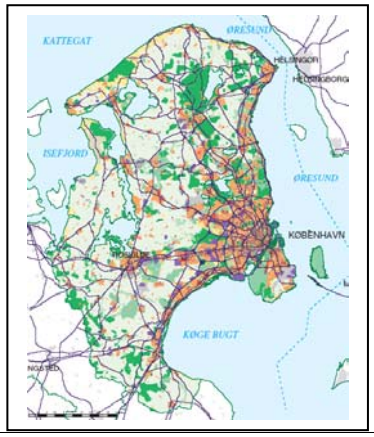
Greater Copenhagen Region

Regional RES-e Map: Electricity from renewable energy sources (RES-e)



The region	Greater Copenhagen
Number of inhabitants	1.71 Mio
Size (in km²)	2870 km²
Capital	Copenhagen

Short description:

Greater Copenhagen Region (GCR) is located on the island Sjælland in the eastern part of Denmark. It consists of: Copenhagen and Frederiksberg municipalities, and the counties Copenhagen, Roskilde, and Frederiksborg. Urban areas cover 28 %, and agricultural areas 47 %. GCR is the leading city region in the Nordic countries and a natural gateway to its neighbours and to the Baltic countries, for businesses and investors alike. The main economic sectors include chemical and medical industries, financial, insurance, and banking services, public administration, and tourism.

Share of RES (total primary energy): 2 %

Share of RES-e (total electricity): 6 %

Target RES-e (Denmark): 29 % (2010)

The partner organisation: Danish Technological Institute (DTI). An independent, non-for-profit technological service institute. The objective of DTI is to address the needs of the industrial sector and society as a whole through the development and dissemination of technological innovation. The number of employees is 900, hereof nearly 500 researchers and scientists.

	Number of plants	Total installed capacity (MW)	Typical installation size (new)	Main present funding mechanism	Short-term perspective (2007)	Mid/long-term perspective (2015)	Main barriers
Wind	170 (wind turbines)	92.6	2.5 MW / 600 kW (on-/off-shore)	Feed-in tariff	Very low	Medium (offshore)	Limited onshore wind potential, level of feed-in tariff, land use (urban sprawl)
Wood & straw biomass	2	50 1)	-	Feed-in tariff	Low	Low	No unexploited resources in region, low feed-in tariff
Biogas	7-8 2)	20-30	?	Feed-in tariff	Very low	Low	Difficult to find places for farm/joint plants, feed-in tariffs only for plants installed until 2008
PV	133	0.50	1 – 5 kWp	Net metering	Very low	Low to medium	High investment costs, generally little knowledge
Hydro <10	2	0.03	0.01	-	None	None	No available sources

1) Half of capacity (estimated) as part of a central combined heat and power station with mixed fuel

2) All except one are sewage treatment plants

Wind

The past: Denmark has since the early 80ies been the leading country in the world in development and exploitation of windpower. Encouraged by profitable feed-in tariffs many wind turbines were established in the 80ies and the 90ies. Many are still in operation. The investment was typically raised by community shares bought by the general public, often from the neighbourhood. In 2000 a windfarm outside Copenhagen with 20 wind turbines, each 2 MW, was commissioned, covering 3 % of the electricity consumption in Copenhagen.

The present: There are not many onshore sites suitable for installation of wind turbines in GCR because of a high population density and vulnerable landscapes, and few are vacant. Offshore there might be a higher potential for new windpower capacity. The feed-in tariffs are at present not very profitable. For the time being the total electrical capacity is hardly growing. A typical modern onshore wind turbine has a capacity of 600 kW (limited by law in height to 70 m), and an offshore wind turbine 2.5 MW. Most of the total capacity in GCR is owned and operated by cooperatives and the rest by single owners and utilities.

Main funding: Marketprice + national subsidy 0.1 DKK, max. 0.36 DKK/kWh in total. Subsidy expires after 20 years.

The main barriers & strategies to overcome them: The present funding conditions do not encourage to install new wind turbines. This problem needs to be addressed at national political level. The height restriction on onshore wind turbines is very rigid, and it is realistic to believe that it might be relaxed slightly. Offshore installations are large and expensive and involves many stakeholders. Besides the economical aspects the main barriers regarding offshore wind turbines are related to visual effects. Realization of an offshore project needs a persistent effort of devoted citizens and NGO's.

Short-term perspectives (until 2007): In the short term the onshore capacity is not likely to grow much. Neither is the offshore capacity, even if the economical prospects were better, because of the time-demanding planning process.

Mid/long-term perspectives (until 2015): There might be a potential for a minor development of the onshore market through replacement of old and small wind turbines with modern and larger types. The largest potential for increasing the generation capacity lies with offshore windfarms. The planning process takes very long time, and involves many stakeholders, but the technical conditions for a medium market development are good.

Wood & straw biomass

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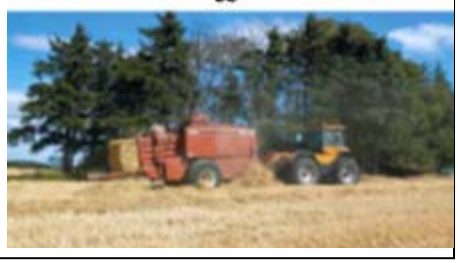

The past: Electricity generation from biomass is a relatively new technology. The development and establishment of plants has mainly been driven by agreements between the state and the power generating sector.

The present: The region holds one big central CHP plant with mixed fuel (wood&straw pellets, orimulsion, fuel-oil, coal), and one medium size (25 MWe) industrial plant fueled purely with wood biomass. In the small scale (<2 MWe) no technology is yet economically feasible, though promising tests with a Stirling engine have been carried out. Nearly all the biomass ressources in the region are exploited. Part of the biomass for the central CHP is imported. A big factory for pellets from wood and straw is residing in the region and is delivering pellets to the above mentioned central CHP plant.

The main barriers & strategies to overcome them: No unexploited biomass in the region. Low feed-in tariffs. Changing subsidy schemes. Technology in medium and small scale for generating electricity from biomass needs further development and demonstration, but funding is hard to find. An international market-place for biomass is not completely in place yet.

Short-term perspectives (until 2007): The prospects are very low. The power generation sector has almost fulfilled contracts with the state regarding installed capacity on the short term (large scale systems). Medium and small scale plants are not economically feasible with the present feed-in tariffs.

Mid/long-term perspectives (until 2015): The prospects are low. Yet, if the possibilities for finding funding to development and demonstration are improved, and if long term and more attractive subsidy schemes are adopted, there migth be interesting prospects for medium and small scale systems.

Biogas

The past: Biogas has been produced and applied for generation of electricity in sewage plants for many years. The electricity is used in the processing of sewage. In the early 1970s a development programme for farm biogas plants and preliminary joint biogas plant projects was initiated. The first farm plants were built in 1975, and the first joint plant in 1984. From the outset the plants had to be commercially viable. However, the prices on fuel fell, and it became necessary to use organic industrial waste as a supplement to liquid manure to increase the biogas production. In the mid 1980s farmers were ordered to increase storage facilities for liquid manure. This made it more interesting to build new joint biogas plants. In the order of 20 plants were built until beginning of the 1990s. The biogas technology was developed in the direction of cheaper standardized units. Prompted by investment subsidies, in the order of 50 farm plants were built in 1999-2002. Repeal of subsidies and uncertainty regarding feed-in tariffs led to a stop in installation of new plants. Biogas is considered to have a very low CO_2 shadow price. In 2004 a scheme that lays down feed-in tariffs for 20 years for new plants installed between 2004 and 2008 was adopted.

The present: In GCR there is a number of sewage plants (in the order of 10). In the agriculture there is only one farm plant. At present no new plants are installed.

Main funding: Feed-in tariff 0.6 dkr/kWh for 10 years after commissioning, then 0.4 dkr/kWh for the next 10 years. Valid for systems installed before end of 2008.

The main barriers & strategies to overcome them: The guaranteed feed-in tariffs are not index-linked. Only very large farms can reach profitability in farm plants. Concerning joint plants It has proven difficult to find places because of the odour nuisances, and the planning process takes very long time, meaning that hardly any plants will be installed before expiration of the installation period 2004-2008, valid for the feed-in scheme. To overcome the barriers biogas must be integrated in the regional planning and a scheme regarding feed-in tariffs reaching beyond 2008 must be adopted.

Short-term perspectives (until 2007): The incentives to install new plants are too small and combined with a time demanding planning process the potential for new plants is low.

Mid/long-term perspectives (until 2015): The trend is that small farms merge to larger units. If a long term strategy which guarantees feed-in tariffs for 20 years also for plants installed after 2008 is adopted, there might be a potential for a minor number of new farm plants. In any case the number is limited due to the high population density and the low number of farms.

PV

The past: PV has a short history in Denmark. The government supported R&D and some demonstration programmes from the beginning of the 1990ies. The first PV system was gridconnected in 1994. At the Danish Technological Institute a test facility was established and quality assurance schemes on components and installers were elaborated. In 2002 after a shift in government most public support to PV was stopped.

The present: Very few PV systems are installed at the moment, because of high investment costs and no public subsidy schemes (except for net metering). Yet interesting initiatives are taken. The Copenhagen Municipality has joined an international network “SolarCity”. The Copenhagen Municipality, Copenhagen Utility, and some NGO’s, citizens, and consultancy companies have initiated a project with the aim of supplying a quarter of Copenhagen with electricity from PV with a share of 10-15 % in year 2025, corresponding to a total area of PV modules of 150000 m^2. A utility in another region of Denmark is working to get political support to initiate a (national) 5000 rooftop programme as a follow up of a 1000 rooftop programme that ends 2005.

Main funding: Small private owners have been granted an exemption allowing to apply the net metering principle.

The main barriers & strategies to overcome them: Main barriers are high investment costs, at present no subsidy schemes, and uncertainty regarding the net metering scheme that expires 2006. Subsidy and metering schemes must be addressed at national political level. In general the knowledge about PV is low. Very few architects are enthusiastic about solar energy, however the gap between engineers and architects is continuously getting narrower.

Short-term perspectives (until 2007): The potential on the short term is very small due to the bad funding conditions, which are mainly determined by the national energy strategy, and very high investment costs due to the current overheated global market for modules. The local and regional authorities will expectedly concentrate on dissemination and pilot projects.

Mid/long-term perspectives (until 2015): PV is enjoying growing popularity as a method to produce electricity in urban areas because of the pollution-free production, modularity, and simple installation. The number of roofs and facades suitable for PV is enormous. If global energy prices continue to soar, the PV might look into a bright future, especially if a long term national strategy is adopted and followed up by concrete targets and subsidy schemes.

Main market actors:

In GCR some very big engineering consultancies (each 1000 to 3000 employees worldwide) reside, which are all world leading in different aspects of windpower technology. Besides in the field of windpower they all do businesses in the fields of biogas and solar energy (and in many other fields). There is a big number of small, specialized companies like planners and engineering consultancies offering services in niches within windpower, biogas, or PV. There are relatively few technology producers, and they are, with a few exceptions, small sized companys. NGO's have played an important role in the establishment of big windpower installations as well as small gridconnected PV systems. One major utility has been a main driver in the installation of PV systems in the region. Finally the associations of windpower industry and of biogas reside in GCR.

Below is a list of the most important companies, institutions, and NGOs, who directly address the needs of the market for components and systems to produce electricity from renewable energy sources.

Technology producers:
- Gaia Solar A/S (PV module producer and systemintegrator)
- Racell A/S (PV module producer and systemintegrator)
- Burmeister & Wain Scandinavian Contractor A/S (producer of biogas plants)
- Hempel A/S (producer of painting: windpower installations)

Consultants & planners:
- Carl Bro A/S (consulting engineers: windpower, biogas)
- COWI A/S (consulting engineers: biogas, windpower, solar energy)
- Niras A/S (consulting engineers: windpower, biogas)
- Rambøll Danmark A/S (consulting engineers: biogas, windpower, solar energy)
- CENERGIA (consulting engineers: PV)
- Esbensen (consulting engineers: PV)
- WEA Technology A/S (consulting engineers: windpower)
- Tripod (consulting engineers: windpower)
- Dansk Solenergi RI (turn-key systems & consultancy: PV)

Research:
- Danish Gas Technology Centre (consulting services and research: biogas)
- Risø National Laboratory (national test center, research: windpower, PV, system analysis)
- Delta (research, certification: windpower)
- Force Technology (consultants: windpower)
- Danish Technological Institute (national test laboratory and research: PV)

Others:
- ENERGI E2 (big production and energy trading company: windpower, biomass)
- Københavns Energi (utility: PV, windpower)
- Københavns Miljø- og Energikontor (NGO consultants, windpower, PV, biogas)
- Copenhagen Municipality
- Danish Wind Industry Association
- Danish Biogas Association

Conclusions:

Denmark has very much experience with windpower, biomass, and biogas for reasons of natural ressources and history. Many installations have been in operation for years on a nearly commercial basis.

GCR is a higly populated region with few undeveloped sites for installations of windpower, biomass, or biogas.

Concerning biomass and biogas, the unused potential (inside the region) of wood, straw, and liquid manure is practically zero. For windpower there is still room for increasing the capacity, especially offshore. The technical conditions are very good (i.e. shallow waters close to Copenhagen and strong electrical networks right at the coast). The obstacles are mainly connected to visual effects of the wind turbines.

Relative to what is installed today the potential for increasing the capacity is much larger for gridconnected photovoltaic systems than for any other technology for generation of electricty from renewable energy sources. There is at present only about 130 installations with a total capacity of about 500 kWp. The number of roofs and facades suitable for PV installations is enormous.

The major barrier is the high investment cost of PV installations. Furthermore there is uncertainty about the net-meetering method, which is allowed to use provisionally until end 2006.

The challenges are many. The overall challenge is to raise know-how about PV at all levels in the society. Most important is it to make the politicians look at the added values and long-term perspectives of PV rather than just looking at the short-term profitability. Architects and consultants should learn about the possibilities and constraints of PV integrated in buildings. Big companies building prestigeous offices should know about building elements with PV as an alternative to traditional exclusive façade elements. And last but not least the public in general need much more information about PV. Once people have learned about PV they usually find the technology very appealing, and many are actually willing to pay quite much money to get their own roof-system. It's like having your own greenhouse – the feeling of being self-supportive is more important than the price.

An important activity of this project will be to coordinate the efforts with initiatives taken by other parties towards enhancing the exploitation of solar energy like the "SolarCity Initiative" of the Copenhagen municipality in order to create as much synergy as possible.

The information activities will include all from telephone advices over written guides to events.