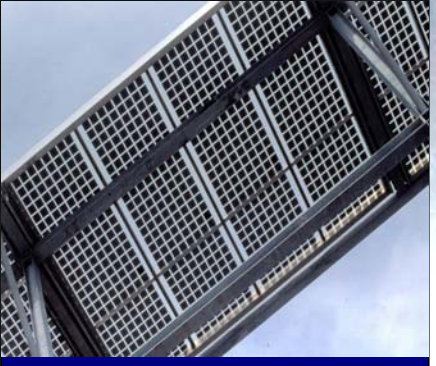

Possibilities for a more sustainable energy use in Hillerød

SECURE

Hillerød is geographically situated in North Zealand and part of the capital region of Denmark. The municipality covers 212.99 km2 and has 46.500 inhabitants, with 30.000 living in the city of Hillerød.

Possibilities for a more sustainable energy use in Hillerød

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Preface

This report describes Possibilities for a more sustainable energy use in the city of Hillerød.

The municipality in Hillerød is the owner of the local energy supply company. This is not normal in Denmark. The normal ownership is that large energy supply companies own the energy production facilities and distribution systems.

The relevant national laws and agreed documentsare are also described, as these affect the way new energy supply systems can be developed.

Further information can be found, on the Municipality Homepage www.hillerod.dk or by contacting energihandlingsplanen@hillerod.dk.

Enjoy the reading

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SECURE

Sustainable Energy Communities in urban Areas in Europe

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Horizontal Key Action 1: Sustainable Energy Communities

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The energy price can be used as a control mechanism

The energy price consists of en annually tax and a price which follows the used amount of kWh. The size of the annually tax is evaluated each year, and normally it covers the costs for the distribution net. The price which follows the used kWh normally consists of a part which follows the raw energy prise, for example the price on raw oil or natural gas, and a part that the energy company puts on the top to earn money. This last part of the energy prise is strictly controlled by the government, at last in Denmark.

The negative part of this kind of energy price system is, that the costumers which use only a little energy, has to pay an equal part of the cost of the distribution net, as the customers which use a lot of energy. This means that customers which only uses a little energy, pays a higher total price pr. kWh, than the costumers which uses a lot of energy, and if the customers which uses only a little energy saves on the energy it doesn't really affect their energy cost because the biggest part of the energy cost is the annually tax.

There are to ways to use the energy prise as a control mechanism. The first and easy way is to remove the annually tax. Instead of shearing it between all the costumers, it could be put on the energy, on the price per kWh. The energy company would get the same income and as a consequence the costumers would save more money when they save energy. The other way to control the energy price is to make an energy consumption limit for each kind of costumer. The electricity limit for a normal household could be 2000 kWh/year. If they uses below this amount they would get a reduced energy price, but if they used more than the limit the energy price would be increased.

It sounds easy to use the energy price as a control mechanism but, in the real life it is a little more complicated because, some costumers just use more energy, for example people who lives in 100 or 200 year old houses. These buildings use more energy because they are badly insulated, and it is not allowed to do a factor 10 renovation because the buildings have a national value. No mater how the energy price is regulated some people will feel it as an extra kind of national tax, and it can be difficult to change that.

Attractive loans for energy saving measures and local renewable energy solutions can be developed

Many building renovations don't change the energy standard for the buildings, but it could be done if the building owner would use only a little more money on insulation, better windows, ventilation etc. The building owners often use all their money on a new kitchen and bathroom, and then they haven't money left for improving the energy performance. This sounds a little weird because it often is cheaper to improve the energy performance than to pay an extra energy bill every month for maybe 30 years. The reason for this

behaviour is that the banks often give the building owners a loan, and then don´t care how the money is used, as long as it is used on the building.

The energy companies could somehow give the same kind of loans as the banks, but the loan from the energy companies should be used on improving the energy performance of the buildings. The payback could then be taken from the monthly energy bill. In this way, the building owner would get a building with a lower energy demand, but the payback would equal the cost for the saved energy, and therefore he would not feel this kind of energy saving as a bad investment. The building owner is nearly getting a better building for free.

Intelligent district heating and CHP solutions with low relative losses can be developed, to prepare for the low energy building of the future

A normal district heating system has the temperatures 70°C/40°C. This means that the water temperature that is pumped into the district heating system is 70°C and the temperature of the water is 40 C when it returns to the plant. For many years the energy demand for a normal Danish dwelling has been approximately 100 kWh/m2*year, and by these amounts of energy, the energy loss in the district heating system has been between 15-20 % of the energy that left the plant. The energy loss in the distribution system is nearly constant but it depends on the water temperature in the pipes.

Low energy buildings will within 5 – 10 years only use 40-50 kWh/m2*year, then the corresponding energy loss in the distribution net will be 30 – 40 % of the energy that leaves the energy plant. These huge losses will affect that the district heating will be to expensive compared to for example natural gas.

The only way to avoid, that the district heating system will be too expensive for the costumers, is to minimise the energy loss. This can nearly only be done if the temperatures are lowered to 60/30 or the best would be 45/25. There is one problem if the temperature constantly is below 50 C, and that is the risk from bacterias, especially the legionella bacteria. Bacteria can grow both in the water in the district heating system, and in the warm water tanks by the customers. Therefore it will be necessary to watch the temperatures in the warm water tanks continually, and when the temperature has been at a critical level for a critical time, the temperature in the whole district heating system should be raised to for example 70 C, until all the warm water tanks have a temperature above 60 C.

If the district heating system is made with the temperatures of 45/25, the energy loss in the pipes will still be at approximately 10 % of the energy demand in low energy houses.

Alternative energy supply solutions like e.g. heatpumps with good COP factors can be developed

One of the larger energy problems is that a lot of dwellings only are heated by electricity, and electrical energy polutes aproximately 2.5 times more than for example the energy in district heating in terms of CO2 emissions. Dwellings are often heated by electricity because the district heating or the natural gas system has not yet reached their areas. When the dwellings are build with electric heating it is expensive to install a central heating system which is the basis of the district heating system or a natural gas system. Therefore many building owners don't want to get connected to a district system even though they have the opportunity.

A good alternative to electrical heating is heat pumps. Heat pumps can generate heat from the air outside or from the ventilation air from the house. It can also generate heat from the earth or soil outside the house (earth-heating) via pipes dug approx. 80 cm into the ground. A heat pump is the opposite of a refrigerator, and instead of cooling it is heating.

An air-to.air heat pumps can be placed on a wall and heat the air inside the house. Such a system does not require a central heating system. It it can also be connected to the warm water tank to heat the domestic hot water, also without the need for a central heating system.

In general a heat pump only uses 30 % of the energy in electricity (COP-value of 3), compared to the energy that would have been used without the heat pump, but there is big differences between the different fabricates. It is therefore necessary to compare different heat pumps to gain the best energy savings.

Heat pumps based on a central heating system and earth-heating can achieve COP-values as high as 4 on a yearly basis. It is important to include energy meters in the systems so that the actual COP values can be measured.

Development of energy supply solutions that include renewables like biomass and solar energy

Most district heating systems consist of one or two larger power plants, and a lot of minor heating centrals. The minor heating centrals are used as back-up on the very cold winter days, or if the larger power plants have problems.

The power plant often uses gas, coal or garbage or other kinds of waste, and the minor heating centrals normally uses gas. A new way of thinking is to use biomass on the minor heating centrals. For example wood chips or compressed wood pellets. They are CO2 neutral and are often cheaper then natural gas, and the wood can be stored in containers

or tanks. The pumps and everything that connects the heating central with that distribution net, is the same kind for all kinds of fuels.

Another way of improving the heating system is to use large solar collectors instead of the minor heating centrals. When the collector once is build, there is no longer a fuel cost and therefore the collectors can stabilise the energy price, even though the oil price is increasing.

Large solar collectors can be built at many places in the cities, but the best places are where the citizens can't see them from there houses. Most people like environmental friendly things as long as they can't see them. The best place to install large solar collectors is on the roofs of large houses or in the areas between larger roads and the city.

As the price for land is increasing, it is becoming increasingly difficult to find places near the cities to put large solar collectors. This makes it even more relevant to put the collectors on the roofs of buildings in such a way that a large part of the roof is covered with collectors – or maybe even the entire roof. Research for such solutions is being planned in Denmark at the moment.

Documentation of good design options for solar energy implementation e.g. solar collectors and PV systems

The policy for many new building areas is that, everything that in some way can be annoying to your neighbour shall be removed. This means that the shining part op solar collector often is prohibited. It is often a good ting for many architects because they don't like solar energy – or maybe they do, but then there must be some unknown factors because they normally don't build solar energy on dwellings.

It is important that the municipality allows solar collectors in new city areas, and it is also important that new building owners have examples to compare with, when they decide whether they want solar energy on their new house or not.

It is important that these examples are well documented and include documentation on recommended collector sizes and water tank sizes, and also with documentation on the best practice of implementation in the roof. There should also be recommendations for PV systems and for solar collectors located on the ground.

Such recommendations could me made in collaboration with producers and installers of the systems so that the house owner can buy a product of a good quality and have it properly installed, all at an attractive price.

Policies for energy savings both in relation to electricity and heating use. E.g. 1 % energy saving per year like in Hillerød to support the Kyoto protocol aims

People normally don't want to be the first, if there is a risk involved, and it is the same thing with the energy savings. Nearly all citizens want to be environmental friendly when buying vegetables, but they would rather buy a new low energy fridge than install PV on their roof. Even though it would be better for the environment to install the PV and the price would be the same.

It is important with an energy saving goal, but the goal doesn't achive the saving alone. It's therefore important to have an energy saving policy in general, and an energy saving action plan that describes how to reach the energy saving goal. And the last ting is that the action plan and the goal should be well known by the citizens.

Registration of heat losses in district heating systems and plans to reduce them

The most important issue in everything which contains money is mass balances. It is very important to be aware of that what comes in to a system must come out. In a district heating system there is a lot of losses and it is important to know each of them, and at least annually compare them to see how they have developed. It is also possible to minimise the losses if they are known, or at least know where it is cheapest to remove the loss.

It is a good idea to model the district heating system in a dynamic model. Then it is possible to describe were the week areas in the system are, at different times of the year.

A large part of the losses from the system is from the connection pipes to each building, whereas the loss from the large distribution pipes is relatively small. The connection pipes that were installed 30-50 years ago often have less insulation and a larger diameter than pipes installed today. It is therefore important for the city to know which pipes it might be relevant to change. This could be done when the sewer or water supply must be renovated.

Spatial planning in Denmark

Denmark has a simple and clear spatial planning system that strongly decentralizes the delegation of responsibility. The municipal councils are responsible for comprehensive municipal planning, detailed local planning and permits for construction and changes in land use in rural zones. The 12 regional planning authorities are responsible for regional planning. The Minister for the Environment may influence decentralized planning through

national planning initiatives. The state may veto the planning of municipalities and regional planning authorities to uphold national interests. Planning decisions may be appealed to the Nature Protection Board of Appeal. Only the legal issues in planning decisions may be appealed.

The Planning Act ensures that the overall planning synthesizes the interests of society with respect to land use and contributes to protecting the country's nature and environment, so that sustainable development of society with respect for people's living conditions and for the conservation of wildlife and vegetation is secured. Spatial planning is especially intended to ensure that:

- the whole country and the individual counties and municipalities develop appropriately, based on overall planning and economic considerations;
- valuable buildings, settlements, urban environments and landscapes are created and conserved;
- the open coasts continue to comprise an important natural and landscape resource;
- air, water, soil and noise pollution are prevented; and
- the public is involved in the planning process as much as possible.

National planing

The rules on national planning were introduced in 1974. National planning is expressed through reports, binding instructions, guidelines and intervention in local planning for themes and projects of national interest. National planning shapes a vision for the development of the whole country that reflects national political objectives. The regional planning authorities and municipalities are required to consider this framework in regional and municipal planning. The Minister for the Environment publishes one or more reports at least every 4 years that describe the state of the environment in Denmark and Denmark's policy on nature and the environment.

Regional planning

Regional planning concretizes the national objectives for regional development and rural development. The regional plan establishes the overall objectives for development in a regional planning unit, mostly counties, for a period of 12 years. In Greater Copenhagen, regional planning is conducted for the entire region. The key themes are urban development and the location of regional functions, the overall transport structure and infrastructure, protection of nature and the environment and leisure facilities and tourism.

The regional planning guidelines establish a framework for municipal planning and a basis for the regulation of land use in the countryside.

Municipality planning

The strength of the municipal plan is that it summarizes and concretizes the overall political objectives for the development of a municipality. The key themes are: the design of urban areas; the location of housing, workplaces, shops and public institutions such as schools, child-care centres and homes for elderly people; transport; and green spaces. The municipal council uses the municipal plan to establish policies for the development of towns and cities and for development of individual districts. The municipal plan comprises the necessary link between the regional plan and the provisions of local plans on land use and settlement in individual districts.

Local Planning

Local plans are the foundation of Denmark's spatial planning system. Local plans concretize the political strategy and objectives of the municipal plan. Whereas the municipal plan provides a comprehensive overview for the whole municipality on such matters as the development of housing and workplaces, transport, services and recreational areas, local plans stipulate how a smaller area may be developed and used. Local plans are legally binding for property owners.

Energy labelling in Denmark

Energy labelling of dwellings is statutory, as well as it is for office buildings, administration buildings and institutions. The aim of the labelling is to make the energy demand visible for the building owners, and to show how it is possible to save energy, with renovation that has a short payback time.

The result of an energy labelling gives good energy saving opportunities for most houses, and it benefits both the private-economics, national-economics and the environment. It also gives a side benefit of better indoor climate.

The following rules is effective for all buildings that is energy labelled

- All single family dwellings and owner-occupied flats shall have made an energy label when they are sold, unless if they have a energy labelling rapport that is maximum 5 years old.

- All buildings larger than 1000m2 shall be energy labelled every 5 years. (Industries and farmers are excepted)

- All new buildings have to be energy labelled before they may be used. (Industries and farmers are excepted)

The energy label gives an overview over the total energy demand of a building, and it shows the options to reduce the use of heat, electricity and water. The total energy demand consists of energy for heating and normal use of the building installations.

Every building gets a mark from A1 to G2. The central part in the energy labelling is the suggestions to energy saving renovations. It is these examples the building owner can use to decide how he is doing the most cost efficient renovation.

The energy labelling may only be done by an energy person, that has the labelling certificate from the national energy services (energistyrelsen in Denmark).

The Danish building regulative

New energy requirements were introduced in Denmark in April 2006. The minimum demands mean that a new building will use 25-30% less energy than a building built before April 2006. The new regulations also introduced 2 new low energy standards, which use 25% and 50% less energy, respectively. It is the idea that these low energy standards will become the standard in 5 and 10 years, respectively.

The new requirements mean that an energy frame is calculated for each building. The energy frame limits the buildings demand for energy to a specific amount of kWh/m2 per year. With the new demands, not only the heating demand is taken into account, but also the demand for electricity for building operation (ventilation, cooling, pumps and lighting (only in commercial buildings)). Energy gains from passive solar heating, internal gains and renewable energy sources are also taken into account.

For houses, hotels etc., the energy frame is: 70 + 2200/A kWh/m2 per year

where A is the heated gross floor area.

The Danish Building Research Institute has issued a guideline which is part of the new requirements, which means that to comply with the requirements the guideline must be followed. Part of the guideline is the computer program Be06 which must be used to calculate the energy demand for all new buildings.

In the program you add information about the U-values and areas for the building envelope including windows and cold bridges. For windows also the orientation, the g-value and solar shading or overhang is typed in. Based on these input, the program calculates the energy balance for all windows.

Data for all electrical installations must be added, including fans, and pumps for the heating system and for the domestic hot water system. For the ventilation system you also

add the airflow and the efficiency of the heat exchanger. Also the infiltration rate due to leakages or natural ventilation is added.

The heating system for the building is described by indicating if the building is heated by district heating, electricity or a boiler (on oil, gas or biomass). Any additional energy sources can be added in terms of PV, solar thermal systems, heat pumps etc.

When the total energy demand of the building is calculated, the electricity demand is multiplied by 2,5, which means that it will be very difficult to comply with the energy frame if electrical heating is used. It is therefore also sensible to use pumps and fans with a reduced electricity consumption, as these often are in operation 24 hours a day.

The program also considers if the building may overheat by determining how much time the temperature will exceed 26°C. It is determined how much electricity would be required to cool the building to 26°C, and this energy consumption is added to the building energy demand – no matter whether the building has cooling installed or not. This is to encourage building designers to create buildings without a need for cooling and with a good indoor environment.