ENERGI STYRELSEN

Report to the European Commission in connection with the implementation of the Cogeneration Directive 2004/8/EC

21 February 2007

The Danish Energy Authority
Ministry of Transport and Energy

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1. Introduction

Under the European Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC (hereinafter: the cogeneration Directive) the Member States must publish the following reports:

1) Under Article 10 (2): A report with the result of the evaluation of progress towards increasing the share of high-efficiency cogeneration as referred to in Article 6 (3). The evaluation must be carried out for the first time no later than 21 February 2007 and thereafter every four years.

   The information required in connection with the duty to report under Article 10 (2) can be found in section *3 Status report for cogeneration in Denmark.*

2) Under Article 10 (1): The results of the analysis and evaluations carried out in accordance with Article 5 (3) (guarantee of origin), Article 6 (1) (potential) and Article 9 (1) and (2) (administrative barriers). This report should have been published on 21 February 2006. However, the report was delayed because the reference values to be used for the calculation of high-efficiency cogeneration were not determined until the decision of the European Commission of 21 December 2006 and were first published in the Official Journal of the European Union of 6 February 2007. The Member States have a duty to put in place a mechanism for issuing guarantees of origin for electricity from high-efficiency cogeneration no later than 6 months after the above reference values were laid down.

   The information required in connection with the duty to report under Article 10 (1) can be found in section *4 Potential for cogeneration*, section *5 Guarantees of origin for high-efficiency cogeneration* and section *6 Administrative procedures*.

Section 2 gives a brief overview of the progress of the implementation of the Cogeneration Directive in Danish legislation.

The section of the report concerning projections and potentials starts with the analytical work in connection with “Energy Strategy 2025”, which contains a comprehensive evaluation of the future supply options up to 2025, including the role of cogeneration and the basis for the government’s energy proposals in January 2007. These evaluations are supplemented by projections of the probable future requirements for district heating and its production. The projections include the effect of the Energy Saving Agreement. In addition, the Danish Energy Authority has had figures prepared in respect of the opportunities for the use of microcogeneration.

2. Status report for the implementation of the Cogeneration Directive in Denmark
Directive 2004/8/EC of the European Parliament and of the Council on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC has been implemented in Danish legislation.

A parallel statement concerning the implementation of the Directive was submitted with the notification of 31 May 2006. It is clear from this notification that the Directive has been implemented in Danish legislation primarily through the Danish Heat Supply Act and Electricity Supply Act. In addition, financial subsidy schemes have been set up by legislation, each of which has been individually notified.

Since that notification in May, a mechanism has been put in place for issuing guarantees of origin for electricity from high-efficiency cogeneration. The Danish Energy Authority issued a notice to this effect on 16 February 2007, to come into force on 1 March 2007.

It has been decided to use Article 12 (3) as a basis for the implementation of the Directive in respect of the financial support schemes. In this connection, the necessary calculations will be made annually to confirm that, on average at the national level, cogeneration that is considered to be eligible for support fulfils the criteria in Annex III, (a) of the Directive.

As stated in Section 1, this present report meets the reporting requirements that are incumbent upon the Member States under Article 10.

3. Status report for cogeneration in Denmark

Cogeneration plays an absolutely crucial role in Danish energy supply, and Denmark is one of the countries with the highest cogeneration cover in the European Union.

District heating, which supplies around 60 per cent of Danish households with energy for heating, constitutes the most important basis for cogeneration, and nowadays the major part of district heating is produced at cogeneration plants together with electricity. In addition, there is a considerable amount of industrial cogeneration.

The widespread cover through cogeneration is the result of a deliberate policy of promoting this form of production, a policy that has laid the foundations for cogeneration to continue to make an important contribution to Danish energy supplies in the future.

In 2005, 63% of thermal electricity production (i.e. total production excluding wind power and water power) was produced together with heat, compared with 55% in the previous year. The rise is due in particular to lower electricity exports in 2005, which led to a reduction in the production of electricity at separate electricity production plants. There has been a general tendency for the proportion to rise. In 1990 the proportion was 37%, whereas in 1980 it was only 18%.[1] Fluctuations in individual years are largely due to differences in the amount of electricity exported, as electricity for export is mainly produced at separate electricity production plants.

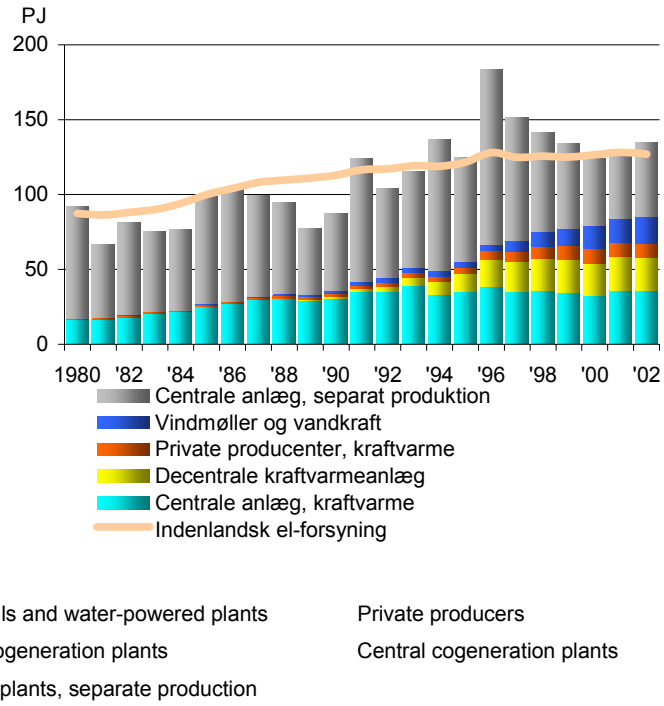


Figure 1. Electricity production classified by method of production

In 2005, Danish electricity production capacity was 13 337 MW. Of this, 3 129 MW came from wind power. Cogeneration is a possibility for most of the remaining capacity. This means that of the 7 993 MW coming from central plants, only 315 MW comes from plants producing only electricity.

[1] Energy statistics 2005, The Danish Energy Authority November 2006

Viewed as a whole, cogeneration plants make up around 9 500 MW_{el}. Central power plant capacity is dominated chiefly by coal-fired plants, whereas natural gas predominates in local plants. All in all, approximately half of cogeneration capacity is coal-fired, whereas natural gas makes up barely one third. Biomass, including biogas, constitutes about 8% of capacity, waste about 4% and oil-fired plants about 6 per cent.

Assessed by technology, steam turbine plants provide the majority of capacity (approximately 70%), followed by combined-cycle plants and engine-driven plants (approximately 13% and. 12% respectively), while gas turbines represent only around 4 per cent of Danish cogeneration capacity.

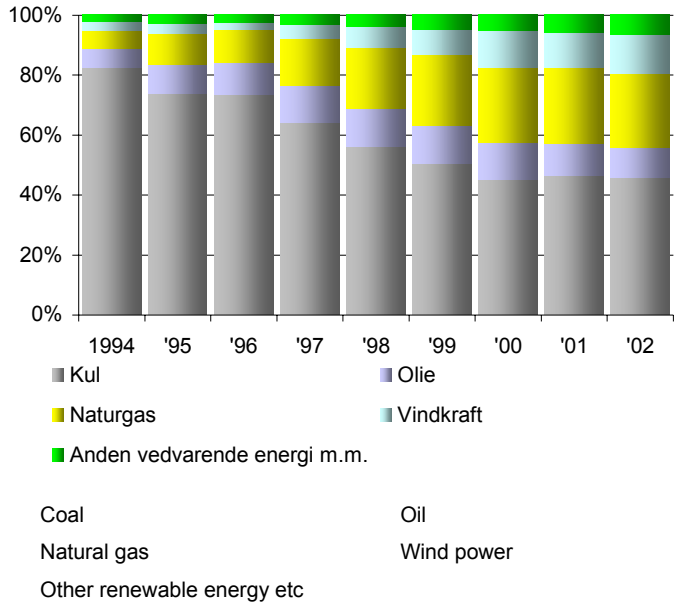
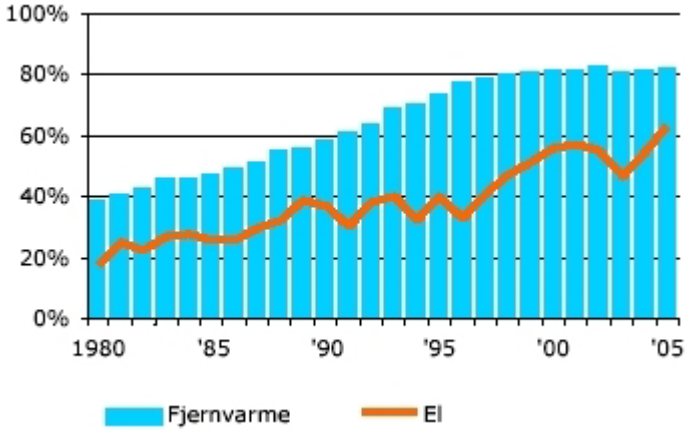


Figure 2. Electricity production classified by fuel

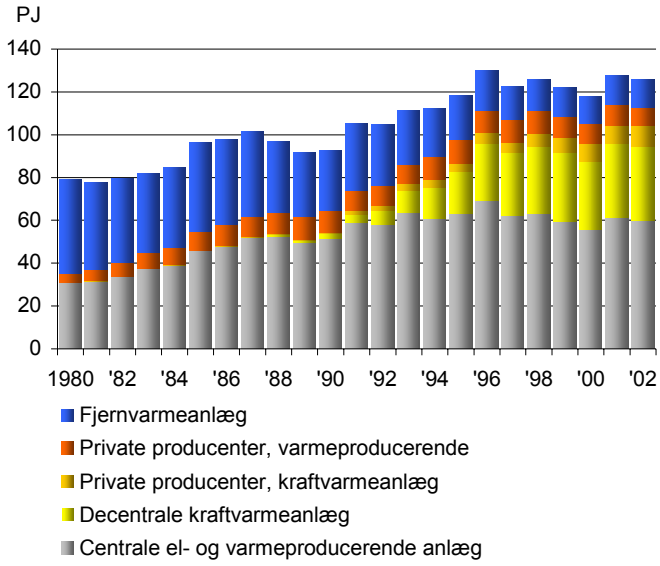
The basis for cogeneration in Denmark is predominantly district heating. In 2005, the final consumption of district heating by end users was 101 PJ. As a result of distribution losses and consumption in production, this required a gross production of 126 PJ. 46 per cent of this was produced at central cogeneration plants, 25 per cent at local cogeneration plants and 12 per cent at private cogeneration plants, while 18 per cent came from plants producing only heat.



District heating Electricity

Figure 3. Cogeneration as a proportion of electricity and district heating production 1980-2005

Viewed as a whole, in 2005, 82% of district heating was produced by cogeneration. In 1990 the proportion was 59% and in 1980, 39%.[2] There will be annual variations resulting from cold or relatively warm winters, just as the amount of precipitation in the Nordic countries affects the price of electricity and consequently the commercial profitability of cogeneration under market conditions.



Private producers, producing heat
Private producers, cogeneration plants
District heating
Local cogeneration plants
Central cogeneration plants

Figure 4. District heating production classified by production plant

[2] Energy statistics 2005, The Danish Energy Authority November 2006

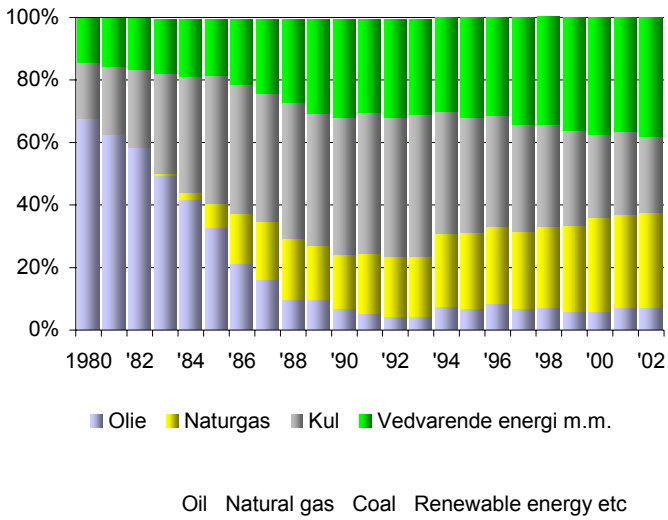


Figure 5. Distribution of fuel consumption for district heating

The use of renewable energy, i.e. primarily biomass including biodegradable waste, constitutes approximately 40% of fuel, thus contributing to the generally high use of renewable energy in Danish energy supply.

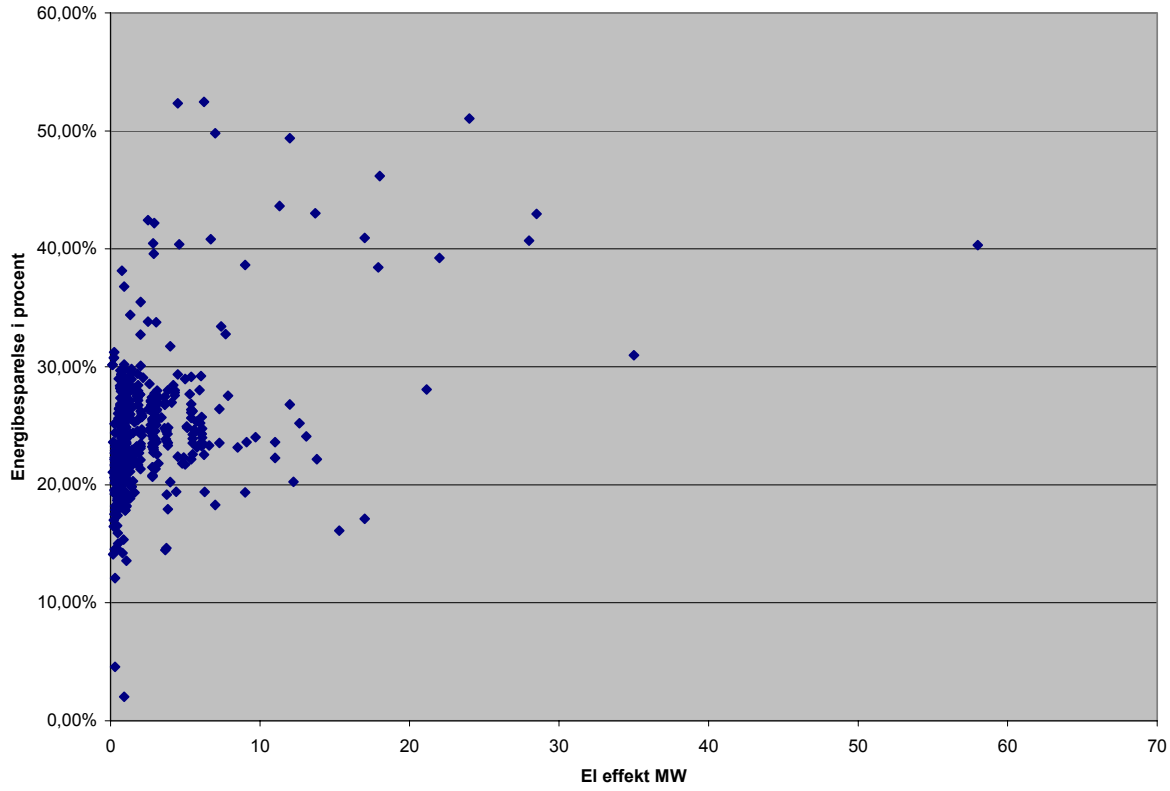
3.1 High-efficiency cogeneration in Denmark

A provisional set of calculations has been produced for cogeneration in Denmark on the basis of the reference values for separate production published by the European Commission on 6 February 2007 and the draft guidelines for these calculations, which have not yet been finally adopted.

The calculations show that Danish cogeneration plants contribute an average primary energy saving of around 25%.

The conclusion to be drawn from the provisional figures is that, all in all, Danish cogeneration plants fully correspond to the definition of high-efficiency cogeneration. The figures also show that, viewed as a whole, the smaller local cogeneration plants using natural gas also contribute to primary energy savings. The highest energy saving percentages are achieved by waste-burning cogeneration plants, which achieve energy savings of around 40%, due to the relatively low reference values for separate production of electricity and heat fuelled by waste.

The initial analyses of cogeneration show wide variations between individual production units. An analysis of individual plants (see figure 6 below) shows the variation in primary energy saving represented as a function of the plants' installed electrical output.



[Vertical axis] Energy saving in percent [Horizontal axis] Electrical output MW

Figure 6. Calculated primary energy saving classified by electrical output of plants.

4. Potentials for cogeneration

Cogeneration is only appropriate insofar as there is an economically justifiable demand for useful heat.

In order to map out the potential for cogeneration, we will first consider the energy requirements that can technically/economically be covered by cogeneration.

Next we will consider the technical and economic possibilities for using these potentials for cogeneration. Electricity production on a given heating basis depends partly on how great a part of the heating basis is covered by cogeneration and partly on the electrical efficiency of the cogeneration units.

The potential for cogeneration in Denmark will in principle be calculated in two separate stages:

A. Calculation of the heating requirements that may form the background for cogeneration
B. Exploitation of the heating basis

The calculation of potential will be divided into

1. District heating
2. Industrial cogeneration
3. Microcogeneration
4. New potential for useful heat

For these segments there will be a description of technologies, including possible fuels and possible ways of improving the efficiency of existing cogeneration plants, and economic evaluations.

Finally the individual segments will be brought together to give an evaluation of total potential.

4.1 District heating

The majority of Danish cogeneration is linked to the supply of district heating.

4.1.a. Demand for district heating

The demand for production of district heating is not expected to rise in the future. This is mainly due to the fact that:

1. The percentage of connection to the existing areas is high (in 2004 the area-weighted connection was 87 per cent)
2. It is expected that fewer new residential areas will be supplied with district heating as a result of falling energy demand in consequence of more stringent building regulations.
3. The energy-saving agreement implies heat savings in the housing stock that is currently supplied with district heating.

Viewed as a whole, this points to a slightly increasing number of customers for district heating with slightly decreasing average consumption.

The official projections for Danish electricity and heat production include projections of the demand for district heating. This will be calculated in two stages:

1. The changes in the distribution of the heating requirement will be assessed using a "bottom-up" model, in which assumptions are made about conversions and new installations.[3]
2. The total energy consumption for heating will be assessed on the basis of assumptions concerning energy prices using a macroeconomic model.[4]

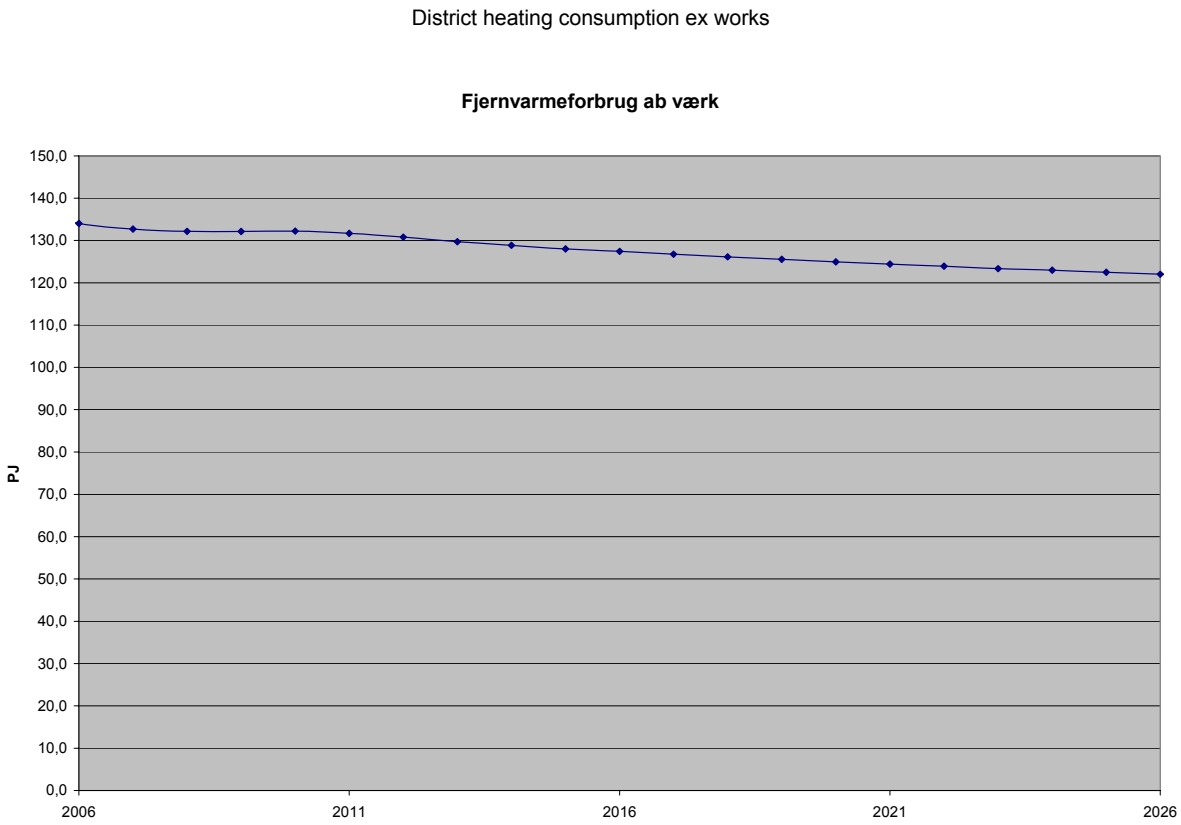


Figure 7. Changes in the demand for district heating ex works.

Consumption will vary as a result of climatic fluctuations. The calculations in the chart are based on a normal year's weather.

4.1.b. District heating production

There are fundamental differences in the production of district heating in central and local cogeneration areas, so it is appropriate to consider the two segments independently.

Central cogeneration plants

[3] "heating model dwelling"

[4] The Emma model

Central cogeneration plants are extraction plants, in which the relation between the production of heat and electricity can be adjusted. The plants can also operate in condensing mode, producing electricity without producing heat at the same time.

These plants use a number of different fuels and are able to switch between them to a certain extent. Coal is the predominant fuel in central plants, but natural gas and biomass are also used. In 2005, central cogeneration plants produced 58 PJ district heat.

Investments in central cogeneration plants are made under commercial conditions. The possibility of selling heat to a district heating network can make a considerable contribution to financial position of the plant. The production of district heat for central areas is already mainly covered by cogeneration, so a new cogeneration plant would not significantly increase the proportion of district heat produced through cogeneration. However, greater electrical efficiency in new plants may increase electricity production in the existing heating base.

Analyses show that in the next few years the price of electricity will not be high enough to allow for investment in new capacity. This is due to the fact that the electricity price is below the long-term marginal costs for a new plant. As older plants are taken out of service, capacity will gradually fall and the price of electricity will rise to a level at which investments may be profitable.

The types of plants to be invested in depend among other things on changes in fuel prices and CO_2 quota prices. In the basic projection, the analyses point to a preponderance of investments in plants burning biomass together with coal. It might be though that higher prices for fossil fuels would increase the proportion of biomass, while lower prices may lead to investments in gas-fired cogeneration plants. Gas technology generally has the highest electrical efficiency.

Local cogeneration plants
Local cogeneration plants only produce electricity in conjunction with heat (back-pressure plants). The majority of these plants use natural gas, while a minority use biomass, including biogas.

The majority of local cogeneration plants receive subsidies for electricity production. In addition the smallest plants are paid according to a special tariff – the three-part tariff. As a consequence of the redirection to cogeneration that has already taken place as described earlier, there is no demand for new cogeneration capacity.

From 1 January 2005, a number of local cogeneration plants (plants with an electricity output of over 10MW) that previously received a fixed price for their electricity production have gone over to payment at market rates. In addition, most plants receive a supplement that is independent of production. This has been done in order to avoid electricity production at times when it is not economically profitable. The consequence will be that a small part of cogeneration production will be replaced by boiler production. Model simulations suggest that the consequence for the amount of total cogeneration will be of minor significance.

From 1 January 2007 the supplement that is not dependent on production will be extended to include all plants with an electricity output of over 5 MW.

As the local plants gradually wear out and need to be renovated or replaced, investments in cogeneration will have to be stopped in favour of purely heat production. It is assumed in the basic projection that cogeneration capacity lost through scrapping will be replaced by new cogeneration capacity. It should be noted that the establishment of new local cogeneration capacity will be dependent on the increase in the price of electricity, fuel prices and technological developments. In the long term, the development of fuel cell technology is judged to be of considerable importance for local cogeneration. An increase in the spread of biomass cogeneration in local areas, either direct or via gasification, could become a live issue if high energy prices are combined with a reduction in plant and operating costs for the relevant technologies. Biogas may also be increasingly important.

Figure 8 Developments in district heat production

Future district heat production
Future production of district heat in Denmark is calculated using the RAMSES model, which suppresses part of the total production of electricity and heat in the Nordic countries. The model is based on normal meteorological years and average downtime (maintenance) for the production units. As weather condition for both wind and precipitation are very important for the actual conditions in the Nordic electricity market (Nordpool), the model calculations will rarely fit the actual historical developments.

With these reservations, it appears that the proportion of Danish district heating produced through cogeneration will remain more or less unchanged for the next decade. The proportion of district heating produced through cogeneration remains constant at around 80 per cent. In absolute terms, a small drop can be seen in the production of heat from cogeneration plants. This can largely be explained by a fall in district heating consumption as a result of energy savings.

4.2 Industrial cogeneration
Industrial cogeneration production means production at a cogeneration plant where the heat is utilised for industrial production processes or for heating commercial premises and supplying them with hot water.

Based on the count of energy producers, it is reckoned that approximately 500 MWe of cogeneration plant was installed in Danish industrial enterprises in 2004. In 2004 these plants produced approximately 1.7 million MWh.

Danish industry is not process-heavy compared with, for example, industry in Norway and Sweden. The potential for industrial cogeneration is therefore of lesser importance in relation to cogeneration for district heating.

In the year 2000, the potential was calculated at 1750 MWe (of which 460MWe was installed). It was also reckoned that only a limited part of the residual potential was economically realisable. At present there are no plans to update the calculation of potential.

It is considered that there is only limited economic potential for further industrial production by cogeneration. However, higher electrical efficiency may result in electricity production increasing in the longer term through the replacement of plant.

In addition, structural changes in the sector in the longer term may lead to developments in Danish industry that will considerably alter the potential for cogeneration.

The projections on which Energy Strategy 2025 is based are calculated on largely unchanged capacity.

4.3 Microcogeneration

According to the cogeneration directive, microcogeneration means plants with an electricity output of under 50 kW. There is a growing market for this type of small plant, which is expected to become more widespread as the technology becomes cheaper and more efficient.

The Danish Energy Authority commissioned an analysis of the potential for microcogeneration. The analysis was carried out by Dansk Gasteknisk Center (DGC). The results show that in 2005 there were only about 45 cogeneration plants under 50 kW in operation. These plants are mainly set up in institutions, and there are very few plants at household level.

DGC analysed the potential for microcogeneration units up to 15 kWe in buildings outside the areas supplied with district heating. Assuming an annual operating time of 4000 hours and a electricity/heat-output proportion of 1:2, they came up with a theoretical potential of 1100 MWe in areas supplied with natural gas (divided between 380,000 units) and a further 1100 MWe in the open country, i.e. where there is no access to either district heating or natural gas (spread over approximately 280,000 units).

The total of 600 000 houses will typically require plants with an electricity output of about 1.5 kW. Units of around this size are now on the market in commercial versions based on traditional engine technology and Stirling Engine technology.

The biggest barrier to the spread is financial, as both purchase and running costs make it unattractive to householders to acquire this type of plant. Also, at the present time, there is no economic advantage in these plants.

In the long term, fuel cell technology is likely to become interesting, not least in consequence of higher electricity production from the same amount of heat production and better ways of modulating operation between full load and low load, without affecting the electrical efficiency.

In addition to the aforementioned potential for small houses, it will be possible for microcogeneration (less than 50 kW) and minicogeneration (over 50 kW and under 1 MW) to enter the supply system in various ways, including as local peak and reserve capacity for district heating systems.

4.4 New potentials

In addition to microcogeneration, other new possibilities for increasing exploitation of useful heat may appear. A number of countries have focussed greater attention on the demand for cooling in buildings etc. In the Danish climate the demand for cooling occurs primarily as a result of the increased use of large glass façades in buildings, in combination with stricter insulation requirements (intended to reduce the demand for heating).

The demand for cooling can technically be satisfied by usable heat, for example by applying the principles of absorption cooling. These technologies are often described under a single name as “district cooling”.

The potential for district cooling in Denmark, (an economically-based demand for cooling), has not been fully mapped out, but work has started with the aim of examining the economics of the existing technologies, the potential for district cooling and the legal barriers.

4.5 Overview of potential

The table below gives a comprehensive overview of Danish cogeneration potentials. The installed output (2005) is calculated. Then the theoretical potential is calculated defined as the electrical capacity corresponding to a substantiated demand for useful heat. The economic potential is defined as the theoretical potential minus that part of the theoretical potential that is judged to be linked to disproportionately high costs.

Cogeneration segment	Installed output [MWe]	Theoretical potential [MWe]	Economic potential [MWe]	Comments
Central district heating	Ca. 7600	Ca. 7600	Ca. 7000	The potential is dependent on the operating time and the electrical efficiency of the plants. From the economic point of view, there is currently over-capacity in electricity production in the Nordic countries. This may indicate that capacity should be reduced over time, whereas operating time should be increased.
Local district	Ca. 1600	Ca. 2400	Max. 2400	In 2004 local cogeneration

heating			(dependent on changes to energy prices, technology etc.)	was produced in the proportion of 1½ units of heat per unit of electricity. In the long term it will be technically possible to improve the electrical efficiency to alter the ratio to approx. 1:1.
Industrial cogeneration	480	1750	<600	Structural changes in the sector may alter the picture in the longer term.
Microcogeneration	~ 0	2200	<100	Technological development may increase the economic potential in the long term as well as the theoretical potential (increased electrical efficiency)
District cooling	~ 0	?	?	Analytical work in progress. With regard to efficiency, there will ideally be a complete merging with cogeneration units producing district heating, so that only the exploitation of capacity is improved.

At present it is judged that Danish potential for installing cogeneration output is largely being exploited. However, new technologies and a change to the rest of the energy system may alter the picture in respect of both theoretical and economic potential.

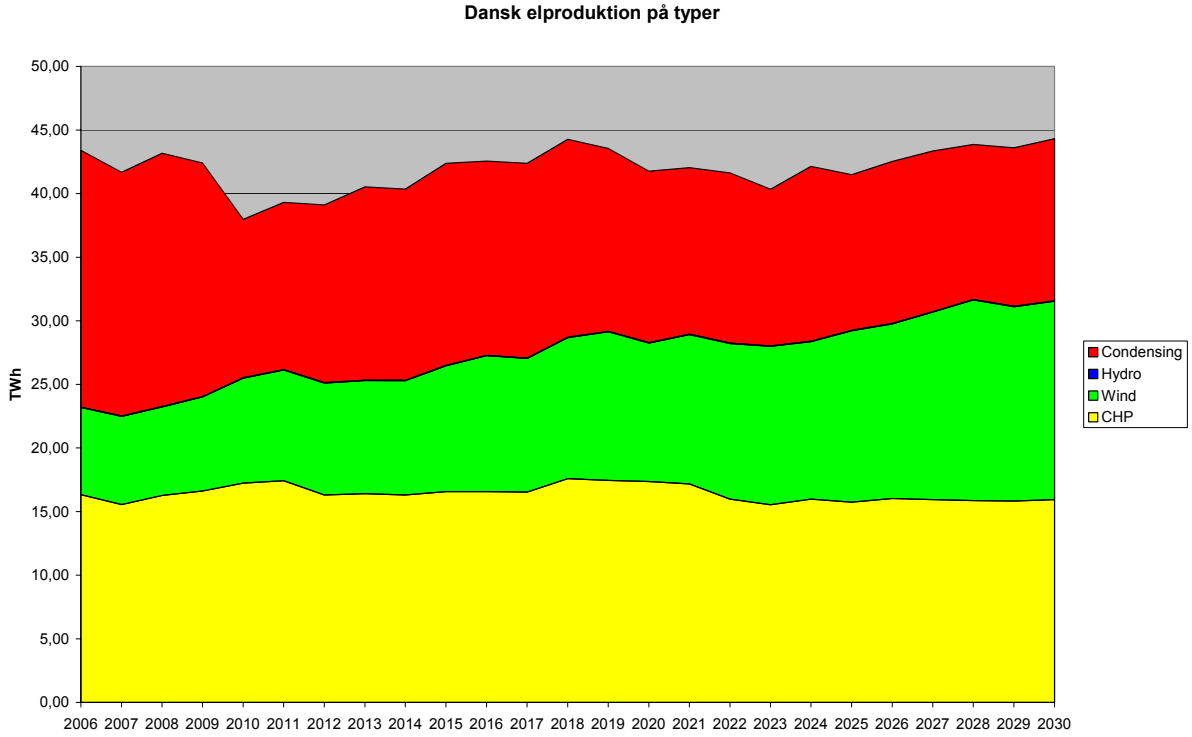
4.6 Projection of Danish cogeneration production

Production of heat and electricity from cogeneration that goes into the Nordic electricity grid is modelled in RAMSES. This provides an estimate of future cogeneration.

The results from the model cannot be directly compared with the historical data, partly because the model is always calculated using normal meteorological years and average downtimes for the production units.

With these reservations, cogeneration is considered to be fairly constant, both in nominal terms and as part of total Danish electricity production, see figure 9.

Possible contributions from microcogeneration and district cooling are not included in the basic projection.



[Heading] Danish Electricity Production by Type

Figure 9 Developments in electricity production

5. Establishing a system for guarantees of origin for electricity from high-efficiency cogeneration

Under the Cogeneration Directive, Member States must, no later than six months after adopting the harmonised efficiency reference values for separate production of electricity and heat, ensure that guarantees of origin can be issued for electricity from high-efficiency cogeneration.

In this connection, on 16 February 2007 the Danish Energy Authority issued an executive order concerning guarantees of origin for electricity from high-efficiency cogeneration. The executive order came into force on 1 March 2007.

This executive order determines the issuing of guarantees of origin. It is apparent that the enterprise responsible for the system, i.e. Energinet.dk will issue the guarantees, at the request of the electricity producer.

The implementation of the scheme in Danish legislation applies the provisions in Article 12 (3) of the Directive. It is apparent from the Directive that, until the end of 2010, a guarantee of origin may be issued without a specific calculation of the primary energy saving for current electricity production, provided that it can be proved that, at national level, cogeneration production is generated with an average saving of primary energy of at least a 10%. In these cases, the electricity producer may choose to have a primary energy saving of 10% shown on the guarantee of origin. If the electricity producer wishes to have a specific calculation carried out, the enterprise responsible for the system will carry out this calculation.

It is apparent from Article 5 (3) of the Cogeneration Directive that in the present report the Member States must outline the measures taken to ensure the reliability of the guarantee system.

In this connection it can be explained that, under the executive order, it is the responsibility of the enterprise responsible for the system to record the guarantees of origin that have been issued. In addition, the responsible enterprise must draw up a quality control system in accordance with the provisions applying to control and supervision with payments to certain electricity producers and electricity production plants etc.[5]

It is also apparent from the executive order that a producer of electricity who requests or has received a guarantee of origin, must after making the request provide the responsible enterprise with all the information that this enterprise considers necessary for the guarantee of origin. In this connection, the electricity producer must solemnly declare that the necessary information that the responsible enterprise will be using for issuing the guarantee is correct.

The responsible enterprise must lay down guidelines for the electricity producer's application for the issuing of a guarantee of origin and documentation stating that the conditions for this have been fulfilled. The responsible enterprise will submit these guidelines to the Danish Energy Authority for approval.

[5] Executive order no. 1521 of 23 December 2004 on control and supervision with payments of price supplements and other payments to electricity production plants etc.

6. Administrative arrangements

6.1 Overall regulation

The cogeneration plants are regulated by both the Electricity Supply Act and the Heating Supply Act according to the following classification:

- Cogeneration plants with an electrical capacity of over 25 MW (central cogeneration plants and large local cogeneration plants) need only be approved under the electricity supply act, whereas the district heating transmission pipes from these plants must be approved under the heating supply act.

– By contrast, small local cogeneration plants (under 25 MW) are regulated by the heating supply act.

The provisions on cogeneration plants in the two acts have different aims:

Under the electricity supply act, electricity production from plants with a capacity of over 25 MW require a licence, and permission is also required for establishing a cogeneration plant or carrying out major alterations.

The licence is a general permission for an electricity producer to produce electricity from plants with an output of over 25 MW. A number of conditions may be laid down in the licence, for example on the duty for cogeneration plants to supply district heating or security for the dismantling of plants. Licences are granted for a minimum of 20 years. There are currently 12 valid licences in Denmark.

Permission is granted for individual cogeneration plants. It is granted by the Danish Energy Authority and is conditional on the plant fulfilling conditions on such things as maximum CO2 emissions. The conditions are general and laid down in executive order no. 493 of 12 June 2003 on conditions and procedures for granting permission for the establishment of new electricity production plants and major alterations to existing plants.

The heating supply act[6] applies to collective heating supply plants, including district heating and cogeneration plants with an output of up to 25 MW.

When a district heating plant or network is to be established or undergo major alteration, e.g. in the case of a change of fuel or expansion of production capacity, a project proposal must be drawn up. The project proposal must be drawn up in accordance with the provisions of executive order no. 1295 of 13 December 2005 on the approval of projects for collective heating supply plants.

The project proposal must include calculations of the economic factors affecting society, consumers and companies, the environment and energy. Guidelines on the requirement for socio-economic calculations and fuel price requirements for socio-economic calculations are distributed for use when drawing up the project proposal. The local authority must approve the socio-economically best alternative.

[6] Executive order of the heating supply act no. 347 of 17 May 2005

6.2 Promotion of cogeneration

As can be seen from the status report on cogeneration in section 2, there has been a vigorous expansion of cogeneration in Denmark since 1990. In the objectives section of the heating supply act, it states that cogeneration shall be promoted as far as possible and the legislation has thus paved the way for the expansion described. From this point of view there are therefore no barriers to the expansion of cogeneration in the overall regulations; on the contrary, it has been a matter of a policy for actively promoting cogeneration.

The expansion of cogeneration has been supported by financial subsidy schemes. Financial support was necessary in order to make it possible to defray the necessary investment costs without unreasonable increases in consumer costs for district heating.

Financial subsidies are paid for the production of electricity by particular types of technology. They are given in the form of a price supplement under the electricity supply act, which electricity consumers pay to the producers over and above the market price, and of a state grant to the producers.

a) Special price supplements are paid for environmentally friendly electricity production, which includes electricity production based on wind, biofuels, biogas, waste and on natural gas in local cogeneration. Price supplements for electricity from cogeneration are usually regulated in relation to the market price, so that the sum of the market price and the price supplements ensures the producer a fixed payment.

b) State grants are paid for electricity produced at local cogeneration plants of 25 MW capacity or less, industrial cogeneration plants and waste-based cogeneration plants.

Grants for electricity production are only paid insofar as production takes place as an element of the total efficient use of energy, including the utilisation of the entire heat production. The grant is only paid for that part of the electricity production on which tax is paid under the law on the taxation of electricity.

A bill to amend the law on grants for electricity production was put before the Danish parliament on 1 February 2007. The bill creates the powers to implement the provisions of the Cogeneration Directive after the end of 2010, after which Article 12 (3) of the Directive cannot be applied.

The Commission has been kept continuously informed of individual subsidy schemes. Please refer to these notifications for more detailed explanations of the subsidy schemes.

6.3 Administrative barriers

It is generally considered that there are no major administrative barriers to the establishment and operation of cogeneration plants. The basis for this assessment is that, as described earlier, a determined effort has been made to switch to cogeneration production.

In 2004, the way the authorities deal with the actual project proposals under the heating supply act was simplified, so that the project proposals now only have to be approved by the district authorities.

With regard to the connecting of cogeneration plants to the electricity grid and the conditions for this, rules have been laid down[7], which mean that grid enterprises, transmission enterprises and the enterprise responsible for the system must set up a programme for internal monitoring with the aim of preventing discrimination towards the users of the grid. Moreover, these companies must publish an annual report with a description of the programme. The Danish Energy Regulatory Authority will check that the internal monitoring programme is in accordance with the legislation. Through this programme initiatives have been implemented to ensure that cogeneration producers receive fair treatment in respect of their connection to the electricity grid.

The current subsidy schemes for the existing plants are considered to offer sufficient security for continued cogeneration production. However, the current subsidy schemes do not provide the same level of support to new plants as to existing plants. Completely new cogeneration plants will mainly be established purely on market conditions. It is therefore considered to be realistic to expect a very limited amount of new cogeneration capacity, unless it is a question of plants with a very long operating period.

In the specific case of microcogeneration, numbers are currently very limited, and no subsidies are given for setting up such plants. In respect of barriers to the expansion of microcogeneration, changes have been made to the payment of taxes and PSO, making it more attractive to establish microcogeneration. However, there is still criticism of parts of the code of practice and the conditions for connection applying to small plants that only produce electricity for their own use. As it becomes more economically attractive to society and to companies to set up microcogeneration, there will be a need to ensure that these plants have reasonable conditions.

[7] Executive order no. 635 of 27 June 2005 on the programme for internal monitoring of grid enterprises, transmission enterprises and the enterprise responsible for the system under the electricity supply act.

7. Future investment in cogeneration

On 19 January 2007, the Danish government presented its long-term energy policy: *A Visionary Danish Energy Policy*. The proposal describes the targets for the government's energy policy up to 2025 and the initiatives to be implemented in order to achieve these targets. The proposal is a follow-up to Energy Strategy 2025 dating from June 2005.

The proposal sets targets for:

- The reduction in the use of fossil fuels
- The proportion of renewable energy
- The annual investment in energy-saving
- Increased investment in research, development and the demonstration of new energy technologies
- The use of biofuels for transport

These targets are to be seen as the first step towards the government's long-term vision of making Denmark completely independent of fossil fuels such as coal, oil and natural gas. With a view to meeting the targets, the proposal sets the scene for the implementation of a large number of initiatives. An overview of all the proposed initiatives can be found in the annex to the proposal.

The targets and initiatives in *A Visionary Danish Energy Policy* were determined on the basis of the energy-specific analyses carried out in connection with *Energy Strategy 2025*. In the meantime, the long-term energy projection has been updated, to take account of such things as the most recent oil price requirements from The International Energy Agency (IEA). In addition the socio-economic cost of the investment in promoting renewable energy and energy savings have been calculated.

The government proposal is currently the subject of negotiation between the partners in the coalition. The subsequent finalisation of the proposal may be significant for the future development of cogeneration in Denmark.

The energy strategy emphasises the fact that in the future there will continue to be a desire for a high proportion of district heating in the Danish energy supply in order to maintain the valuable flexibility and efficiency it represents. It is therefore expected that in future the necessary heat basis for extensive cogeneration production will continue to exist.

With regard to the aspect of security of supply, the government considers it important that the electricity market should function efficiently and that the general conditions for electricity production should stimulate cost-effective electricity production. The reference to cost-effectiveness also means that it should be possible for the production of electricity to react to market signals, in order to avoid expensive electricity production at times of low market prices.
From the point of view of security of supply, it is a distinct advantage that the Danish electricity system is characterised by a high degree of decentralisation, offering a high degree of flexibility. Local cogeneration plants make an important contribution to local electricity production.

With regard to meeting the climate targets, particularly the reduction of CO_2 emissions from the energy sector, electricity and district heat production play a crucial role. The implementation of the EU CO_2 quota system has meant that an important instrument has been applied. It has created an incentive for promoting the most efficient technologies, including cogeneration. The quota system offers direct financial incentives to those energy producers that make the most efficient use of fossil fuels and makes it more attractive to switch to a CO_2 neutral fuel.

From the point of view of growth and industrial development, there are two aspects for the energy sector. Firstly it is necessary to establish a market that operates efficiently, with a good security of supply and low prices, and secondly there should be an expansion of Denmark's positions of strength in the development and production of efficient energy technology.

The conscious effort to expand cogeneration has contributed to increased security of supply through decentralisation and flexibility in the use of fuels. Danish cogeneration plants are generally very efficient, thus contributing to major energy savings. Technologically speaking, Danish cogeneration production represents a wide spectrum of different solutions, which have been important for the development of new technologies. Important technological developments have been initiated, not least in connection with the use of biomass for cogeneration production. Further development of this technology may pave the way for biomass to replace natural gas to an increasing extent in local cogeneration.

Based on the Energy Strategy, the main reason for development in the field of cogeneration is that, with the redirection of financial support to local cogeneration and the other adjustments to market conditions, the necessary initiatives have been implemented for ensuring that the existing cogeneration production capacity can operate in a liberalised electricity market.

Around 80% of district heating (2004) is already produced through cogeneration and the remainder is produced either in biomass-fired district heating plants or at peak and reserve load plants for cogeneration plants.

A switch from biomass district heating to biomass cogeneration is technologically possible, but is not socio-economically sensible until the investments in the new plants can be reduced or if there is a considerably higher price level for electricity.

Modernisation of the existing cogeneration plants in order to achieve greater efficiency and electrical efficiency will come about as the plants become run down or as a consequence of stricter environmental requirements. It is not considered to be socio-economically sensible, to carry out a forced replacement of plants that are operating well. In the case of local expansion of district heating supply, the heating supply act specifies that a cogeneration solution is to be presented. In connection with this, an analysis of the general conditions for cogeneration production of district heating is to be carried out.

With regard to the potential for microcogeneration, a significant technical potential of 2200 Mwe has been calculated. The economic assessment of microcogeneration shows that it is not attractive in the short term either socio-economically or for property owners. A collaboration has been set up with the industry with a view to continuous monitoring of both economic and technological developments. It is also crucial that the establishment of microcogeneration plants makes a positive contribution considered in relation to the entire energy system. With regard to technological development, there are particular expectations in connection with fuel-

cell technology, because it has good prospects for achieving greater electrical efficiency than the current engine-based solutions.