

The background features a pattern of green dots on a white background, transitioning into a solid green area at the bottom. Overlaid on this are several black, hand-drawn, wavy lines that resemble topographical contours or abstract shapes.

THE DANISH MODEL

Danish experience with sustainable and low carbon urban development





Four decades with national Danish sustainable planning

Denmark is widely recognized for its high standards and remarkable results throughout four decades in areas such as environmental protection, wind power, energy efficiency, district heating, energy saving and introducing decentralized produced renewable energy into the power grid system.

In 1971 Denmark established the first Environmental Ministry in the world and got the first legislation covering issues related to the environment as a whole including protection of drinking water, shores and air. A result of this restrictive policy was establishing of improved sewage systems and water purification plants in every city in Denmark and filtration- and desulphurization plants by every combustion plant or process air emitting plant resulting in a significant better water and air environment.

In 1973 Denmark was - like many other countries - badly hammered by the OPEC oil embargo resulting in banning all Sunday driving for a while. Another result was the awaked political awareness and willingness to establish a focused and systematic energy policy to avoid a similar situation in the future. Denmark was lucky to discover some oil and gas in the North Sea to become more independent of foreign oil resources. But despite that, the Danes imposed on themselves a set of gasoline taxes, CO2 taxes and building-and-appliance efficiency standards that allowed growing the economy while barely growing the energy consumption - often called "The Danish Model". All in all

this gave birth to a Danish clean-power and clean-tech industry that is one of the most competitive in the world today. Denmark today gets nearly 20% of its electricity from wind.

Hydropower has never been an option in Denmark due to the small size and flatness of the country with no rivers with a significant hydropower potential. Nuclear power was a hot political item during the late sixties but due to a massive popular resistance it was not chosen as a reliable energy strategic way to follow. Despite that Denmark earlier had build up significant competences in the national nuclear research center Risø, Denmark has today no remaining competences and will be totally dependent of foreign know-how and energy resources if nuclear power should ever be implemented in Denmark.

During late seventies and eighties massive investments were made in a new natural gas grid bringing the gas from the North Sea to almost every corner of Denmark and in a lot of small decentralized natural gas fired combined heat and power plants (CHP). Using the produced heat from the power production to heat up houses and factories by means of a collective district heating system gives a very high overall efficiency of the CHP plants. This high efficiency in combination with the lower carbon content compared to oil, related to the calorific value, reduced the emission of fossil CO2 during the eighties in Denmark.

During the nineties a lot of wind turbines were erected in Denmark due to a supportive policy from the Danish government. Today Danish wind turbine industry is the

largest in the world. 32.000 wind turbines from the company Vestas are installed in more than 60 countries. The Danish energy company DONG Energy is main contractor on what will be the world's biggest off-shore wind turbine park with a total installed capacity of 1800 MW. The park will be located in England.

Agriculture in Denmark is in many ways the foundation of the Danish welfare state and agriculture is still today a substantial source of the Danish income due to the export of meat. Denmark has a production of 20 mio. pigs every year leaving the society with a big manure problem. Due to the water protection legislation manure must only be brought out on the fields in the plants growing season, but the methane produced due to the microbiological decomposition of the manure is a serious green house gas, much worse than CO₂. To avoid this emission of methane the manure can be utilized in a biogas plant producing green CO₂ neutral heat and power – a double positive effect! During the nineties several biogas plants were established in Denmark and this was stimulated by the government by giving a good price pr. produced kWh (As for power produced from wind turbines) but some technical problems limited the usage of the technology. Today the technical problems have been solved and the present government wants now to three-double the biogas production by supporting the possibility of upgrading the biogas to natural gas quality (taking out the CO₂) and inject it into the natural gas grid.

In the new Millennium other biomass resources such as wood-chips, straw etc. have become economic feasible

due to increasing oil and gas prizes as fuels for CHP plants. For many years industrial and municipal waste has been managed in Denmark in a way to eliminate the need for deposit. The priority of the waste handling in Denmark is: Waste reduction, waste recycling and waste to energy. In the last decades waste to energy has been practiced in combined heat and power plants connected to local district heating. Today coal has become a backbone in the energy supply of Denmark, but Denmark has build up know-how and competences in building and running coal-fired CHP plants with a very high efficiency to reduce the emission of fossil CO₂. It is the present government's explicit policy to make Denmark to a society totally independent of fossil fuels within a few decades.

In addition to the above mentioned low carbon technologies, Denmark has in the past four decades focused a lot on energy saving by establishing energy management procedures and systems in public and private organizations and has – as we shall describe in details in the following – build up a substantial expertise in this field. Development and introduction of different energy saving and producing equipment such as heat pumps, water pumps, ventilation systems, insulation technologies etc. etc. has also been of great importance in the implementation of the "Danish Model". But Denmark has also managed to involve the citizens in creating awareness for taking care of the environment. It is a national sport in Denmark to bring your household waste to the local "Recycling central" Sunday morning. It is amazing to see people carefully sorting there waste in dozens of categories consulted by the engaged "Recycling central" staff.





Norway

Oslo

Sweden

Stockholm

Frederikshavn

Göteborg

Aalborg

Århus

Copenhagen

Denmark

Esbjerg

Odense

Germany

Frederikshavn – located in the center of South Scandinavia

Frederikshavn is a middle-sized North-Danish municipality with app. 60.000 inhabitants located in the center of the South Scandinavian Region with several daily ferry connections to Oslo, the capitol of Norway and to Gothenburg, the second largest city of Sweden and located in one of the most industrialized areas in the hole Scandinavia. Frederikshavn is a strategic logistic gateway from Scandinavia to continental Europe, linking

the ferries to the European main highway E 45. A lot of goods and people come daily around the busy harbor of Frederikshavn. Frederikshavn is also hometown for a big Danish navy base.

The South Scandinavian Region also includes the capitol of Northern Jutland, Aalborg and the second largest city of Denmark, Århus. Within a few hours travel from Frederikshavn you reach the universities in Oslo, Gothenburg, Aalborg and Århus so the region has as a hole a big knowledge potential. There has been lively maritime ac-





tivity and trade in the region at least back to the period of the Vikings a thousand years ago and the area is today one of the richest and well developed in the world. The economy is based on high efficient agriculture and fishery production but also on heavy and light industry, service and tourism.

The decades with a strict legislation from the Danish and the other Scandinavian Parliaments to protect the environment and to make the transition to more energy independency based on local energy production have forced the enterprises to develop new successful areas of clean-tech business. Clean-tech methods and technology are widely and successfully exported to and implemented in other regions of the world.

A very important lesson is that technology alone can't do it. Implementing clean-tech involves in very high degree political processes at all levels and education, information and involvement of the citizens to be successful! We have in Scandinavia developed a mindset of awareness for the environment and taking care of the earth's limited resources, where, what is experienced as disadvantages by changing the energy supply system like energy taxes, noise from wind turbines, smell from biogas plants etc., are widely accepted.

Sustainable urban planning in Frederikshavn

As described above there is in Denmark a long tradition of working on environmental protection, rational use of resources and implementation of renewable energy. The oil crisis of the 1970s contributed to serious reflection on the Danes' use of energy both in private and in industry. These considerations resulted in numerous changes in the Danish energy legislation, especially on construction law.

In order to keep the new rate there was established several energy and environmental management tools that could ensure the nation's long-term action plan for reducing energy consumption, rationalization of resources and conversion to promote renewable energy. These policies and management tools later formed the foundations of European Union policy on energy and environment, together known as climate change today.

Frederikshavn Municipality has been one of the first municipalities that have implemented seriously Denmark's overall policy on climate change into the municipality. Today, more than 94% of Frederikshavn city joined the collective district heating where heat is produced as a secondary product in the production of electricity in a combined heat and power plant, CHP. The plant uses combustible household waste as fuel. Before the waste is incinerated, it is sorted for all recyclable materials, which then goes to recycling.

In the winter, where the need for comfort heating is greatest, a natural gas fueled CHP plant supplies the city's electricity and heat as needed.

Frederikshavn is considered as one of the main municipalities in Denmark where the Danish off-shore wind turbine will be tested. There are installed more than 70 wind turbines in Frederikshavn Municipality, of which 4 are offshore wind turbines just outside the port of Frederikshavn and there are many more coming. Today Frederikshavn city is supplied 24% by renewable energy.

Likewise, Frederikshavn Municipality through three decades accumulated specific knowledge on energy efficiency, energy saving and environmental protection. Municipal resources have contributed to the elaboration of standardized management systems which are currently used both by on national level and by other EU countries.

As the first municipality in Denmark Frederikshavn Municipality signed an agreement with the national environmental organization to reduce its CO₂ emissions by 3% per year.

Implementation of the concept of Energy City Frederikshavn will lead Frederikshavn to becoming the first city in the world to convert its energy consumption of electricity, heat and transport to 100% renewable energy at the end of 2015.



Energy City Frederikshavn – a national test-site

The idea of the project: “Energy City Frederikshavn” was born on a national event in 2006, the so called Energy Camp, where energy experts from all over Denmark every year suggest new ways to improve Danish energy policy and technology. One workshop worked with the possibility to find a suitable Danish urban society where it could be demonstrated in practice that it is possible with proven technology to make

a 100% transition from fossil fuels to renewable energy including power, heat, industrial process and transportation.

The choice the experts made was Frederikshavn because it had a suitable size, not too big and not too small. Frederikshavn is located with good windy and sunny conditions for wind turbines and solar heat plants and nearby biomass resources. Frederikshavn has a strong political commitment and willingness to risk caused by the fight to survive and recover when the city’s two shipyards closed in the eighties resulting in 7000 workers unemployed. As foreseen the City



Council of Frederikshavn adopted the idea and since then a powerful organization has been created to secure the realization of the visionary project creating a Danish national demonstration-site showing the world, that it is possible to make the transition to a 100% renewable energy supply within the year 2015.

Is this possible?

We are sure that it is possible and we have made a specified plan for the transition that can be seen on our home-site www.energycity.dk. The backbone in this renewable energy supply in 2015 is that app. 30% is coming from wind turbines, app. 30% is coming from urban waste and app. 30% is coming from biomass. The rest will come from sun heat and heat pumps. Today we have 24% RE supply.

According to the plan we will reach 40% RE in 2010 due to already planned and fully financed plant investments from private investors including DONG Energy. A big challenge is the transportation sector excluding all transit traffic including only vehicles based in the defined area of the Energy City of Frederikshavn. As we cannot force people to buy RE vehicles we simply define that we have reached the goal when we can fully in practice supply the transportation sector in the energy city with RE fuels. In our traffic strategy we operate with vehicles powered by upgraded biogas (where the content of CO₂ is removed), electricity and fuel-cell hybrids powered by methanol made by upgraded biogas.

The big challenge in the "Socio-Technological" project: "Energy City Frederikshavn" is not the technology itself. As mentioned before is the technology for the transition

basically present today. That is why we can give ourselves the short limit in 2015. Wind turbines, CHP Waste Plants and Biogas Plants are ready for reliable energy production and the energy resources are present. Here and now biogas can supply busses, trucks and private cars. The bi-fuel cars (Cars that can drive on biogas and gasoline as well) are widely available on the market. 15.000 vehicles are on biogas in Sweden and hundreds of filling stations are present in a lot of European countries including Sweden, Germany and Italy. So we can get started with a well proven technology while we are waiting for the development of the electric and electric/fuel-cell hybrid cars to get satisfactory performance for the common public.

No the big challenge is not the technology itself. It is the political process. It is, when it comes to the point, what influence will the realization of this project have to the single citizen. Can we convince the single citizen that he or she will benefit of it in the long run? We know that the fossil resources are limited and that the demand for energy will explode in the coming years. We know, and the International Energy Agency tells us so, that the prices on oil and other fossils will explode in the years to come, but will the citizen take that for granted? If we are clever enough to convince the citizens about the perspectives in this magnificent project for sustainable prosperity the politicians on all level will support it too and the investors will see the business possibilities. If we are clever enough we can convince the citizens that despite there are disadvantages in the transition process, the advantages are much bigger.

That is why involvement of the citizens is so important.

Criteria for definition of the “Low Carbon City” concept (World Wildlife Fund, WWF)

Background

In 2050, there will be 9 billion people on Earth. All this population growth will occur in cities. Therefore, the existing cities around the world expand rapidly and completely new cities will shoot up. If we are to curb climate change, the cities must help to create the climate solutions we need, but how do we realize it?

WWF is calling for Technology Action Programs to be established under the UN Framework Convention on Climate Change (UNFCCC), to speed up the development and demonstration of new technologies and the better diffusion of existing sustainable technologies. WWF will promote low carbon development policies such as low carbon city index. The Low Carbon City Initiative is an example where governments are already coming together to demonstrate clear actions for climate changes.

Low Carbon City Planning (LCCP)

The concept of Low Carbon Cities is closely aligned with sustainable development. Through the adoption of sustainability as the driving planning objective, and the integration of ecological and resource management principles into the urban planning decision making process, carbon emissions can strategically and effectively be reduced without compromising the need of urban economic growth. The way we build and use our cities together with the way we are used to consume the resources around us accounts for the largest carbon emis-



sions which means if we design and use our cities better and if we raise our awareness of social responsibility and move towards sustainability, we can dramatically reduce the environmental impact.

Carbon emissions are important. But they are only part of the evidence of the inefficient way in which natural resources are being used everywhere. As these resources are decreasing, so environmental and economic pressure increase to use them less wastefully. Which is why an energy efficient, sustainable city will also be a more competitive, wealthier city. Considering issues such as Low Carbon Economy and Low Carbon Life Style are two parameters which can help us to achieve our goal.

Low Carbon City Planning is to be considered as a concept which deals with following issues:

- Low Carbon City organization establishing (to implement the concept and to ensure that the city continues to perform to its design intent after handover).
- Resource management
- Energy efficiency and conservation
- Sustainable traffic planning
- Resource recycle planning
- Low Carbon and renewable technology planning

- Low energy building planning, training and building managing
- Reduction of Building's energy cost
- Cost effective improvements to an existing building's energy efficiency
- Incorporation of low carbon and renewable technologies
- Developing and designing a corporate social responsibility agenda.

The key partners integral to a successful Low Carbon City Planning (LCCP) are the main public sector bodies (local government, universities) with other major influencers of city carbon emissions such as housing associations, large businesses and appropriate consumer, community, faith and voluntary groups. Regional governing bodies and energy suppliers are also required to be engaged.

LCCP TOOL in steps

Step 1: Identify Key City Stakeholders

There can be a long list of potential stakeholders for the plan within a city context, for example:

- The Local Authority
- Higher Education Establishments
- Private Business
- Building authorities
- Local community

Step 2: City-Wide State of Play Audit

- The city provides performance indicators for as many resource consume as possible
- The city provides so many emission indicators as possible
- Establish a bank for your own indicators
- Compare your indicators with other Low Carbon Cities indicators by using audits.



Step 3: Collate Opportunities From Each Organization

A good first step is to create a long list of project ideas. This should be as broad and ambitious as possible and may include enabling projects and/or direct emissions reduction projects (for example, waste CHP-energy supply planning, Low energy building planning, rain capturing, or a large biomass heat planning). These ideas might be generated by a brainstorming session, site walk-arounds or site surveys and audits organized by key stakeholders.

Step 4: Define City Target

The aim of this step is to finalize the Carbon Reduction Strategy and Implementation Plan, a document which explains at a high level the 'what' and the 'how' of the Carbon Reduction Plan going forwards in time. Much of the strategy and opportunities development work has been completed in earlier steps, but you should now decide on a target for the city.

Aspirational, loose targets may have already been set earlier in the process but they must now be written as quantified, time bound targets against a baseline. The ideal is probably a single, round number target with stated scope, timescale and baseline.

For example:

'A reduction by 2015 of 15% from 2008 levels in CO₂ (or equivalent) emissions resulting from key stakeholder activities in the areas of buildings, transport and waste.'

However, short, medium and long term targets are also helpful in maintaining focus without losing flexibility.

Step 5: Launch City Strategy

Consider an internal launch for the City-wide Carbon Reduction Plan.

Communicate the overall objectives and key outputs of the plan to relevant staff and let them know what they can do individually to support achievement of the objectives of the plan. Those staff directly involved in implementation will have been consulted and informed while the Plan was being prepared. Consider talking to them in advance of the launch to test and reinforce their understanding of their roles, and to let them know about the intentions of the launch. Ensure that responsibilities are clearly allocated and timescales for implementation are fully understood by each member of staff concerned.

Consider publicizing achievements outside the city. Getting an article about the City-wide Carbon Reduction initiative in the local press might assist with building broader community awareness and establishing the initial key stakeholders as an example of best practice for others to follow.

The implementation plan guidance notes provide some advice on setup before projects are implemented.



Temagruppe erhverv

- Workshop den 11/3 kl. 16.00-18.30
- Velkomst ved Jørgen Ove Jensen (5 min) kl. 16
- Fællesforedrag om vedvarende energi ved Mikael Kau (20 min) kl. 16.35
- Kystkommunikation og bæltet om vedvarende energi ved Bo Holbæk (20 min) kl. 16.55
- Pause (5 min) kl. 17.45
- Lærerenkøbsforening: Energi- og Miljøsektoren ved Børge Mølle (15 min) kl. 18.00
- Dagsordenforretten: I det Bølg ved Michael Reuss (15 min) kl. 17.05
- Markedsføreren ved Michael Reuss (15 min) kl. 17.20
- Lærerenkøbsforening (30 min) kl. 17.35
- Workshop grupper: "Erhvervsrets muligheder og udfordringer" (45 min) kl. 18.05
 - Lag
 - Service
 - Industri
 - Landbrug
- Præsentation af resultater fra workshops (35 min) 18.50
- Opsamling og afrunding ved Jørgen Ove Jensen (5 min) 19.25





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