

1. Danish Energy Policy

Danish energy policy is in a constant process of change. The Government's Energy Action Plan of 1996, Energi 21, is the fourth in a series of plans that all have or have had as their aim to optimise the Danish energy sector to the present national and international conditions in the field of energy.

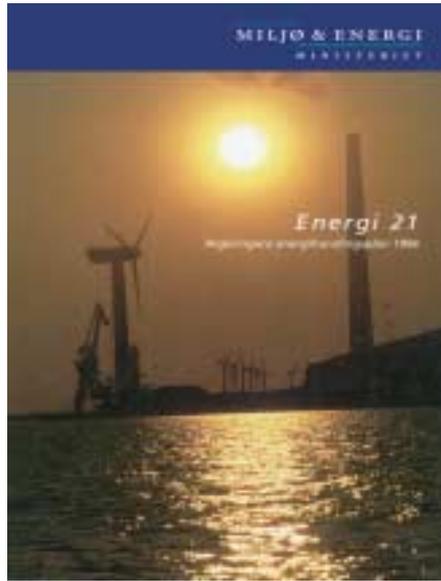
The Four Energy Plans

The aim of the first energy plan, Danish Energy Policy 1976 (Dansk Energipolitik 1976), was to safeguard Denmark against supply crises like the energy crisis in 1973/74.

The second energy plan, Energy Plan 81 (Energiplan 81), gave added weight to socio-economic and environmental considerations, thus continuing the efforts of reducing the dependence on the import of fuels.

The third energy plan in the series is the action plan Energy 2000 (Energi 2000) /ref. 1/ of 1990. This plan is an ambitious attempt to increase the use of environmentally desirable fuels. At the same time, the aim of a sustainable development of the energy sector is introduced. In Energy 2000, the environmentally desirable fuels are defined as natural gas, solar energy, wind, and biomass (straw, wood, liquid manure, and household waste). The use of biomass is based on the facts that it is CO₂ neutral, that it saves foreign currency, that it creates Danish jobs, that it utilises waste products from agriculture, forestry, households, trade and industry. The ambitious aim of Energy 2000 is that Denmark compared to the year 1988 shall achieve the following aims by the end of 2005:

- Reduce the energy consumption by 15%.
- Increase the consumption of natural gas by 170%.
- Increase the consumption of renewable energy by 100%.
- Reduce the consumption of coal by 45%.
- Reduce the consumption of oil by 40%.
- Reduce the CO₂ emission by at least 20%.
- Reduce the SO₂ emission by 60%.
- Reduce the NO_x emission by 50%.



Energy 21 (Energi 21) shall contribute to a sustainable development of the Danish society. The energy sector shall continue to be a financially, vigorously, and technologically efficient sector that forms part of a dynamic development of society.

The aims are achieved by means of a wide range of activities: Energy savings, tax on CO₂ emission, conversion to the use of environmentally desirable fuels by means of CHP generation, subsidised construction and operation of district heating systems, subsidised establishing of biofuel boilers in rural districts etc.

The fourth and last energy plan is Energy 21 (Energi 21) /ref. 2/ that was introduced in 1996. The intention of this plan is that the administration of our resources shall have a central role. Our consumption of depletable, fossil energy sources, and emissions resulting from the consumption and energy production shall be further reduced. A significant aspect of Energy 21 is thus that the existing aim of Energy 2000, i.e., that Denmark should reduce its CO₂ emission by 20% in 2005 compared to the 1988 level, is supplemented with a long-term aim. The CO₂ emission should be halved in 2030 compared to 1998. In addition, international climate change negotiators will advocate that the industrialised countries by 2030 halve their emissions of CO₂ compared to the 1990 level. At the UN Climate Change Conference in Kyoto in 1997, the EU reduction was

fixed at 8% in 2012 compared to the 1990 level.

Denmark's CO₂ aim shall be achieved by both improving the energy intensity by 50% up to the year 2030 and by renewable energy contributing by 35% of the gross energy consumption in 2030.

Energy 21 assumes that renewable energy covers 12-14% of the country's total energy consumption in 2005. By far the most significant renewable energy source is and will continue to be biomass. Biomass contributed with 61 PJ in 1996, which should increase to 85 PJ in 2005 and 145 PJ in 2030. The increase up to 2005 will primarily be achieved by the centralised power plants' increased use of straw and wood chips (see the section on the Biomass Agreement). An increased use of biomass and landfill gas also contributes to achieving the aim of 85 PJ. In connection with Energy 21, the Danish island Samsø has been declared a renewable energy island, and the island shall thus function as display window for Danish renewable energy technology.

Thus the initiatives in the field of biomass are directed at the following partial aims of Energy 21:

- Increased use of straw and wood chips at centralised power plants.
- Increased CHP generation based on straw, wood chips, biogas, and landfill gas.
- Conversion to the greatest possible extent of block heating units above 250 kW in rural districts from fossil fuels to biofuels.
- Permission to establish biofuel systems and biogas production from collective systems, industrial systems, and landfill sites etc. in areas previously reserved for natural gas.

Figure 2 shows the distribution of the individual renewable energy sources.

EU Influence

EU Commission Renewable Energy White Paper 1997/ref. 3/ fixes an increase in the EU use of renewable energy from 6% to 12% up to the year 2010. It is estimated that the biomass sector will be the fastest growing sector

in the field of renewable energy technologies. The use of agricultural land is closely connected with the EU agricultural policy. The most recent EU draft proposal for future agricultural policies suggests that the legal obligation to fallow land shall be abolished, and that there shall be one rate for subsidies no matter the choice of crop. This will affect the farmers' managements also with regard to growing energy crops on land, voluntarily left fallow. Energy 21 mentions explicitly that the aim of 45 PJ energy crops in 2030 can be achieved by other biomass use subject to EU modifying its agricultural policy and subsidy schemes so as to encourage this.

The Heat Supply Act

For the purpose of implementing the activities suggested in Energy 2000 /ref. 1/, the Heat Supply Act June 3, 1990 was passed by the Danish parliament "Folketinget". This Act gave the Minister of Energy wide powers to control the choice of fuel in block heating units, district heating plants, and decentralised CHP plants. This was accomplished by the so-called "Letters of Specific and General Preconditions" /ref. 5/ that are circulated to municipalities and owners of plants in three staggered phases. The "Letters of Specific and General Preconditions" describe in details the conversion to environmentally desirable fuels to selected municipalities and owners of plants. In addition, "Letters of General Preconditions" that describe the prospects of voluntary conversion from coal and oil to more environmentally desirable fuels are circulated to all Danish municipalities.

The conversion was immediately implemented. Phase 1 took place from 1990-1994 and included the conversion of a number of coal and natural gas-fired district heating plants that should be converted to natural gas-fired, decentralised CHP. Phase 2 took place from 1994-1996 and included the remaining coal and natural gas-fired district heating plants that are converted to natural gas-fired, decentralised CHP. In addition, small district heating plants outside the large district heating systems should be converted to biofuels. Phase 3 began in 1996 and is not finished yet. The aim was that small, gas-fired district heating plants should be converted to natural

gas-fired CHP plants and the remaining district heating plants to biofuels. See also the section on the Biomass Agreement on the adjustment of the progress of the phase.

The CO₂ Acts

The Heat Supply Act was followed by three new acts offering the prospective of subsidising the process of conversion to environmentally more desirable fuels. The purpose was that the Minister of Energy could then counteract consumers being charged higher heating prices as a result of the conversion.

The three acts are Acts Nos. 2, 3, and 4, 1992 and the titles are:

- "State-Subsidised Promotion of Decentralised Combined Heat and Power and Utilisation of Biomass Fuels Act". Under this act, it is possible to receive subsidies of up to 50% of the construction costs. In practice, subsidies have been in the range of 20-30% of the construction costs.
- "State-Subsidised Electrical Power Generation Act". A subsidy of DKK 0.10 /kWh is granted for electrical power generation based on natural gas, and a subsidy of DKK 0.17/kWh for electrical power generation based on straw and wood chips. On January 1, 1997, an executive order was put into force requiring e.g. a biomass plant overall efficiency of 80% in order for the plant to receive the max. subsidy. In addition, the CO₂ tax of DKK 0.10/kWh is refunded in the case of renewable energy. Thus private producers of renew-

able energy receive a total subsidy of DKK 0.27/kWh.

- "State-Subsidised Completion of District Heating Nets". Under this act, up to 50% of the construction costs could be subsidised. The scheme expired at the end of 1997.

The present subsidies of DKK 0.10/kWh and DKK 0.17/kWh respectively in connection with the electrical power reform will be financed via the consumption price in a transitional period. In the future, the electrical power generation subsidies and the DKK 0.10/kWh from the CO₂ tax will be replaced by "green" renewable certificates with the minimum price being DKK 0.10/kWh. The organisation and function of the "green" market will be clarified during 1999.

Development of Renewable Energy Scheme

A 3-year bioenergy development programme for 1995-97 (BUP-95) /ref. 6/ has had the aim to encourage the technological development in the field of biomass-based systems. The programme recommends the following activities:

- The development of CHP technologies based on straw and wood chips as fuels. The technologies are steam, gasification, and the Stirling engine.
- District heating systems should focus on fuel flexibility and an environmentally desirable handling of fuels.
- Environmentally desirable and user-friendly boiler systems should be developed for private dwellings.

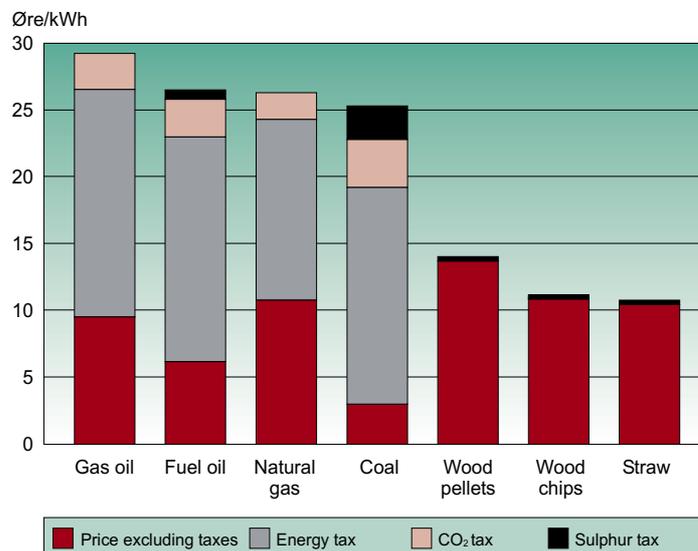


Figure 1: Fuel prices at the beginning of 1999 for district heating purposes including taxes but excluding VAT /ref. 4/.

- Energy crops should be investigated with a view to the growing, handling, and use of them.

The Danish Energy Agency's scheme, the "Development Scheme for Renewable Energy", subsidises projects for the promotion of biomass in the energy supply and uses e.g. the Bioenergy Development Programme (BUP)-95 as the basis of their decisions when considering applications for subsidies.

The Plant Pool

The Government subsidises the promotion of decentralised CHP generation and the utilisation of biofuels. The scheme includes subsidies for the conversion of district heating plants to CHP plants based on biofuels and for the promotion of an increased use of biofuels in areas without collective heating supply. Under this scheme, subsidies amounting to DKK 25 million can be granted per year.

The Biomass Agreement

In order to ensure the achievement of the aims of Energy 2000, the Government, the Conservative Party, the Liberal Party, and the Socialist People's Party entered into an agreement on June 14, 1993, on an increased use of biomass in the energy supply with a special view to use at centralised power plants. The main points of the agreement are as follows:

- A gradual increase in the use of biomass at power plants shall take place so that the consumption by the year 2000 amounts to 1.2 million tonnes of straw and 0.2 million tonnes of wood chips per year equal to 19.5 PJ.
- Eleven towns in natural gas districts that have not converted to natural gas-fired CHP generation within Phase 1 or Phase 2 may choose between biofuels and natural gas as fuels. It is possible to wait until 2000 in order to e.g. await the development and commercialisation of technologies in the field of biomass.
- Phase 2 towns outside natural gas areas can postpone the conversion until

PJ/per annum

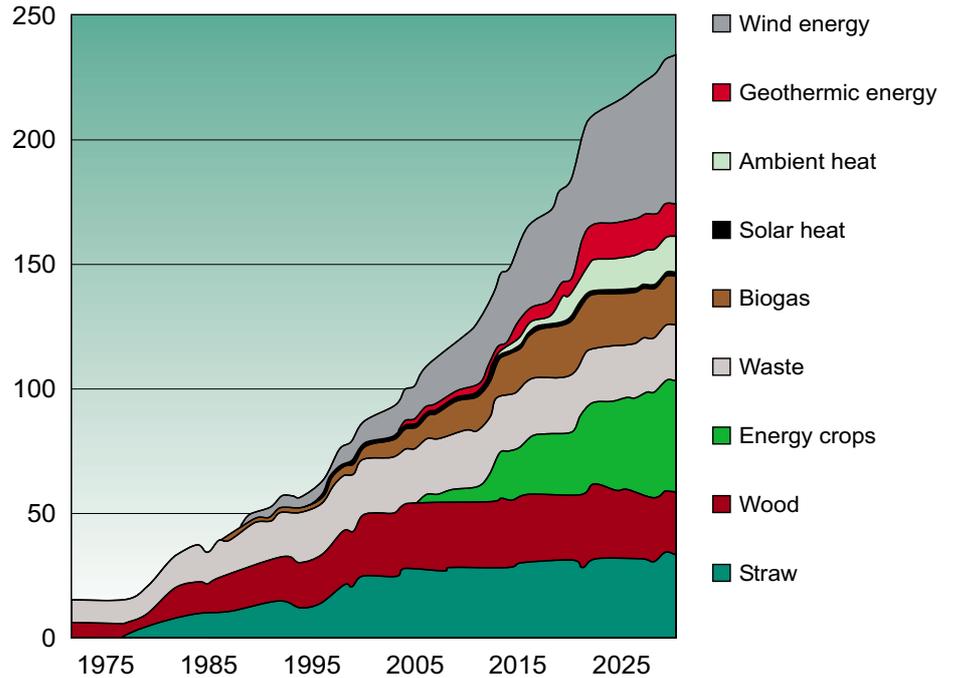


Figure 2: Energy 21 (Energi 21) proposal for the use of renewable energy sources up to the year 2030 /ref. 2/.

- 1998 if they choose biomass-based CHP.
- Six towns in Phase 3 may postpone the conversion to biomass-based CHP until 2000.
- Approx. 60 small towns in Phase 3 should be converted to biomass-based district heating by the end of 1998.

The agreement has resulted in Sønderjyllands Højspændingsværk (electricity utility) having constructed a biomass-based power plant in Aabenraa with a consumption of 120,000 tonnes of straw and 30,000 tonnes of wood chips per year. Sjællandske Kraftværker (electricity utility group) has constructed a straw and wood chip-fired CHP plant in Masnedø with an annual consumption of 40,000 tonnes of straw and 5-10,000 tonnes of wood chips, and is presently also constructing plants in Maribo-Sakskøbing and in Avedøre near Copenhagen.

On July 1, 1997 the political parties to the Biomass Agreement drafted a supplementary agreement with the intention of improving the prospects of integrating biomass in the energy supply. In principle, the supplementary agreement means that:

- The centralised power plants are allowed a freer hand when choosing among straw, wood chips, and willow chips, since the consumption should include 1.0 million tonnes of straw and 0.2 million tonnes of wood chips but with the remaining part being optional, but so as to make out a total of 19.5 PJ.
- Biomass-based CHP generation will be permitted in natural gas areas.
- The municipalities shall give priority to CHP generation based on biogas, landfill gas, and other gasified biomass.
- Seven towns in Phase 3 may continue the present district heating supply until a conversion to biomass-based CHP generation is technically and financially appropriate.

Political Harmony

It is characteristic that since the middle of the 1980s, changing governments, parliamentary majorities, and ministers of energy have persisted in the importance of an active energy policy thereby adding weight to the resource-based and environmentally responsible policy. Denmark has a leading position in several fields of renewable energy, and Energy 21 will maintain this leading position.