energy system. This is a way of gathering much of the plan's technical content into just a few figures, which are handy to have for use in conclusions and summaries. A so-called energy flow chart (Sankey diagram) provides a good picture of the energy flow within the municipality, as well as across municipal borders. Mapping the generation, distribution and consumption of energy largely provides the necessary data basis for preparing such a diagram.

The diagram can be designed in many different ways, and with as much detail as desired. Special software tools have been developed for this purpose, but it can also be made using more common drawing programs such as Visio or Adobe Illustrator. However, in the interest of saving time, special tools are recommended. Many such programs are available on the Internet, such as Sdraw and eSankey.

The diagram in Figure 3 is fairly simple, showing only generation and consumption divided among hydro power, bioenergy and fossil fuels for stationary and mobile purposes. Efficiency rates and distribution loss are not included. The energy supply is divided between imported and local resources to highlight the degree to which the municipality is self-sufficient in terms of energy

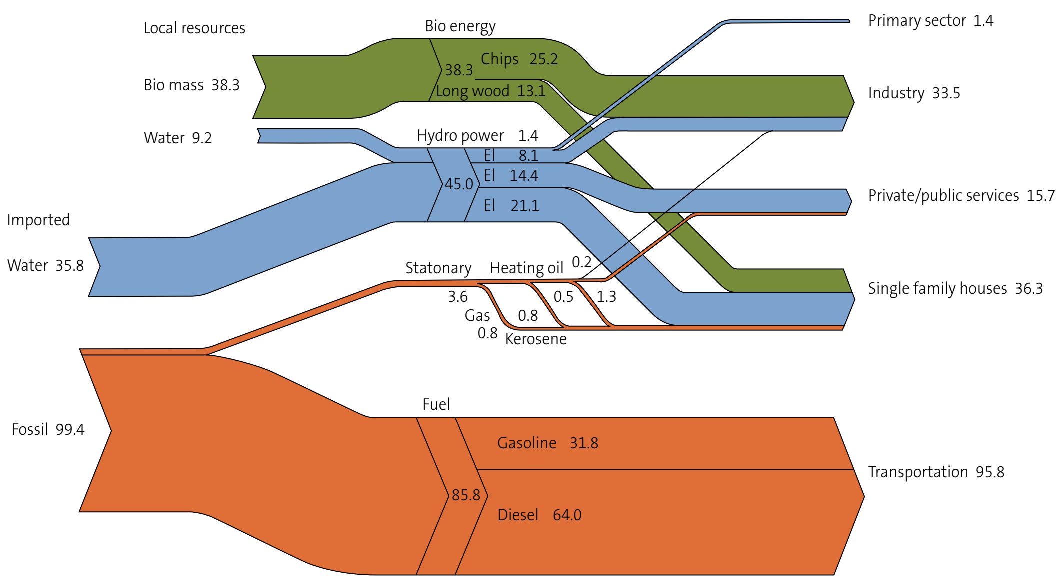


Figure 3: Example of an energy flow diagram, obtained from the energy and climate plan for Stor-Elvdal municipality , Norway (all figures in GWh/year).

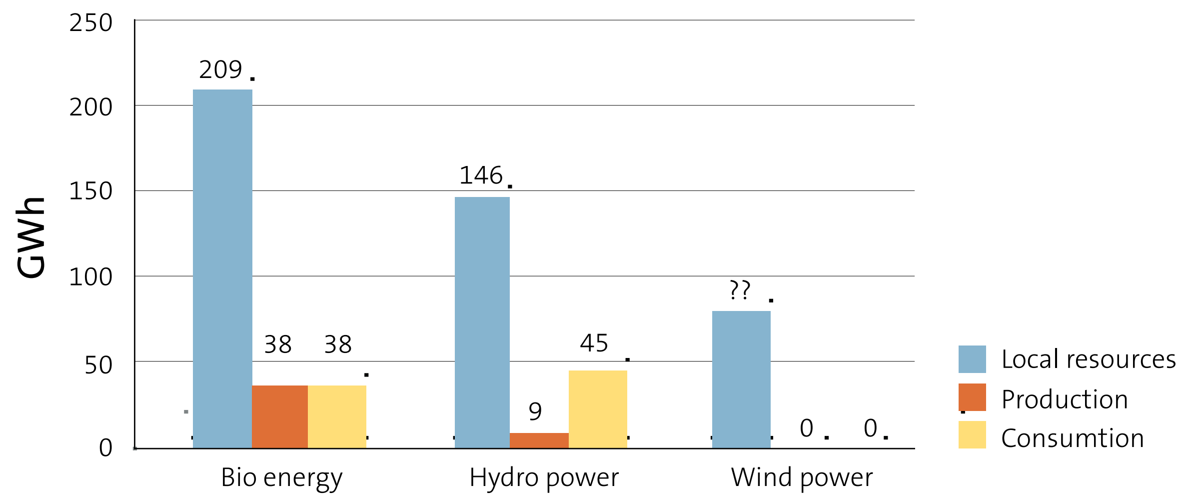


Figure 4: Energy flow in Stor-Elvdal municipality, Norway

4.1.8 Assessment of local environmental factors

In addition to having a positive impact on the climate, measures that reduce use of coal and oil will often also reduce other emissions that can harm the environment and have adverse local health effects. It is also obvious that measures that reduce the need for transport and conversion to more environmentally friendly means of transportation can have a similar positive effect.

Nevertheless, there are also potential conflicts between greenhouse gas reduction targets, energy restructuring, increased generation of renewable energy and local environmental considerations. Development of windmill parks and small hydro power plants can often entail conflicts of variable intensity as regards preservation of natural resources. Conversion from oil to biomass in heating plants can lead to more road transport and increased emission of nitrous gases. Large-scale production of biomass can also lead to a loss of biodiversity. An evaluation of such potential local conflicts is important, with reference to any previous evaluations made by the municipality or regional authorities. This can lay the foundation for the ongoing process of choosing and prioritising measures and projects.

4.1.9 Future development, projections and scenario development

Municipal development

The municipality's own long-term plan shall, of course, be used as a basis when describing the expected activity in the coming 10-20 year period. Expected residential construction and development plans in industry and business are determining factors for how both the population and energy consumption will develop. This survey provides important signals about the types of challenges the municipality will face. Some municipalities expect strong growth, which would indicate increasing demand for energy. Other municipalities experience the departure of companies and the jobs that go away with them. In such cases, it may be a good idea to reverse the issue and use energy generation and local resources to create jobs. In any event, it is important that politicians and the administration reach agreement on which forecasts to use in the continued work on the plan. This will also lay the foundation for developing demand. Ideally, the municipality should prepare several forecasts/development paths, such as a reference path, an optimistic path and a more moderate path. This may be perceived as being overly complex. As a starting point, a municipality with relatively stabile prospects can make do with a reference path, thus making it possible to estimate the effects of measures. However, the municipality should address and comment on any special external factors that could entail major deviations from the reference path - as well as consider whether and how the measures must be adjusted. These special factors could be (1) higher or lower than expected population growth, (2) greater or less than expected growth in business and industry - particularly major establishments or shut downs, and whether they are considered to be conceivable, and (3) major changes in energy prices.

National statistics normally have figures for population forecasts. This provides a good basis for the projections.

Historical data for energy consumption on a national basis shows that energy consumption per citizen within the household sector has stagnated, remaining relatively stabile since the mid-1990s. This can also be used as an assumption at the municipal level, unless there are known local variations. Energy consumption in the agricultural sector depends in part on changes in operating patterns. Conversion to more ecological operations will, among other things, lead to more mechanical preparation of the soil and increased fuel consumption. The development in the transport sector will normally follow population growth and consumption per citizen. Energy consumption for passenger transport is somewhat connected to both of these, while energy consumption for freight transport is, on the other hand, controlled more by the development in business and industry and, in many municipalities, by the development for just a few transport-intensive companies. With regard to the industrial and service sectors, major shutdowns/development plans should be taken into account as they can lead to changes in energy consumption that do not necessarily follow population trends.

Another recommendation is to prepare projections for the price development of the various energy carriers. The previously mentioned indicators will give some idea of the size of future demand, while the price development will largely determine how much the individual energy carriers will cover, that is, the energy mix. The price of oil is linked to a global market, the price of electricity is linked to the European market, while national, regional and local differences in biofuel prices are much greater. The authorities can also regulate the price level of the various energy carriers through taxes, thus making it very difficult to forecast price development; nor is it expedient for the municipalities themselves to make such predictions. For the municipalities' own projections it may be equally appropriate to apply the current price scenario for the years to come.

If this is viewed in context with other indicators, such as historical development in consumption, population trend forecasts and expected development in consumption per citizen, projections can be prepared to give an indication of energy consumption in the municipality in the upcoming 10-20 year period. Together, these projections will make up an important part of the necessary input data, if the municipality wishes to use software tools for scenario development.

Scenario development

As previously mentioned, preparing at least three different scenarios is recommended to ascertain how energy demand in the municipality can change, and the consequences this will have on emission of greenhouse gases.

Examples of scenarios:

- **Reference scenario:** Based on the development the municipality has experienced in recent years, taking into account the consequences of decisions already made (BAU - business as usual).
- **Optimistic scenario:** Based on what one hopes will occur in terms of a positive development in the municipality, as well as regards technology and environmental and climate requirements.
- **Moderate scenario:** Based on a more realistic development, both as regards the municipality, technological change and environmental and climate requirements.

The problem often becomes complex when attempting to coordinate all of the above-mentioned possible changes. Using modelling tools in the work on projecting the energy mix could simplify this important part of a municipal energy and climate plan. Availing themselves of such tools, municipalities can compile and systematise all of the collected data in an expedient manner. The results from modelling or simulations will clarify the municipality's development potential and the options it has. There is some software available for this purpose; and which is the right software depends on the size of the municipality and the challenges it faces. More information about available modelling tools can be found in Appendix.

Results, summary and discussion

The results of the work on these scenarios will provide the municipality with good indications of how the energy system and the demand for various energy carriers could develop, given a number of assumptions.

Not least, it will provide good indications of what actions are needed in order to reduce emissions of greenhouse gases. The results will outline the municipality's options for further management/administration of the energy system and related emissions of greenhouse gases. The results should be discussed and viewed in context with the surveys that have been done of energy consumption, energy generation and energy resources, as well as forecasts for future trends in the municipality. The results can provide a good basis for subsequent assessments of relevant measures and projects for priority implementation by the municipality. This is an excellent way of quality-assuring the choices and prioritisations that must be made in order to achieve the goals set for energy restructuring and emissions of greenhouse gases. This is described in more detail in Part 2.

4.2 Part 2 - Planning and implementing measures

Based on the analysis of potential future scenarios, an overview should now be prepared covering the measures that should/must be implemented in order for the municipality to achieve its energy and climate goals. Together, the measures and the action plan comprise the most important part of the energy and climate plan.

4.2.1 Summary of measures, with prioritisations and reasons

In this section there should be a summary and explanation of the concrete measures recommended for implementation or further study.

4.2.2 Goals, measures and activities

At this point in the process, there are probably various brief descriptions of potential measures that should be initiated over the short and longer term. However, concrete action plans are needed, all the way down to the activity level, in order to be able to practically convert the plans into actions. The measures part of the energy and climate plan includes a list of concrete measures linked to several secondary goals. These measures can then be further broken down to the activities level. The intention is to have concrete issues to work on. As the tasks are completed, they can be checked out of the list, and new tasks can be added. An example of a structural list of activities and measures can be seen in appendix 6.1.

Primary goal:

The primary goal of the measures section is to concretise the more overarching objectives set forth in the long-term municipal plan, and this goal will be subject to ongoing adjustment as the energy and climate plan is developed. In the 2007 energy and climate plan for Trysil municipality, Norway, the primary goal focuses on energy and is worded as follows:

- Through concrete measures and activities, Trysil municipality shall, in cooperation with local market actors, contribute to better energy efficiency and increased use of local bioenergy resources. This development is expected to provide a substantial contribution to local value creation and employment.
- In the time up to 2025, all stationary energy consumption is to become CO_2-neutral in that more than 50 per cent of the energy consumed for heating shall transfer to district heating, nearly 20 per cent shall be covered by locally produced wood pellets (primarily in new buildings), and the rest shall be covered by earth/water heat pumps, traditional wood heating and electric heaters (primarily in older buildings). In addition, a transition to biofuel in the transport sector is desired.
- Key figures from Finland (NTA 2004, Paananen, December 2006) indicate that one new job can be expected for each 400-600 MWh of new locally produced bioenergy.

The primary goal of the 2007 energy and climate plan for the municipality of Stavanger , Norway focuses on greenhouse gases and is worded as follows:

Increasing energy efficiency

- In 2010, the stationary energy consumption shall be at the same level as in 2000, and emissions of greenhouse gases shall be 30 per cent lower in 2010 than in 2000.

Energy conversion and energy generation:

- Use of fuel oil and kerosene for heating and hot water shall be discontinued by 2010.
- Facilitation of development and use of energy sources which are alternatives to electricity for heating and hot water.

Greenhouse gas emissions/environmental targets:

- Emissions of greenhouse gases from landfills to be reduced to 50,000 tonnes of CO_2 equivalents in 2010.

- Percentage of passenger transport attributable to automobiles to be reduced from 68 per cent in 1998 to 60 per cent in 2010.
- Collective transport percentage to be increased from 8 per cent in 1998 to 10 per cent in 2010.
- Bicycle percentage to be increased from 6 per cent in 1998 to 10 per cent in 2010.
- Walking percentage to be increased from 17 per cent in 1998 to 19 per cent in 2010.
- Environmentally-friendly vehicles to be increased from about 40 today to 5 per cent of the vehicle fleet by 2010.
- The regional boat transport to/from Stavanger to convert to environmentally friendly fuels.
- Agriculture and construction sectors to convert to environmentally friendly machinery.
- Reduce air travel.
- Stimulate/set requirements for development of more environmentally friendly aircraft.
- Reduce total consumption and increase recycling.
- Raise awareness in households, the public and private sectors regarding resource efficient and environmentally friendly goods and purchasing.
- Residual waste from households to landfills to be reduced from about 50 per cent in 2001 to 0 per cent in 2010.
- Increased recycling and recovery of household, construction and demolition waste and waste from business and trade.
- Increased use of environmentally friendly and locally-produced construction material.
- Increased use of locally-produced food products.
- Increased use of organically produced food products.
- Contribute measures and competence that can stimulate development and better living conditions in twin towns, but ensuring that this takes place within their ecological sector

The primary goal for all municipalities should include a realistic target for reducing greenhouse gas emissions through e.g. energy efficiency, conversion from oil and fossil gas to renewable energy sources, reduction of methane emissions from landfills, agriculture, etc.

Ensuring local support for the energy and climate plan work in the municipality
There will be many different potential models for how the municipality should organise the work to achieve such general objectives, but some type of topical program division should be considered. The municipality should place itself in a central and paramount position, and establish specialised topical programs that are run to a lesser or greater extent by relevant, preferably private, stakeholders. For example, a specialised topical program for "energy supply with district heating" should be operated by a district heating company.

Many municipalities already have a well-established structure for setting up and implementing such processes. This can obviously also be used in the work to prepare goals, measures and an action plan for energy and climate.

The figure below shows an example of such a topical program division.

It must be emphasised that this is only an example. It will also be relevant for many municipalities to have a topical program within agriculture. For example, in municipalities where there are large companies that have process emissions, consideration should also be given to establishing a special program for these emissions. One of the great advantages of establishing such a program structure is that it will make it easier to establish operative secondary goals that support the primary goal for each topical program, while at the same time the secondary goals give direct guidance on measures and activities under each topical program.

Clear secondary goals should be established for both energy efficiency, energy conversion and energy generation. All municipalities can increase the efficiency of their energy consumption, and this should therefore be a central goal in the energy and climate plan. Many municipalities can also convert energy consumption or develop new energy generation.

Examples of secondary goals:

Secondary Goal 1
Business development, enhancing expertise and communication
Business development, enhancing expertise and communication in connection with efficient energy consumption and generation of renewable energy in the municipality - the municipality is to play an active role in building up a competitive business community based on alternative forms of energy.

Secondary Goal 2
Efficient energy consumption - municipal buildings
Through goal-oriented energy conservation measures, the overall energy efficiency of municipal buildings shall be improved by XX per cent by 2012.

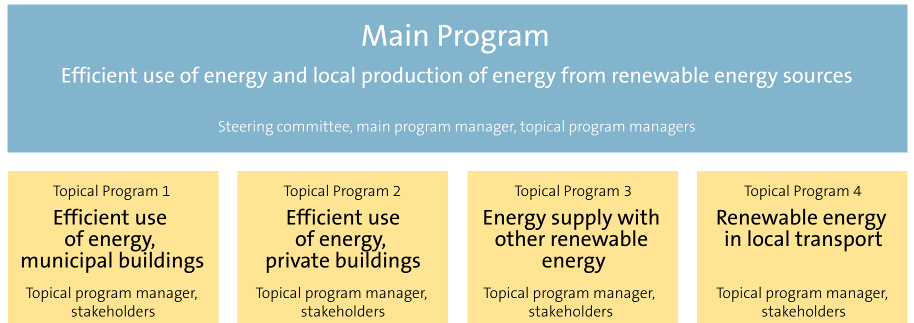


Figure 5: Example of program division

Secondary Goal 3
Efficient energy consumption - private buildings
Private commercial buildings and homeowners/housing cooperatives shall, through goal-oriented information and assistance in energy conservation measures, improve their energy efficiency by XX per cent up to 2015.

Secondary Goal 4
Energy supply using district heating, local heating (mini-grids) and other renewable energy
Energy supply using district heating, mini-grids and other renewable energy shall be given priority. Oil heating shall be phased out. All new buildings and existing buildings that can be modified to use local, renewable energy sources for heating/cooling shall use such systems.

Secondary Goal 5
Renewable energy in local transport solutions
Renewable energy shall be assigned priority in the local transportation infrastructure. All municipality vehicles shall use biofuels and electricity by 2010.

4.2.3 General tips and aids to concretise measures

Improving energy efficiency - municipal buildings
A package of measures should include the following as regards improving energy efficiency:

- Project follow-up and administration, which means continuous project follow-up and administration, both local and overall, including project management, reporting, financial management and project accounting
- Mapping the status of energy efficiency measures and actual figures for participating buildings

Develop best practice for energy consumption by:

- Further develop central requirement specifications for technical facilities and purchasing agreements that ensure efficient energy consumption
- Make sure that efficient energy consumption receives full consideration in the development of the respective buildings
- Preparations for implementing measures
- Focus on energy efficiency/operations analyses of buildings and technical facilities; reveal and implement measures (the main activity - 80 per cent of the funds)
- Introduce energy management and establish a system for energy follow-up (EOS) in the municipality (storage and administration) and participating buildings
- Consider establishing staff on-call systems for continuous monitoring of technical facilities. This should be implemented in cooperation with the caretakers'/watchmen's organisation
- Implement measures to enhance competence and establish forums and networks for exchange of experience within the municipality
- Establish contact with the National Association of Municipal Engineers, (Forum for Buildings and Property in the Municipalities) or similar organisations.
- Implement training and competence-enhancing measures for those who can influence the operations (such as procedures in shops and for service personnel)
- Carry out investments in equipment and measures/solutions that ensure consideration for energy efficiency in new buildings, renovations and remodelling projects
- Carry out investments in minor energy efficiency measures that contribute to increasing the potential

for improved energy efficiency, breaking down energy conservation barriers, pilot measures, etc. where documentation of energy results is a central part of the measure
- Carry out internal and external information activities. Ensure good press and media coverage locally and nationally, as well as internally through the munici pality's own information channels

Some activities will be prioritised at an early stage of the project. This applies particularly to the following activities:
- In cooperation with national energy agencies, develop a common stan dard for reporting energy reduction and setting nor mative figures for individual projects
- Revise standard requirement specifications for techni cal facilities and solutions in shops. This should be done early on in the project, so that the standards are set as early as possible for selecting energy ef ficient solutions in the planned investments. If this is not prioritised, the selection of less energy efficient solutions will work against achievement of the proj ect's goals during the rest of the project period
- Introduce energy management

Work list to get started:
- Designate an energy manager in the municipality
- Make sure that there are fresh, complete floor space figures for the buildings
- Install electronic metres so that all energy is mea sured and data can be processed electronically
- Prepare an overview of the buildings' specific energy needs and compare with normative figures .
- Calculate total energy conservation potential
- Prepare a concrete measures plan/action plan which prioritises the work in the buildings
- Prepare a total budget and target for the energy ef ficiency work
- Apply to national/regional financing structures for support/assistance

Reduction of greenhouse gas emissions

Measures aimed at reducing greenhouse gas emissions may have two different main focal points, or a combination thereof:
- Reduce the scope of the activity/consumption, such as the amount of fuel oil, petrol and/or the number of kilometres driven, amount of nitrogen used for fertilizer
- Make the activity more efficient/less polluting, lower the activity's emission factor. For example, the amount of fuel oil can be reduced through improving energy efficiency, or by replacing fuel oil with energy carriers that yield lower/no emissions of greenhouse gases, such as biomass. The emissions from road transport can be cut by reducing the need for trans port, by changing to vehicles that use less energy, and by replacing fossil fuels with biofuels or electricity.

Many measures aimed at reducing greenhouse gases often have additional effects that improve usefulness and thus cost-effectiveness. Examples of this include less local air pollution, less run-off of nutrient salts and soil to water (agriculture), less noise and fewer accidents and/ or lost time.

Some municipalities have significant emissions from an industrial company that dominates the municipality's emissions through sheer volume, and that is not covered by the municipality's policy instruments. As previously mentioned, both energy consumption by and emissions from such companies should be listed in separate tables so that the municipality also has the possibility to compare itself with other municipalities that do not have this type of industry. It is just as meaningful to implement minor emission reductions here as in a municipality without industrial emissions, even though it may seem insignificant in relation to the industrial company's total emissions. Finally, the emissions of greenhouse gases are summarised, both nationally and locally.

Indirect emissions - materials, construction and operations

It is easy to forget to include the indirect emissions when introducing alternative technology.
Wind power is not 100% emission-free if one includes the emissions associated with changes in area usage, construction and operation, surface roads and manufacture of the turbine components. These hidden emissions can be identified using so-called life-cycle analyses. Other examples of technologies that have such hidden emissions are hydro power, nuclear power and gas power. These emissions occur in other sectors/other municipalities, or even other countries, from the transport, building and construction activity, manufacture of steel and concrete, or in the waste management sector. Databases do exist - such as the Swiss Ecoinvent - which provide energy consumption and emission figures for the lifetime of most energy technologies. Most of these databases are not free. In a local energy and climate plan, such considerations will often be overly complicated and difficult to concretise. However, municipalities should attempt to take this into consideration in connection with major developments and measures.

Complex measures
The total effect of some measures may be difficult to calculate. In densely populated areas it is easy to think just about the reduction effects associated with the possibility of introducing district heating or local heating (mini-grid) systems, and improved public transportation.

A low emission intensive development can have positive effects including:
- Lower emissions from facilities and operation of infra-structure due to shorter road networks, water and sewage facilities, street and road lighting and the electricity grid
- Efficient transport solutions such as:
- Shorter transport distances
- Greater ability to meet transport needs through public transportation, biking and walking, which also decreases the need for transporting people who can not drive themselves
- Better options for district and local heating
- Choosing materials with low emission intensity for infrastructure
- Buildings with low energy needs

Experience indicates that the difference in emissions from a municipality that has a commitment to more low emission intensive development increases over the years, compared with a reference path of normal development. The reason for this could be that low emission intensive development influences the citizens' attitudes towards lower emission behaviour.

Information sources that can be used to calculate greenhouse gas emissions
Two programs are discussed in Appendix 9, REAM and E-transport, that can be used to identify cost-optimal solutions for the energy system and the resulting emissions of greenhouse gases. These programs do not deal with the transport sector, nor with emissions from processes in agriculture, waste management and industry. Other information sources should be used for these sectors.

- National Pollution Control authorities may have analyses of measures for greenhouse gas reduc - tions (link to a Norwegian example can be found on www.SFT.no under "green house gases"), most recently from June 2007. There is a long list of measures here, including effect, costs, cost-effectiveness and potential obstacles. These are based on a general, national level, and cannot automatically be applied on a municipality level. The report contains calculation methodology and references that may be useful.
- The Norwegian National Pollution Control's website for local climate work, including a climate measures page outlining good examples of various types of climate measures that the municipality and other local stake holders can implement. The page is continuously updated with information about experience gained from municipalities and contact addresses, telephone numbers.

The website also contains links to useful foreign websites, such as the Swedish climate municipalities.

4.3 Conclusion, specific short-term measures

The energy and climate plan is part of the process towards a more sustainable energy system in the municipality. After a policy process, the plan could gain the status of a municipal plan, and that is when the process moves from being a planning process to being a number of measures to be implemented.

It is at this very juncture that many energy and climate plans have run aground, and are likely to run aground in the future - when the plan is to be implemented! Here are a few simple rules to reduce the risk of the energy and climate plan bogging down before the work even really gets started:

1. Continue and possibly expand existing measures that have already yielded a good effect in the municipality.
2. Start with a few simple new measures that carry a substantial signal effect, and take the more compli cated measures gradually.
3. Get the schools involved, e.g. through concepts for children and young people

.

4. Build on the input that has been received from local stakeholders in the planning work.
5. Establish close cooperation with the national energy agency,, preferably through concrete projects for which the agency can provide financial support.

Possible proposals for recommendations:

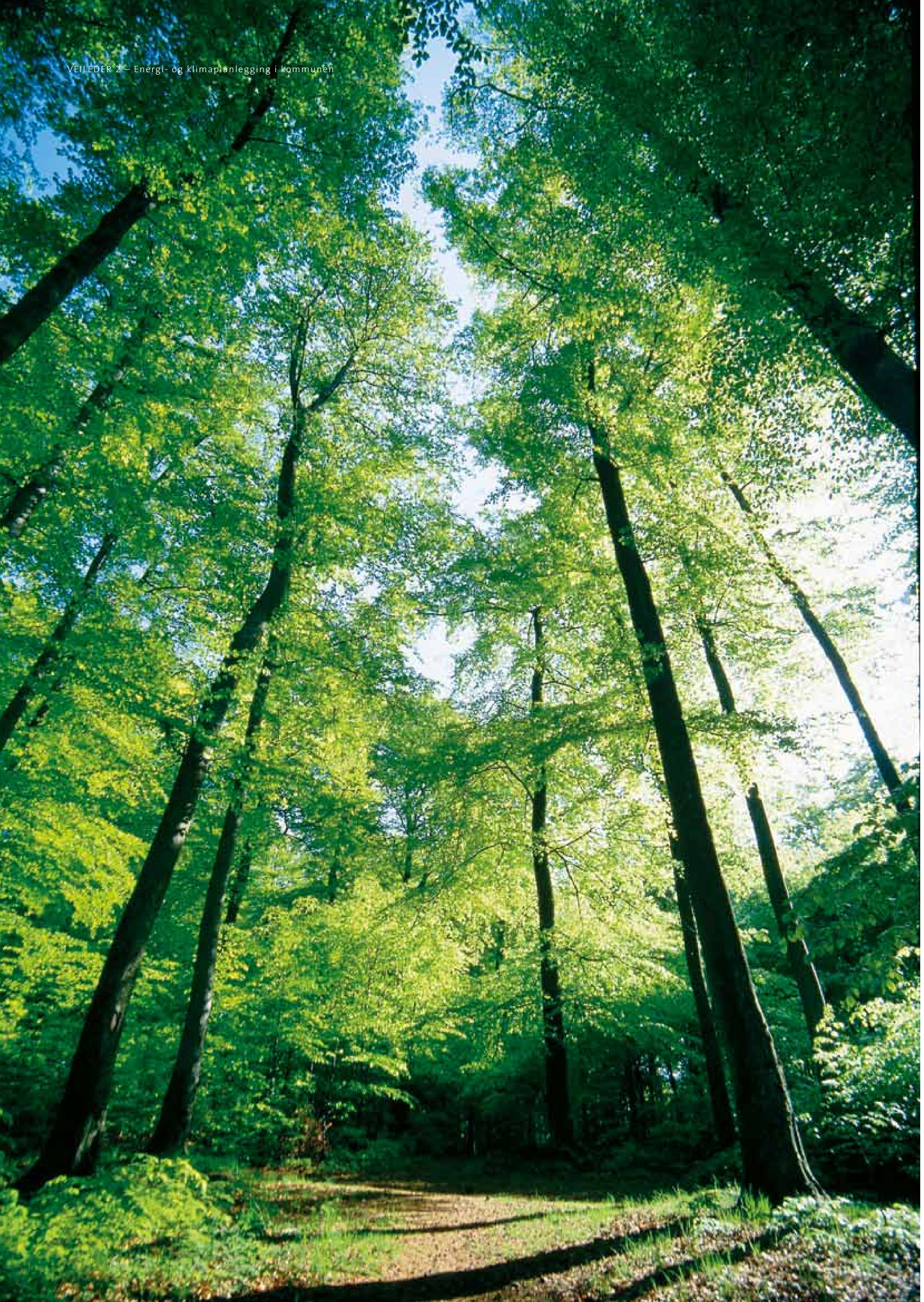
Recommendation 1:
A great many energy efficiency measures have already been implemented in the municipality's own buildings. This work should be continued, and an update of the energy efficiency potential in the municipal buildings should be made, with proposals for additional conservation measures. The continued work to improve energy efficiency should be coordinated with the previously identified, necessary maintenance work.

Recommendation 2:
The municipality should encourage all primary schools in the municipality to become "Energy Efficient Schools. Local/regional or national school authorities can supply information material and teaching units free of charge. Such initiatives have proven to be very popular.

Recommendation 3:
The municipal plan's energy chapter states that all oil-firing in the municipality shall be phased out. This is an ambitious, but realistic goal that follows up one of the measures regarding the national climate goals. A survey of all buildings in the municipality with oil-fired heating should be carried out. The municipality should actively contribute to all of these facilities being offered assistance to install alternative heating systems based on pellets or heat pumps.

Recommendation 4:
The idea of a regional cooperation with other municipalities in the region has been launched through the planning process. Such collaboration could be crystallised around comparable local energy and climate plans for the other municipalities, which can be elevated to the level of a regional energy and climate plan.

Recommendation 5:
Establish a routine for all relevant development projects to study how different alternatives affect energy consumption and emission of greenhouse gases.



5 Organisational capacity for change

Energy and climate planning is not just about euros and dollars, but is equally focused on organisation, competence, ability to make decisions, timing and common sense.

The timing aspect is important. Small steps should be taken, one at a time, in order to maintain the necessary enthusiasm over a longer time period. This makes it possible to see the results, and then proceed. It is also important to adapt the prevailing strategy to the relevant national framework conditions at any given time.

Therefore, an energy and climate plan should also cover aspects related to the municipality's activities (management, policy, resources, processes, internal and external organisation, as well as measurement of results). In this way it is possible to determine whether the municipality is able to convert the measures proposed in the energy and climate plan into practical action. Several management models and systems have been developed exactly for this purpose, and two of those are briefly described in the following:

Such an evaluation should focus on specific factors linked to sustainable development, and at the same time result in a number of concrete proposals for improvements in the municipality's activities in this area, and the various roles the municipality has in the work to reduce energy consumption and emission of greenhouse gases. Elements of the CAF model (Common Assessment Framework) or the Integrated management System (IMS) mindset can be used in this context.

5.1 Common Assessment Framework

At the very start of the work on the energy and climate plan, an initial self-assessment should be made of the municipality's "ability to follow through", based on the nine main criteria in the CAF/Excellence model. The evaluation can be done simply in the form of interviews with key persons in the municipality. A new and somewhat more extensive self-assessment should be made when the energy and climate plan begins to take form, and the accumulated results can then be presented in an updated version of the energy and climate plan before it is subjected to political consideration in the municipality. Examples of how to use the CAF/Excellence model are found in Appendix (4).

5.2 The Integrated Management System

The complicated system of cities and regions needs management on various levels. To name but a few, economy, the social sector and personnel are all managed in one way or another. Managing tasks individually or sectorally, however, are often inefficient and leads to increased workload and weak results. In the Integrated Management System (IMS), basically a variant of the well known "Demings cycle", Or PDCA (Plan Do Check Act) model, the effort lost in running several parallel management systems can be turned into sustainability.

The IMS consists of five major steps repeated in annual cycles: Baseline review, Target Setting, Political Commitment, Implementation and Monitoring and finally Evaluation and reporting.

Although the system follows an annual cycle, full revision will be required only every 3-5 years unless evaluation of achievements and results at the end of an annual cycle suggest reconsideration.

The cycle begins with a baseline review, in which the current state of sustainability factors in the city is mapped. As the next step, targets are set for the priorities identified as a result of the baseline review. Political commitment is needed throughout the cycle but becomes most crucial when the outcome of the target setting, i.e., the strategic programme, is being approved by the city council. After the preparatory steps of the cycle, the implementation of the actions decided earlier takes place. The actions taken are to be monitored during their implementation in order to gather information on the functionality of the system. During the last step of the system, evaluation and reporting, the collected information is evaluated and is used for reporting the successes and possible draw-backs of the process. It provides the basis for a city council decision on how to continue in the next annual cycle. More details about the IMS-model is in Appendix 5.

6 Appendices

6.1 Appendix - Tables

A set of standard tables has been prepared to assist in the presentation of the survey work. The tables can be downloaded from Enova's website, and it is recommended that these tables be used.

6.1.1 Energy consumption

A template for presentation of collected consumption data with forecast consumption up to 2025. It is important to include the possible realisation of the energy conservation potential in all sectors.

The table is to be completed for each of the eight consumer sectors: primary industry, industry, services, households, road traffic, aircraft, ships and other transport.

Energy consumption [GWh]	1991	1995	2000	2004	2005	2010	2015	2020	2025
Electricity									
Coal, coke, petroleum coke									
Wood, waste wood, waste liquor									
Gas									
Petrol, kerosene									
Diesel, gas, light fuel oil									
Heavy oil, waste oil									
Waste									
Total	o	o	o	o	o	o	o	o	o

Building information	Area in m2			Consumption 2002	Estimated consumption 2002		Normative figures	Potential savings		
Name of building	Gross-area	Netto-areal	Vaske-areal	Total kWh/yr	Degree-day corr. kWh/yr	Spesifikt kWh/m²/år	Spesific kWh/m2/yr	Spesific kWh/m2/yr	Total kWh/yr	Percent %
FLOSTA PRIMARY SCHOOL incl. pool	015.2	2877.6	2391.0	419 714	407 403	170.4	188	0.0	0	0.0 %
NESHEIM SCHOOL	2347.0	2003.7	1570.8	253 725	246 283	156.8	168	0.0	0	0.0 %
NESHEIM SCHOOL. SFO building	220.9	193.0	107.6	21 361	20 734	192.7	168	24.7	2 657	12.8 %
STOKKEN PRIMARY SCHOOL	3471.3	2883.9	2522.5	367 803	357 015	141.5	168	0.0	0	0.0 %
MOLAND LOWER SECONDARY SCHOOL w/pool	068.4	4233.0	4107.0	367 803	367 803	208.7	188	20.7	84 863	9.9 %
MOLAND LOWER SECONDARY SCHOOL w/ pool	068.4			514 318	489 176					
FABAKKEN DAY-CARE	432.0	381.9	370.0	92 043	89 343	241.5	186	55.5	20 523	23 %
NEDENES DAY-CARE	276.0	226.0	216.2	59 668	57 918	267.9	186	81.9	17 705	30.6 %
PUSNES DAY-CARE	146.0	126.9	117.8	24 995	24 262	206.0	186	20.0	2 351	9.7 %
RYKENE DAY-CARE	476.0	332.9	308.3	69 120	67 093	217.6	186	31.6	9 749	14.5 %
FAGERHEIM DAY-CARE	765.6	753.9	678.5	284 782	276 429	407.4	186	221.4	150 228	54.3 %
HISØYHALLEN	1887.2	1590.0	1485.0	216 954	210 591	141.8	250	0.0	0	
NEDENESHALLEN	2818.7	2606.5	1887.0	369 947	359 096	190.3	250	0.0	0	
STUENESHALLEN	3118.7	2016.6	1814.4	310 653	301 541	166.2	250	0.0	0	
TROMØYHALLEN	1754.3	1582.6	1475.0	206 348	200 296	135.8	250	0.0	0	
BIRKENLUNDHALLEN	2431.4	2020.0	1830.0	376 280	365 243	199.6	250	0.0	0	
ARENDAL TOWN HALL	2386.0	1823.0	884.4	335 800	325 951	368.6	190	178.6	157 915	48.4 %

A suggested template for how to illustrate energy consumption and potential savings in the municipality's own buildings.
Source: Arendal Municipality.

6.1.2 Greenhouse gas emissions

A template for presenting greenhouse gas emissions related to energy consumption. Separate tables are prepared for stationary combustion and for mobile combustion. Reference is made to Appendix 3 for conversion of emission volumes of the various greenhouse gases into CO2 equivalents.

Mobile combustion	CO2	CH4	N2O
Light vehicles: petrol			
Heavy vehicles: petrol			
Light vehicles: diesel etc.			
Heavy vehicles: diesel etc.			
Motorcycle, moped			
Domestic aviation			
Ships and boats			
Other			
Total	o	o	o

Stationary combustion	CO2	CH4	N2O
Oil and gas production			
Industry and mining			
Other industries			
Private households			
Combustion of waste and landfill gas			
Total	o	o	o

Process emission	CO2	CH4	N2O
Oil and gas production			
Industry and mining			
Agriculture			
Waste and landfill gas			
Other process emissions			
Total	o	o	o

6.1.3 Energy resources

Template for presentation of data from resource surveys. Maximum output is indicated only where relevant:

Energy resources	Max. output [MW]	Potential [GWh/yr]
Hydro power, small-scale		
Wind power, large-scale		
Wind power		
Bioenergy		
Solar energy		
Geothermal energy		
Total	o	o

6.1.4 Energy generation

Template for presentation of data from the survey of energy generation. Maximum output is indicated only where relevant:

Energy resources	Max. output [MW]	Potential [GWh/yr]
Hydro power, small-scale		
Wind power, large-scale		
Wind power		
Bioenergy		
Solar energy		
Geothermal energy		
Total	o	o

6.1.5 Energy and climate facts

Conversion tables for energy

Some suggested tables showing energy content and conversion factors, obtained from ssb.no.

Energy carrier	Theoretical energy content	Density	efficiency		
			Industry and mining	Transport	Other consump-tion
Coal coke	28.5 GJ/tonne	..	0.80	0.10	0.60
Petroleum coke	35.0 GJ/tonne	..	0.80	-	0.60
Crude oil	42.3 GJ/tonne = 36.0 GJ/m3	0.85 tonne/m3	0.80	-	-
Refinery gas	48.6 GJ/tonne	..	..	..	..
Natural gas (2004)2	40.1 GJ/1000 Sm3	0.85 kg/Sm3	0.95	..	0.95
Liquid propane and butane (LPG)	46.1 GJ/tonne = 24.4 GJ/m3	0.53 tonne/m3	0.95	..	0.95
Fuel gas	50.0 GJ/tonne	..	0.95	..	0.95
Petrol	43.9 GJ/tonne = 32.5 GJ/m3	0.74 tonne/m3	..	..	..
Kerosene	43.1 GJ/tonne = 34.9 GJ/m3	0.81 tonne/m3	0.20	0.20	0.20
Diesel, gas and light fuel oil	43.1 GJ/tonne = 36.2 GJ/m3	0.84 tonne/m3	0.80	0.30	0.75
Heavy distillate	43.1 GJ/tonne = 37.9 GJ/m3	0.88 tonne/m3	0.80	0.30	0.80
Heavy oil	40.6 GJ/tonne = 39.8 GJ/m3	0.98 tonne/m3	0.80	0.30	0.70
Methane/	50.2 GJ/tonne	..	0.90	0.30	0.75
Landfill gas	16.8 GJ/tonne = 8.4 GJ/fast m3	0.5 tonne/fm3	..	..	..
Wood	16.25-18 GJ/tonne = 6.5-7.2 GJ/fm3	0.4 tonne/fm3	0.65	-	0.65
Waste wood (solids)	10.5 GJ/tonne	..	..	..	..
Waste	3.6 GJ/MWh	..	..		
Electricity	430-688 TJ/tonne	..	1.00	1	1
Uranium	430–688 TJ/tonn		..		

	PJ	TWh	Mtoe	Mbbls	MSm3 o.e. oil	MSm3 o.e. gas	quad
1 PJ	1	0.278	0.024	0.18	0.028	0.025	0.00095
1 TWh	3.6	1	0.085	0.64	0.100	0.090	0.0034
1 Mtoe	42.3	11.75	1	7.49	1.18	1.055	0.040
1 Mfat	5.65	1.57	0.13	1	0.16	0.141	0.0054
1 MSm3 o.e.oil	36.0	10.0	0.9	6.4	1	0.90	0.034
1 MSm3 o.e. gas	40.1	11.1	0.9	7.1	1.12	1	0.038
quad	1053	292.5	24.9	186.4	29.29	26.33	1

1 The theoretical energy content can vary for the respective energy commodities; therefore, the values are average values.

2 Sm^3 = standard cubic metre (15 °C and 1 atmosphere pressure).

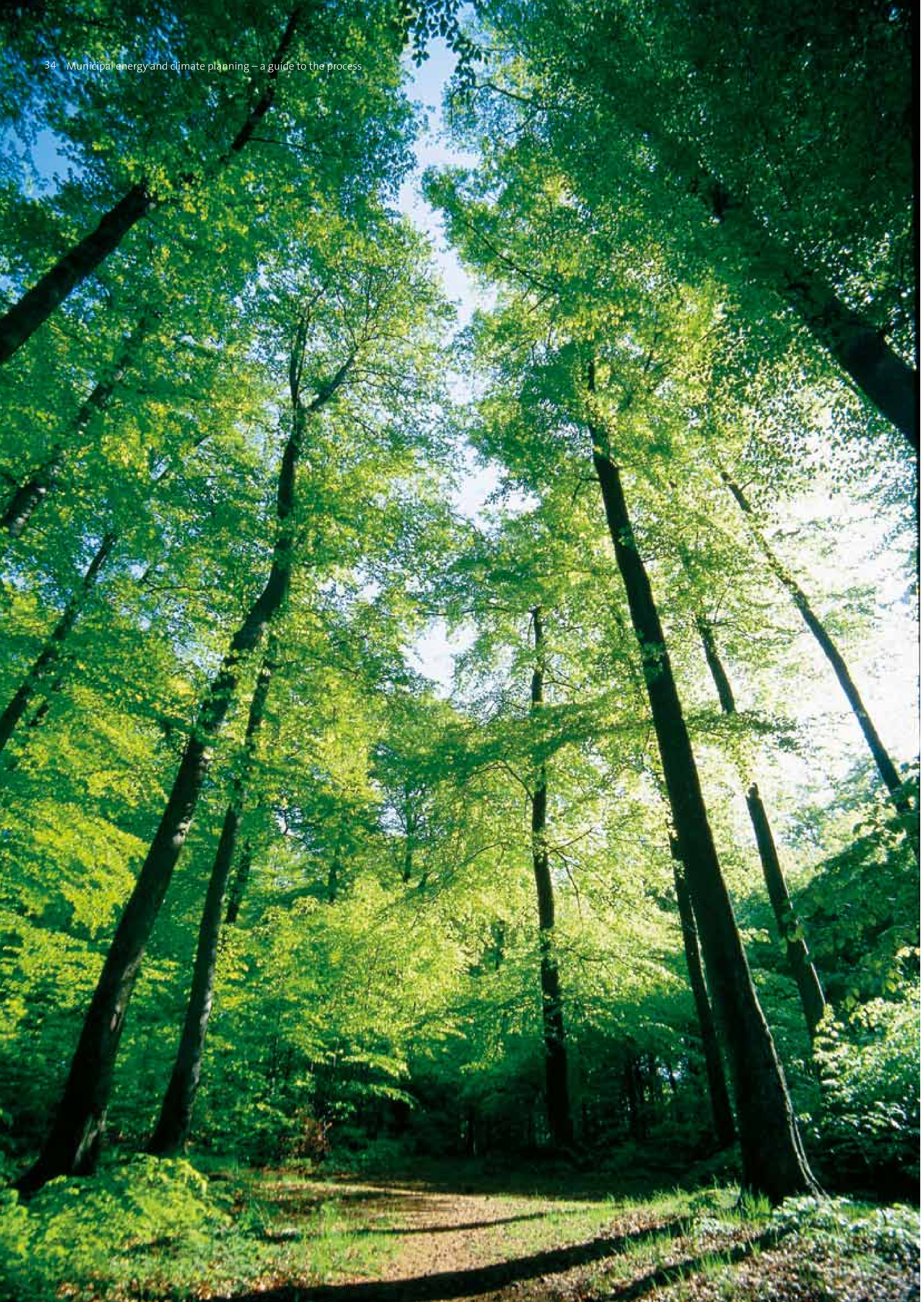
1 Mtoe = 1 million tonnes (crude) oil equivalents
1 Mbbls = 1 million barrels of crude oil (1 bbl = 0.159 m3)
1 MSm3 o.e. oil = 1 million Sm^3 oil
1 MSm3 o.e. gas = 1 billion Sm^3 natural gas
1 quad = 1015 Btu (British thermal units)
1 joule (J) = 1 watt x 1 second

Source: http://www.ssb.no/magasinet/miljo/tabell.html

Bioenergy, forms and energy content

Table of energy content in various bioenergy carriers

Energy carrier	Specification	Energy content
Wood	Untreated	2.33 MWh/fm3
Waste wood	Plain waste wood Logging waste Sawdust Wood chips/pieces Industry chips,dry	4.51-5.00 MWh/tonne 1.25 MWh/fm 2.13 MWh/fm3 2.31 MWh/fm3 2.00 MWh/fm3
Manure	60% methane	5.91 kWh/m3
Household waste	Residual waste	2.92 MWh/tonne



6.1.6 Activities and measures

Template for a structured overview of identified measures and activities for the imaginatory municipality of "Sustopia" is described in the following.. Working version (excel) can be downloaded from http://www.nepas.no/products-and-services-models-and-tools.aspx

Subtarget 1 – The climate programme

"Total annual emissions of 43,000 tonnes of CO_2 equivalents are expected in Sustopia Municipality by 2030. Excluding emissions for through traffic (8,000 tonnes/year) from the accounts, the total emissions in Sustopia Municipality will be 35,000 tonnes of CO2 equivalents per year. 70% of Sustopia Municipality's building stock is already connected to district heating and the last oil heater in local authority buildings is soon to be replaced. Sustopia Municipality is also leading the way in the use of bioenergy for stationary use in the country. Using this as a starting point, Sustopia Municipality wishes to accelerate this positive trend in order to enable Sustopia to become the country's first climate-neutral municipality, however, by no later than 2030, measured as achieved emission reductions and binding of greenhouse gases in 2030 as follows:

- 20,000 tonnes/year of emission reductions internally in Sustopia
- 15,000 tonnes/year binding through net forest growth as a result of Sustopia's roughly estimated share of the country's approved contributions from forests in line with the Kyoto Protocol"

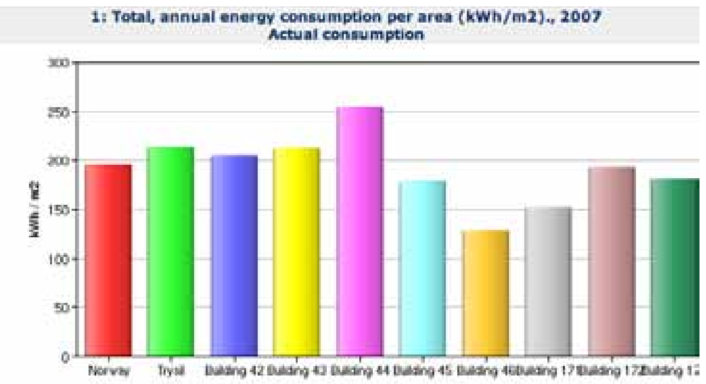
Measure group	A	Activity description	CO2-ekv. savingspot. (tonn/yr)	Costs (Eur/yr)
Programme structure – Establish a suitable programme structure in own organisation and delegate responsibility for various sub-programmes. An annual budget should be established for operation of the climate programme, which should also include the requisite own input (estimated one full-time equivalent).	1.1.1	Follow-up political adoption processes and statutes	-	-
	1.1.2	Prepare topical plans and targets and establish steering group.	-	-
	1.1.3	Plan and implement kick-off event for the programme	-	-
	1.1.4	Program implemnetation, follow-up, monitiring and evaluation	-	-
			-	600 000
Climate fund – Support work to establish a county municipal climate fund, financed by the county municipality. This type of emissions fund will make it possible to provide support for the municipalities and private players, and help achieve targets relating to climate neutrality.	1.2.1	Assist the county municipality in investigating the need for and the size of a county municipal climate fund.	-	-
	1.2.2	Support the establishment of a regional climate fund which can provide top funding for specific projects at municipal and regional level.	-	-
			-	-
Coordination – Funding from any county municipal climate fund must be coordinated with funding from other energy and climate-related, external projects (Interreg, Intelligent Energy, Enova, the municipalities' own projects)	1.3.1	Maintain a constant dialogue with the County Municipality, Enova and Innovation Norway with a view to boosting their economic support for projects in Sustopia Municipality.	-	-
	1.3.2	Stimulate private and public stakeholders to actively participate in EU-funded energy projects (Interreg, Intelligent Energy Europe and others)	-	-
	1.3.3	Establish efficient forms of collaboration in the Regional Council, and with other local players. Work to ensure that the Regional Council can appoint and finance a designated individual who can follow up the municipality's energy plans and stimulate regular follow-up of these.	-	-
			-	-
Processes – Review internal processes with a view to identifying potential improvements in relation to energy and the climate.	1.4.1	Sustopia Municipality has introduced balanced target-orientated management. The overarching management card is to be extended to cover a fifth area: Energy and climate.	-	-
	1.4.2	Sustopia Municipality will consider to establish a local program for Environmental Ligthouses, in order to stimulate local enterprises to certify their environmental profile		
			-	-
Education and training – Establish and enhance education and training programmes in order to boost competence levels relating to energy and climate within all sectors, in collaboration with the county authority and Regional Council.	1.5.1	Establish energy and climate-related training in primary and secondary schools and Solør upper secondary school, at the same time as using the school buildings as practical assignments.	-	-
	1.5.2	Benefit from the reginal councils and the county's resource team on energy efficiency and renewable energy matters in order to follow-up the implementation phase of the SEAP.	-	-
	1.5.3	Carry out training courses for developers, banks and other local stakeholders to ensure a sustainable handling of building licence applications.	-	20 000
	1.5.4	Run courses for own caretakers.	-	20 000
			-	40 000
Communication strategy – Prepare a communication strategy for the climate programme for use in own activities, and by the local authority's residents and local commerce.	1.6.1	Plan and implement information campaigns/energy days aimed at internal, municipal staff and subsidiaries.	-	15 000
	1.6.2	Plan and implement information campaigns/energy days aimed at citizens	-	35 000
	1.6.3	Plan and implement information campaigns/energy days aimed at local business.	-	10 000
			-	60 000
			-	660 000

6.1.7 Benchmarking of municipal buildings

It is obvious that local communities have significant potentials in terms of saving energy and convert to more sustainable energy sources. However, they need to identify their potentials, and realise them!
As part of the target setting process, benchmarking is a very useful tool for a municipality to compare the energy performance of their own buildings and technical installations with other municipalities. Benchmarking can therefore be used to understand your own performance compared to best practice at regional, national or even at EU-level, or own progress compared to previous years. Thus, benchmarking is a good basis to set realistic targets, i.e. identify areas of improvement, identify specific measures, establish programs for energy efficiency etc. However, in order to make good comparisons, there needs to be a critical mass of data providers. Another critical factor is the need for absolute consistency in the data definitions, time-series, collection methodologies and calculation of benchmarks. This consistency can only by achieved using standardized methodologies or models.

The SEC-BENCH project

The IEE-supported project "Sustainable Energy Communities – Benchmarking of energy and climate performance indicators on the web (SEC-BENCH)" demonstrates the feasibility of benchmarking energy performance of municipal buildings and technical installations. The bottom-up comparison of individual buildings will be on several levels; i.e. between municipalities regions, member states and probably also on a European level. Setting local targets and monitoring their achievements through web-based benchmarking will be a bottom-up approach to what could develop into a European initiative for improved statistics of local energy planning and benchmarking. In order to get a critical mass of municipalities in a longer term benchmarking scheme, the SEC-BENCH makes use of existing networks of municipalities working with sustainability.
The SEC-BENCH project will develop relevant indicators for energy performance of municipal buildings. These will be quantitative indicators, as well more qualitative indicators. The project will recommend 3-4 key indicators, each with 3-4 sub-indicators. All in all, the SEC-BENCH project will recommend 10-16 indicators for municipal energy management.
This project is about finding indicators that give municipalities valuable information regarding the development of their energy and climate performance, so that they can find areas of improvement. Most municipalities have not even a good overview of their own building stock and other technical installations. This is therefore the first place to start, namely the municipal buildings and installations.
The critical issue in this project is the availability of good energy consumption data in the individual buildings. This means that all the buildings should be monitored in one way or another, and this is can of course a rather work-intensive activity. However, in order to meet any of the set targets, this is the least effort one has to do!!!
The figure below is one example of such benchmarks, in this case kindergartens in the Municipality of Trysil, Norway. More information about the SEC-BENCH project can be found at www.sec-bench.eu



6.2 Appendix 2 SEAP - Template Emission Inventory

The following table is the template emission directory for the Sustainable Energy Action Plans to be developed by the signatories to the Covenent. A working version (excel) can be downloaded at http://www.eumayors.eu/mm/staging/library/SEAP_template_overview.pdf

Covenant of Mayors

Sustainable Energy Action Plan (SEAP) template

BASELINE EMISSION INVENTORY

1) Inventory year

For Covenant signatories who calculate their CO_2 emissions per capita, please precise here the number of inhabitants during the inventory year:

? Instructions

2) Emission factors

Please tick the corresponding box:

☐ Standard emission factors in line with the IPCC principles
☐ LCA (Life Cycle Assessment) factors

Emission reporting unit

Please tick the corresponding box:

☐ CO_2 emissions
☐ CO_2 equivalent emissions

3) Key results of the Baseline Emission Inventory

Green cells are compulsory fields

Grey fields are non editable

A. Final energy consumption

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Category	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings,equipment/facilities																
Tertiary (non municipal) buildings,equipment/facilities																
Residential buildings																
Municipal public lighting																
Industries (excluding industries involved in the EU Emission trading scheme - ETS)																
Subtotal buildings, equipments/facilities and industries																
TRANSPORT:																
Municipal fleet																
Public transport																
Private and commercial transport																
Subtotal transport																
Total																

Municipal purchases of certified green electricity (if any) **[MWh]:**	
CO_2 emission factor for certified green electricity purchases (for LCA approach)**:**	

B. CO_2 or CO_2 equivalent emissions

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Category	CO_2 emissions [t]/ CO_2 equivalent emissions [t]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings,equipment/facilities																
Tertiary (non municipal) buildings,equipement/facilities																
Residential buildings																
Municipal public lighting																
Industries (excluding industries involved in the EU Emission trading scheme - ETS)																
Subtotal buildings, equipments/facilities and industries																
TRANSPORT:																
Municipal fleet																
Public transport																
Private and commercial transport																
Subtotal transport																
OTHER:																
Waste management																
Waste water management																
Please specify here your other emissions																
Total																

Corresponding CO_2-emission factors in [t/MWh]	
CO_2 emission factor for electricity not produced locally [t/MWh]	

C. Local electricity production and corresponding CO_2 emissions

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Locally generated electricity (excluding ETS plants , and all plants/units > 20 MW)	Locally generated electricity [MWh]	Energy carrier input [MWh]											CO_2 / CO_2-eq emissions [t]	Corresponding CO_2-emission factors for electricity production in [t/MWh]
		Fossil fuels					Steam	Waste	Plant oil	Other biomass	Other renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal								
Wind power														
Hydroelectric power														
Photovoltaic														
Combined Heat and Power														
Other *Please specify: ____________*														
Total														

D. Local heat/cold production (district heating/cooling, CHPs…) and corresponding CO_2 emissions

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Locally generated heat/cold	Locally generated heat/cold [MWh]	Energy carrier input [MWh]										CO_2 / CO_2-eq emissions [t]	Corresponding CO_2-emission factors for heat/cold production in [t/MWh]
		Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	other		
		Natural gas	Liquid gas	Heating oil	Lignite	Coal							
Combined Heat and Power													
District Heating plant(s)													
Other *Please specify: ____________*													
Total													

4) Other CO_2 emission inventories

If other inventory(ies) have been carried out, please click here ->

Otherwise go to the last part of the SEAP template -> dedicated to your Sustainable Energy Action Plan

More information: www.eumayors.eu.

6.3 Appendix 3 Models

REAM

Large municipalities that need solutions to meet increasing energy consumption sustainably and efficiently can opt to use the computer tool REAM - Regional Energy Analysing Model. Smaller municipalities that want to clarify their options regarding restructuring of energy consumption and/or generation will also benefit from this program. REAM is a multi-scenario tool for modeling the stationary energy systems in a geographical area, along with associated emissions. REAM is based on a cost-minimizing equation, i.e. the cheapest energy carriers and technologies are selected.

However, the world is not always cost-optimal, and we consumers do not always choose the solutions that are most inexpensive in the long term. Therefore, users have the option of introducing limitations and boundary conditions for the various technologies so that the model can form a realistic picture of the development. By setting minimum requirements and/or maximum limits, municipalities can prevent certain technologies from achieving excessive latitude or from being phased out too quickly. This can also be used to reduce emissions of greenhouse gases in the model. In other words, REAM is not a forecasting tool, even though the simulations can approximate forecasts through active use of limitations and boundary conditions in the model. In this way, REAM can be a useful tool when staking out the course ahead.

Technical/financial data must be gathered in addition to consumer data and prices of energy carriers for all technologies included in the model, from pellet stoves and oil boilers to large production facilities and distribution networks. Reference is made to the REAM user manual for a more detailed description. It is assumed that those municipalities that want to use data models to make projections will have access to both up-to-date data sets for prices on the relevant technologies and energy carriers. It may also be relevant for smaller municipalities to use experts in the area to make these projections, but then in close cooperation with the municipality.

eTransport - new model for local energy planning

Investments in alternative infrastructures for energy supply (electricity, district heating, biomass/waste, etc.) are extremely capital-intensive, and it is important to avoid making decisions on a faulty or deficient basis. Over a period of several years, SINTEF Energiforskning AS has developed a new analysis tool for planning local energy systems in which the interplay and competition between several different energy carriers are incorporated. Development of the model, called "eTransport", has been financed by the Research Council of Norway and Norwegian energy companies through a number of case studies. Today, eTransport is a fully operative prototype, but further development continues with SINTEF/NTNU.

eTransport was developed in order to combine two important topics that are normally examined separately in traditional system analyses: investment analysis over a long time horizon and relatively complex representation of geographical infrastructure. The model can combine many different technical components and energy forms in a single analysis. The current model finds the best development plan for local infrastructure over a given time horizon (10-30 years) by minimizing operational investments and environmental costs. Both socio-economic and commercial profitability can be assessed.

Since the model takes the entire infrastructure into consideration, investments in transmission networks, pipelines and cables can all be evaluated on an equal basis with investments in energy generation units (such as hydro/wind power and gas power), conversion (such as heating plants, boilers) and end use sorted by purpose. This makes the model very suitable for planning (investments in) local energy supply systems such as electricity, district heating or gas. The model is also relevant in the preparation and documentation of municipal energy studies/energy plans. A fully graphical Windows user interface provides the user with a good overview of a given energy system (e.g. municipality, city, neighborhood) and makes it easier to communicate the solution to complex problems to people and decision-makers without a technical background.

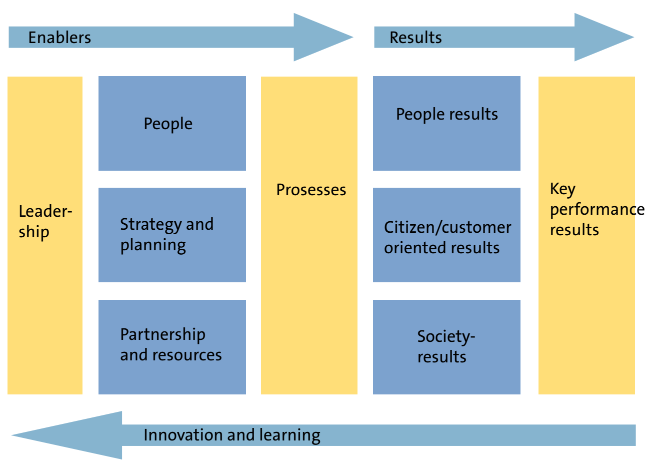
The model is divided into an operations model (energy system model) and an investment model. The operations model contains a library of sub-models for all the energy carriers and technologies among which the user can choose. The time horizon for the operations planning is relatively short (1-3 days) with typical time units of one hour. The operations module is run repeatedly for different seasons (such as heavy load, light load, medium load), different periods (e.g. every fifth year) and relevant system designs.

The investment module is separated from the operations analysis. Annual operations and environmental costs from the operations module are delivered to the investment module, which identifies which investment strategy yields the minimum total present value over the planning horizon. During 2008, eTransport will be able to take into account the uncertainty associated with energy prices and demand over time, and will provide different investment strategies with different probability/risk.

6.4 Appendix 4 Common Assessment Framework (CAF)

There is increasing interest in the public sector for working with quality and comprehensive management models to improve individual enterprises. Various national and international models are available, and it is difficult to say which of these models is best. However, we have provided a description here of the CAF model (Common Assessment Framework), which is a quality model specially developed for the public sector. CAF was

The CAF Model



developed under the direction of the EU and is based on the Excellence model, which was previously used by the European automotive industry, the EU Commission and EFQM (European Foundation for Quality Management). The model can be applied in public administration for self-evaluation of own activities and for benchmarking between comparable activities.

The Agency for Public Management and eGovernment (Difi) was established 1 January 2008, following a merger of the previous public agencies Statskonsult, Norway.no and the Norwegian eProcurement Secretariat. In a CAF assessment report (May, 2003), Statskonsult found CAF to be a useful tool for public sector entities that wish to make a general "diagnosis" of their own condition. Such a self-evaluation may be of assistance in uncovering factors where there is room for improvement.

CAF can be used as a basis for a critical evaluation of an organisation. The model is simple, and can be used for self-evaluation of all types of public sector entities. CAF does not require a particular level of management, a particular type of task or a particular organisation size.

The purpose of CAF:

- to capture the special characteristics that apply to public sector entities
- to be an introduction tool that can give public sec tor entities an impression of how such tools function
- to bridge the gaps between different models and methods used to develop quality
- to enable benchmarking between public sector entities

CAF consists of nine criteria; five enabler criteria and four results criteria, which cover the main areas of most organisations. Sub-criteria in the form of questions to be asked about the respective main areas of an organisation are listed under each of the main categories.

Among the benefits to be gained from such a review of the organisation are learning about one's own enterprise, assessment based on facts rather than assumptions, identification of areas where the enterprise can improve, and involvement of staff in improvement activities. It must also be emphasised that the CAF tool is much simpler and less detailed than, for example, more advanced quality tools using external assistance.

6.4.1 CAF in local energy planning

An EU-financed project (3-NITY) was initiated in 2006 for purposes such as tailoring a variant of the CAF model for use in local energy planning. Skedsmo municipality, Norway has participated as one of several European "test municipalities" in projects that also involve a number of European technical milieus in the fields of energy and quality management. In addition to the work on the CAF model, 3-NITY has also further developed an existing Swedish technical-economical simulation tool for local energy planning (KRAM), as well as extensive lists of measures that should be included in an energy and climate plan. The 3-NITY project has prepared an integrated system for all parts of an energy and climate plan, and the adapted CAF model "Sustainable Excellence" is a particularly good tool that municipalities can use to assess their own capability to convert the plan into action.

A simple spreadsheet has been prepared that can be used as a basis for the municipality's own self-evaluation. Municipalities are recommended to start the whole energy and climate plan process by having the municipality's energy and climate planning group ask itself nine questions related to energy and climate factors in the municipality, one for each of the CAF criteria. Each of the responses is scored using a simple scale, and most municipalities will find that there is considerable work to be done before they can earn a passing grade (this is presumably part of the explanation for why many energy and climate plans never become anything other than plans). In principle, the purpose of this first self-evaluation is to draw attention to some important factors that should be included in the ongoing work.

This self-evaluation must be repeated before the energy and climate plan is readied for political consideration, but this time the process must be more thorough, including three more detailed questions for each of the CAF criteria. The responses are scored in the same manner as previously, and some small progress can usually be measured in most cases. Discussions in the energy and climate planning group will normally reveal some internal factors that are not optimal for facilitating implementation of even several of the first, simple measures proposed in the energy and climate plan.

Attempts should therefore be made to concretise some proposed improvements. These are often qualitative/organisational improvements that should be included as part of the first, simple measures in the energy and climate plan, and which should be highlighted before the plan is submitted for political consideration.

The following is a recap of the main points from each of these nine criteria.

Criterion 1: Municipal leadership
To what extent has the municipal management initiated measures to carry out the municipality's desire to achieve better energy efficiency, a higher percentage of renewable energy resources in the local energy supply and reduction of greenhouse gases?

Criterion 2: The municipality's policy and strategy
Has the municipality framed and communicated a clear energy and climate strategy, and is this strategy firmly anchored in a philosophy that includes sustainable energy management?

Criterion 3: Staffing in the municipality
How has the municipality contributed to ensuring that its own employees have a good awareness regarding sustainable energy and climate management throughout all areas where the municipality has activities?

Criterion 4: The municipality's partnerships and resources
How is the municipality developing so-called partnerships with other local stakeholders, and how does the municipality cooperate with energy suppliers to increase exploitation of local energy resources while simultaneously increasing focus on efficient energy consumption and greenhouse gas emissions? How are financial and human resources allocated for this purpose?

Criterion 5: The municipality's processes
How does the municipality define, implement and revise its internal processes to ensure that they are in line with the municipality's energy and climate strategies in the short, medium and long terms? Are processes in place that have sustainable energy and climate management as their primary focus?

Criterion 6: Measuring results at the customer/ citizen level
How does the municipality measure the results achieved in sustainable energy and climate management from the citizens'/customers' perspective?

Criterion 7: Measuring results among own employees
How does the municipality measure the results achieved in sustainable energy and climate management from the perspective of its own employees?

Criterion 8: Measuring results at the society level
How does the municipality measure the results achieved in sustainable energy and climate management at the society level? This includes general society results such as reduced energy consumption, reduced greenhouse gas emissions, jobs, increase in prosperity and environmental consequences at the local, national and global levels.

Criterion 9: Key performance results
What key results has the municipality achieved as regards implementing its policy and strategy to achieve sustainable energy and climate management in the municipality?

After the municipality is well into the implementation phase of its energy and climate plan (for example, after about one year), a third self-evaluation is done using the same three questions linked to each of the CAF criteria. Assuming that the municipality has followed up the first, simple measures in the energy and climate plan, in most cases a higher score will emerge on all criteria at this point, while the list of possible improvements continues to grow.

This indicates that the municipality is at least close to fulfilling one of the critical success criteria discussed earlier in this guidebook.

6.5 Appendix 5 The Integrated Management System Model

The integrated management system in support of local and regional Sustainability

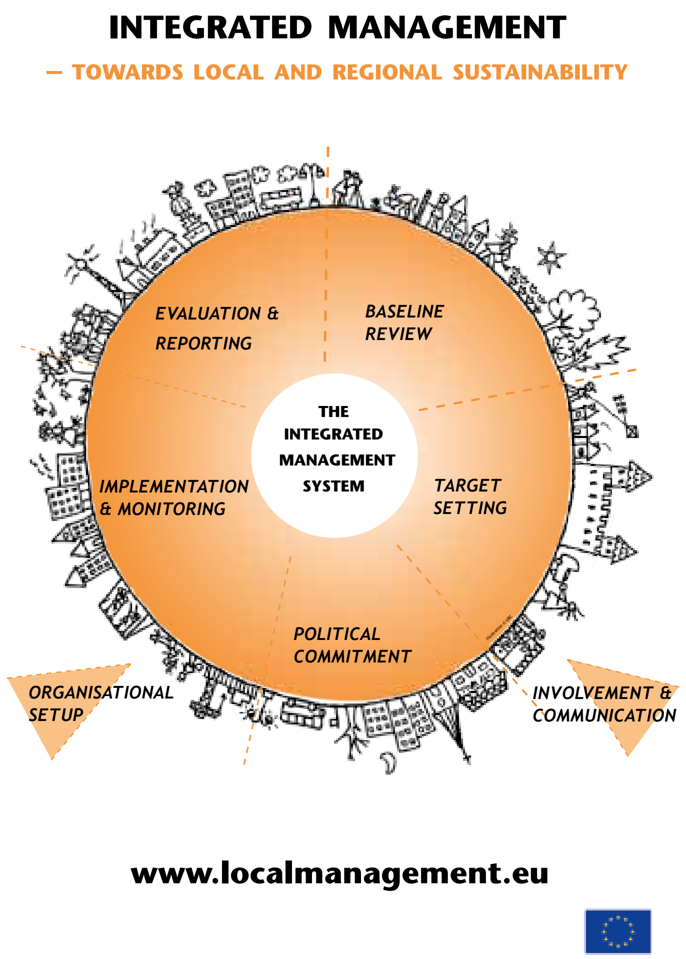
The Managing Urban Europe-25 project has developed and implemented a model (the IMS model) for local and regional sustainability applicable to all cities in Europe.

The MUE-25 model examines the emerging opportunities for advanced and strategic approaches, building on existing environmental management systems such as EMAS, ISO 14001 and ecoBUDGET and widening the scope to include all sustainability dimensions. The extension of the scope is suggesting a new perspective which is progressively less rigid about the line between society, economy and the environment focusing on how social and economic dimensions are challenged and developed through an engagement with the environment. The MUE-25 model has a use as a policy and planning tool for indicating the way towards sustainability, revealing the nature and severity of the occurred impacts and the self-repairing capability.

Highlighted in Commission guidance
The concept of integrated management has proved to have a precise role in translating policy at national and EU level into the local level. The model was highlighted in the published guidance in relation to the Thematic Strategy on the Urban Environment (Technical Report - 2007-013).
The Thematic Strategy recognises the specific importance of urban areas in delivering the objectives of the EU Sustainable Development Strategy: "In urban areas the environmental, economic and social dimensions meet most strongly". To help ensure that decisions and policies in one part of local government do not have adverse effects for other policies, there is a need for developing integrated approaches for the management of the urban environment. The MUE-25 project shares the vision that an integrated approach is considered to be the most effective way to manage the urban and regional environment.

A basis for European measures
It is important that European measures recognise and build on already existing environmental management systems that have produced good results, and support local governments that are making efforts to promote sustainable urban development. These must be taken on board before framing new systems. Therefore, harmonisation measures required to adapt to any new systems must not involve duplication of effort or costs.

Fulfilling EU policies
The IMS is the key for cities and regions to fulfil EU policies such as Lisbon Agenda, EU Sustainable Development Strategy, Leipzig Charter on European Sustainable Cities, as well as to implement the Aalborg Commitments. In particular, these policies have recognised and admitted that for the sake of local sustainability, the economic, social and environmental aspects have to be considered simultaneously and equally. Furthermore, only by advancing together they can reinforce innovation, creativity, economic growth and job opportunities.



6.6 Appendix 6 Relevant European energy policy, directives and initiatives

Energy is what makes Europe tick. It is essential, then, for the European Union (EU) to address the major energy challenges facing us today, i.e. climate change, increasing dependence on imports, the strain on energy resources and access for all users to affordable, secure energy. The EU is putting in place an ambitious energy policy - covering the full range of energy sources from fossil fuels (oil, gas and coal) to nuclear energy and renewables (solar, wind, biomass, geothermal, hydro-electric and tidal) - in a bid to spark a new industrial revolution that will deliver a low-energy economy, whilst making the energy consumption more secure, competitive and sustainable.

Energy efficiency

Reducing energy consumption and eliminating energy wastage are among the main goals of the European Union (EU). EU support for improving energy efficiency will prove decisive for competitiveness, security of supply and for meeting the commitments on climate change made under the Kyoto Protocol. There is significant potential for reducing consumption, especially in energy-intensive sectors such as buildings, manufacturing, energy conversion and transport. At the end of 2006, the EU pledged to cut its annual consumption of primary energy by 20% by 2020. To achieve this goal, it is working to mobilise public opinion, decision-makers and market operators and to set minimum energy efficiency standards and rules on labelling for products, services and infrastructure.

Policy orientations

- Energy efficiency for the 2020 goal
  Member States have made a commitment to reduce consumption of primary energy by 20% by 2020. There are still many barriers to the implementation of effective measures. This Communication describes the current position of future projects aiming to reach the '20-20-20' goal.
  Reference: Communication from the Commission of 13 November 2008 - Energy efficiency: delivering the 20% target [COM(2008) 772]
- Action Plan for Energy Efficiency (2007-12)
  The Commission has adopted an Action Plan aimed

at achieving a 20% reduction in energy consumption by 2020. The Action Plan includes measures to improve the energy performance of products, buildings and services, to improve the yield of energy production and distribution, to reduce the impact of transport on energy consumption, to facilitate financing and investments in the sector, to encourage and consolidate rational energy consumption behaviour and to step up international action on energy efficiency.
Reference: Communication from the Commission of 19 October 2006 entitled: Action Plan for Energy Efficiency: Realising the Potential [COM(2006) 545]

- Competitiveness and Innovation Framework Programme (CIP) (2007-2013)
  In order to meet the objectives of the renewed Lisbon strategy, and thus stimulate growth and employment in Europe, a Competitiveness and Innovation Framework Programme CIP has been adopted for the period 2007-2013. The programme supports measures to strengthen competitiveness and innovation capacity in the European Union. It particularly encourages the use of information technologies, environmental technologies and renewable energy sources.
  Reference: Decision 1639/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Competitiveness and Innovation Framework Programme(2007-2013).
- The Global Energy Efficiency and Renewable Energy Fund
  A proposal has been made to set up a Global Fund of risk capital with a budget of 100 million to mobilise private investment in projects promoting energy efficiency and renewable energy in developing countries and emerging economies.
  Reference: Communication from the Commission to the Council and the European Parliament of 6 October 2006: "Mobilising public and private finance towards global access to climate-friendly, affordable and secure energy services: The Global Energy Efficiency and Renewable Energy Fund" [COM(2006) 583 fina]l

Delivering energy efficiency

- Energy end-use efficiency and energy services
  The European Union (EU) has adopted a framework for energy end-use efficiency and energy services. Among other things, this includes an indicative energy savings target for the Member States, obligations on national public authorities as regards energy savings and energy efficient procurement and measures to promote energy efficiency and energy services.
  Reference: Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.
- Cogeneration
  The energy-saving potential of cogeneration is currently under-utilised in the European Union (EU). The purpose of this Directive is to facilitate the installation and operation of electrical cogeneration plants (a technology allowing the production in one process of heat and electricity) in order to save energy and combat climate change.
  Reference: Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC.
- Energy efficiency: energy performance of buildings
  The Member States must apply minimum requirements as regards the energy performance of new and existing buildings, ensure the certification of their energy performance and require the regular inspection of boilers and air conditioning systems in buildings.
  Reference: Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

Energy Efficiency of products

A number of product related directives and council decisions set minimum standards for energy efficiency requirements:

- Clean and energy-efficient road transport vehicles
- Tyre labelling
- Ecodesign for energy-using appliances
- Household appliances: energy consumption labelling
- Energy efficiency of office equipment: The Energy Star Programme (EU - US)
- Energy efficiency: energy efficiency requirements for ballasts fluorescent lighting
- Hot-water boilers
- Domestic refrigeration appliances: energy efficiency

Renewable energy

Renewable sources of energy - wind power, solar power (thermal and photovoltaic), hydro-electric power, tidal power, geothermal energy and biomass - are an essential alternative to fossil fuels. Using these sources helps not only to reduce greenhouse gas emissions from energy generation and consumption but also to reduce the European Union's (EU) dependence on imports of fossil fuels (in particular oil and gas). In order to reach the ambitious target of a 20% share of energy from renewable sources in the overall energy mix, the EU plans to focus efforts on the electricity, heating and cooling sectors and on biofuels. In transport, which is almost exclusively dependent on oil, the Commission hopes to increase the current target of a 5.75% share of biofuels in overall fuel consumption by 2010 to a 10% share by 2020.Policy orientations.

- Renewable Energy Road Map
  The Renewable Energy Road Map assesses the share of renewable energy in the energy mix and the progress made in this area. It also includes the target of producing 20% of total EU energy consumption from renewable energy sources by 2020, as well as measures for promoting renewable energy sources in the electricity, biofuels and heating and cooling sectors.
  Reference: Commission Communication of 10 January 2007: "Renewable Energy Road Map. Renewable energies in the 21st century: building a more sustainable future" [COM(2006) 848 final - Not published in the Official Journal].
- Promotion of the use of renewable energy
  The Commission proposes a framework for the promotion of energy from renewable sources, including national targets to be achieved by 2020 and measures to guarantee the quality of the energy produced.
  Reference: Proposal for a Directive of the European Parliament and of the Council of 23 January 2008 on the promotion of the use of energy from renewable sources.

Electricity

- Renewable energy: the promotion of electricity from renewable energy sources
  The European Union is creating a Community framework for promoting renewable energy sources for electricity production. It is setting an objective for renewables of a 21% contribution to electricity production and is laying down specific measures relating to evaluation of the origin of the electricity, connection to the grid and administrative measures, among others.
  Reference: Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity from renewable energy sources in the internal electricity market [See amending acts].

In 2005, RES electricity accounted for about 15% of total EU consumption. Based on current policies and actions, the Commission believes that this figure will reach 19% in 2010, which is close to the target (21% for the EU-25). However, progress varies: while countries such as Germany, Denmark and Spain are on course to achieve their 2010 targets, other countries are far from being so, for example, France, Italy and Austria. Hydroelectricity is still the main source of RES-E (it reached 67% in 2005); however, it offers little potential for future growth. Wind energy is very successful, with strong growth in Europe (33% share of new electricity production installations and 2.6% of total EU electricity consumption) and a world market share on the increase. Electricity produced from biomass covers 2% of total EU production and its growth has been accelerating in recent years. The report also contains recommendations to be put into effect without delay
Reference: Communication from the Commission of 10 January 2007 entitled "Green Paper follow-up action Report on progress in renewable electricity" [COM(2006) 849 final - not published in the Official Journal].

- Support for electricity from renewable energy sources
  The Commission analyses the progress made in the area of renewable energy sources. It reports on the growth in the generation and circulation of renewable energy on the internal market. Public support plays an important role in cooperation between the Member States. The Commission considers that harmonisation of the rules in the field of renewable energy is not feasible at present. However, in the long term, this would be the path to take.
  Reference: Commission Communication of 7 December 2005 "The support of electricity from renewable energy sources" [COM(2005) 627 final - Official Journal C 49 of 28 February 2006]

Heating and cooling

- Biomass Action Plan
  In the face of Europe's increasing dependency on fossil fuels, using biomass is one of the key ways of ensuring the security of supply and sustainable energy in Europe. This communication sets out a series of Community actions aimed in particular at increasing the demand for biomass, improving supply, overcoming technical barriers and developing research
  Reference: Communication from the Commission of 7 December 2005 - Biomass Action Plan [COM(2005) 628 final - Official Journal C 49 of 28.02.2005].

Biofuels

- EU strategy for biofuels
  The European Union (EU) sets out seven strategic policy areas for the development of the production and use of biofuels by the Member States and developing countries.
  Reference: Commission Communication of 8 February 2006 entitled "An EU Strategy for Biofuels" [COM(2006) 34 final - Official Journal C 67 of 18 March 2006].
- Motor vehicles: use of biofuels
  The European Union (EU) creates a Community framework to promote the use of biofuels in order to reduce greenhouse gas emissions and the environmental impact of transport, and to increase security of supply.
  Reference: Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport.

Wind Energy

- Promotion of offshore wind energy
  The development of renewable energy must contribute to the objectives of the new Energy Policy for Europe. Maritime wind energy is a relevant alternative in this respect, insofar as it represents a source of clean, indigenous and renewable energy.
  Reference: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions of 13 November 2008 – 'Offshore Wind Energy: Action needed to deliver on the Energy Policy Objectives for 2020 and beyond' [COM(2008) 768 final – Not published in the Official Journal].

The Covenant of Mayors

The European Union (EU) is leading the global fight against climate change, and has made it a top priority. Its ambitious targets are spelt out in the EU Climate Action and Renewable Energy Package , which commits Member States to curb their CO2 emissions by at least 20% by 2020. Signatories of the Covenant of Mayors contribute to these policy objectives through a formal commitment to go beyond this target through the implementation of their Sustainable Energy Action Plan.

Key role for local authorities

Local authorities have a key role in mitigating climate change. Over half of greenhouse gas emissions are created in and by cities. 80% of the population lives and works in cities, where up to 80% of energy is consumed. Local authorities, being the closest administration to the citizens are ideally positioned to understand their concerns. Moreover, they can address the challenges in a comprehensive way, facilitating the conciliation between the public and private interest and the integration of sustainable energy into overall local development goals, be it development of alternative energy more efficient energy use or changes in behaviour.
Local governments must therefore become leading actors for implementing sustainable energy policies, and must be recognised and supported in their effort. The Covenant of Mayors is an ambitious initiative of the European Commission that gives the lead to Europe's pioneering cities to mitigate climate change through the implementation of intelligent local sustainable energy policies that create stable local jobs and increase citizens' quality of life and address crucial social issues.
The formal commitment of signatories is translated into concrete measures and projects. Signatory cities accept to report and being monitored on their implementation of the Action Plans. They also accept termination of their involvement in the Covenant in case of non-compliance. Cities also commit to allocating sufficient human resources to the tasks, mobilising society in their geographical areas to take part in implementation of the action plan, including organisation of local energy days, and networking with other cities.

6.7 Appendix 7 Statutes, regulations, directives and national Policy guidelines

6.8. Appendix 8 National statistics and sources of information