

Danish Experience in Local Energy Planning

Henrik Lund, Aalborg University, Denmark

Per Alex Sørensen, PlanEnergi, Denmark

Abstract

Local energy planning has played an important role in the implementation of Danish energy policies. Aims of reducing oil dependency and pollution has been achieved by means such as energy conservation, decentralised combined heat power production (CHP) and utilisation of local renewable energy sources. The technological change has been characterised by a change from undifferentiated solutions implemented by few stakeholders into differentiated solutions implemented by many stakeholders.

As a result Denmark has been able to stabilise the primary energy supply during a period of 30 years. Moreover, the innovative development has led to a major Danish export of green energy technologies. During the last decade the export has increased from 4 to 30 billion DDK per year. This is the result of conducting many years of national energy planning, in which local energy planning involving the participation of the public and local authorities has played an important role.

After summarising the results of 30 years of Danish Energy Planning, this paper describes the influence from public participation and local energy planning. Public participation has influenced the formulation of national energy objectives since the early 70ies. And local energy planning has been important in the implementation of technological change. Examples of local energy planning from Ærø and Samsø islands are included.

The results of Danish Energy Planning

During a period of 30 years Denmark has been able to stabilise the primary energy supply. Thus today the energy consumption is the same as in 1972 when the first oil crisis started. (See diagram 1). The diagram also illustrates how a situation of completely oil dependency in 1972 has been changed into a differentiated fuel supply including a high per cent of natural gas and renewable energy sources.

This has been achieved in a period of normal economic growth. Consequently Denmark has been able to disconnect growth in wealth and energy demand. (See diagram 2).

In the same period Denmark has started to exploit domestic oil and gas resources, and replaced oil by coal, natural gas and renewable energy. Thus today Denmark is self-supplied with oil and gas. Renewable energy sources constitute more than 10 per cent of the primary energy supply, and wind power produce more than 15 per cent of the electricity demand.

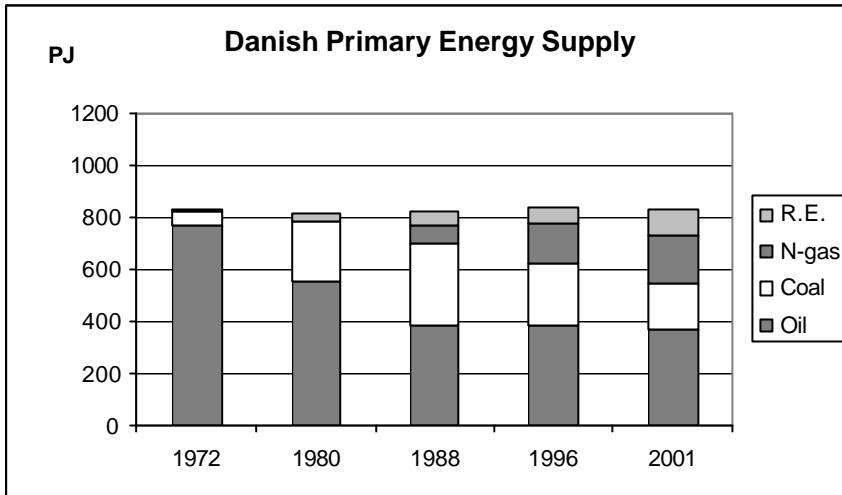


Diagram 1: Denmark has able to stabilise the primary energy supply.

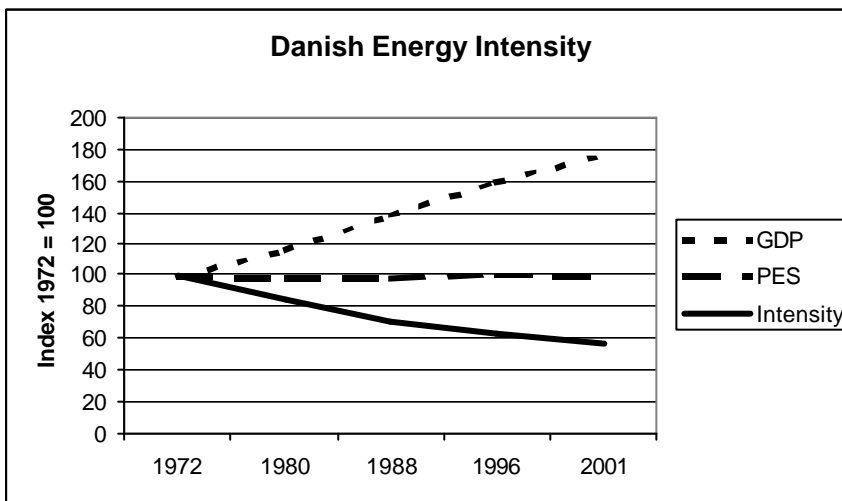


Diagram 2: Economic growth and stabilisation of primary energy supply has lead to a more energy efficient production in Denmark.

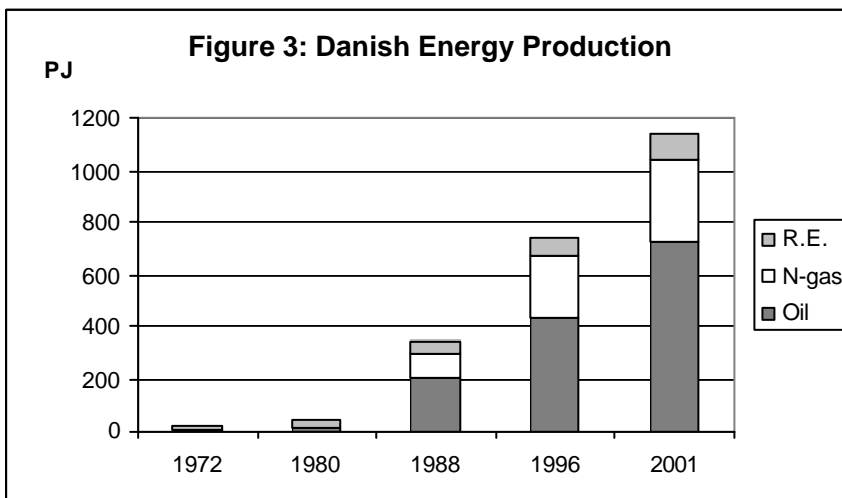


Diagram 3: Denmark has become self-supplied with oil and natural gas.

Public participation and Danish energy policy objectives

Energy security and climate change responses have been major objectives for Danish energy policy. During the past 30 years these objectives have been expressed through a number of energy plans adopted by the Danish Parliament. Meanwhile both the focus on different objectives and the means of implementation have changed over the years due to a constant interaction between parliament and the public participation.

In the period from 1972 to 1980 the leading objective was to become less dependent on oil imports. (See diagram 4a). The measures included plans for introducing nuclear power and to some extent natural gas. The plans for nuclear started public resistance and draft for an alternative plan was put forward by the anti nuclear movements introducing energy conservation, CHP and renewable energy.

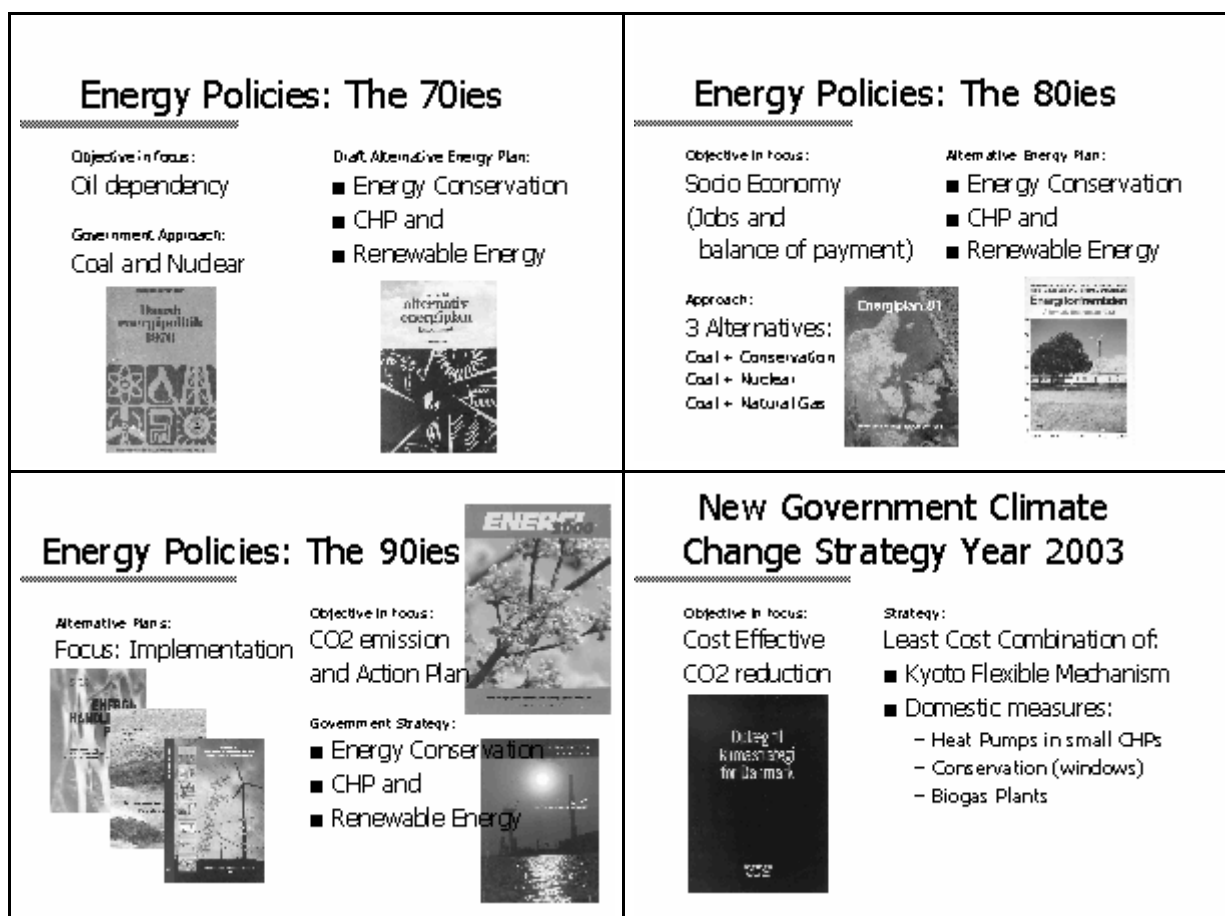


Diagram 4: Danish Energy Policy debate and objectives.

In the period from 1980 to 1990 the leading objective became socio economy. The official energy plan "Energy 81" was issued by the government. This plan put forward a number of alternatives to be considered by the parliament and by the public. Meanwhile, the alternatives were very similar since all of them included increasing

demands and a high degree of coal. Moreover one of the alternatives included nuclear power. Consequently, the official plan was again met by an alternative plan. (See diagram 4b).

In March 1985 the Danish parliament decided to exclude nuclear power from future energy planning. And a few years after the UN emphasised the importance of global environment and development leading to climate change response policies. And in 1990, the Danish energy policies leading objective became the reduction of CO₂-emissions. In this period alternative plans tended to focus on the implementation (See diagram 4c).

The Danish energy policy has also had its failures. For example the expansion of decentralised CHP was delayed for several years because the potential was considered too small to motivate development. And while large investments were made in insulation during the 1970s and 1980s none were made in electricity savings. This resulted in increased fuel consumption for electricity production while the fuel consumption for domestic heating decreased.

Local Energy Planning

In the 1970s and 1980s the objective of energy security (decreasing oil dependency) was met partly by energy savings and partly by increasing oil production and by replacing oil with other fuels, mainly coal and natural gas. Power stations converted from oil to coal. During a period of five years the Danish electricity production changed from a 90% use of oil to a 95% use of coal. Houses were insulated and central heating systems were converted from oil to natural gas or district heating based on coal-fired CHP. Even though the area of heated space increased by 23 per cent from 1972 to 1980, the heating demand decreased by 11 per cent. And the amount of district heating produced in CHP was multiplied by three from 1980 to 1996 (see diagram 5).

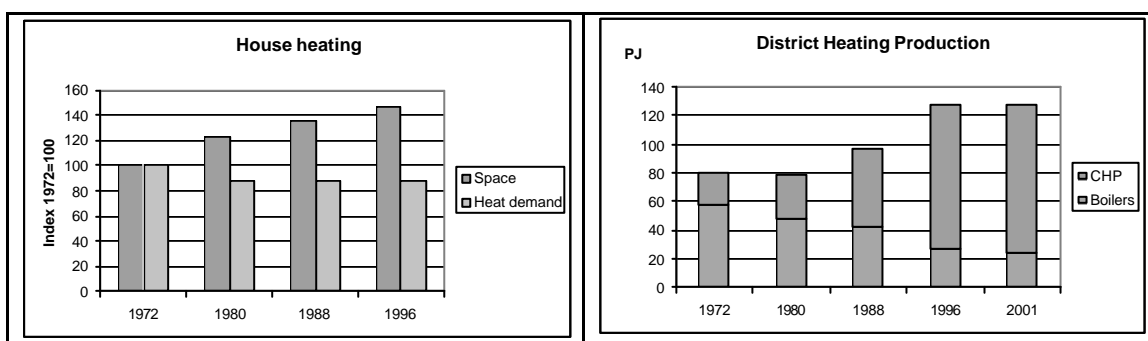


Diagram 5: Energy conservation and CHP has led to severe fuels savings in the house heating sector.

Thus, already in the period before 1990 Danish energy policy has had a number of successes in meeting the objective of climate change response. First, insulation of

houses and an extensive expansion in the use of CHP lead to decreased fuel consumption for domestic heating (See Diagram 6). Second, different types of renewable energy were introduced; e.g. wind power which now produces approximately 15% of the Danish electricity supply (See Diagram 7).

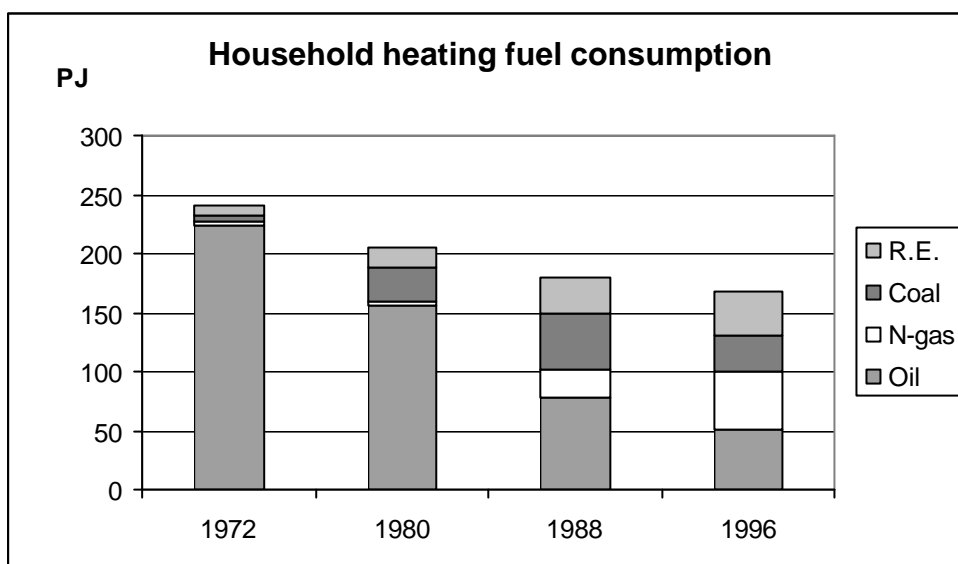


Diagram 6: House heating fuel consumption has decreased and oil has been replaced by coal, natural gas and biomass fuels.

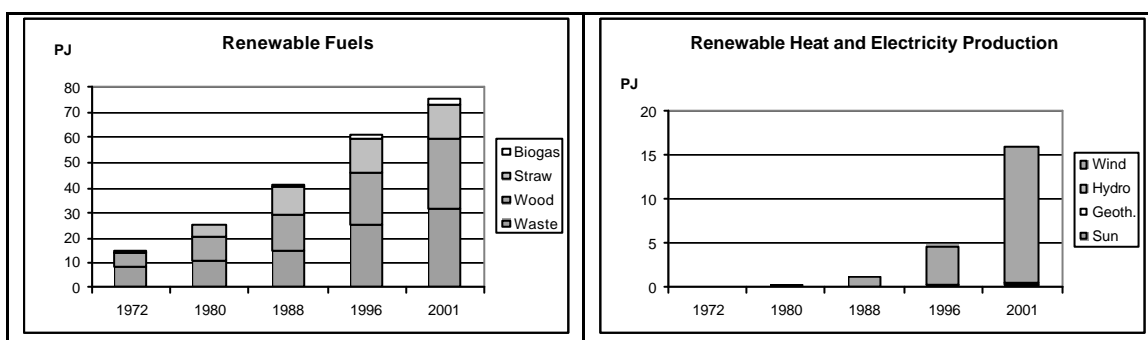


Diagram 7: The increase in renewable energy sources.

Along with Parliament's introduction of the climate change response objective in 1990 it was also described how this objective should be reached by various types of initiatives. According to Energy 2000 the current technology, with coal-fired power generation should be replaced by new technologies, such as energy conservation, decentralised CHP and renewable energy. Since 1990, all strategies in Parliament's energy plans have been based on these principles of technology change and consequently Parliament decided that Denmark should implement a major change in energy technologies.

Opposed to old technologies such as coal-fired power stations, new technologies were being widely distributed throughout the areas of consumption and are therefore characterised by the following:

- implementation of new technologies were carried out by multipurpose organisations. Electricity savings had to be implemented by private households and industries with other main objectives and with little interest in electricity consumption. In the former situation investments in supply technologies were carried out by single-purpose organisations such as utility companies and gas supply companies,
- investments were implemented by many independent organisations,
- technical solutions differ from one place to another,
- sometimes new and partly unsafe and not well-proved technologies were implemented. Maintenance of such new technologies depend on the ownership and organisation. Along with the implementation of new technologies new types of organisations emerged. Maintenance of biogas plants and straw fired district heating systems, for example, resulted in new organisations in which corporations of farmers own the production facilities while corporations of district heating consumers own the distribution facilities.

Altogether, the technological change was characterised by a change from undifferentiated solutions implemented by few single-purpose organisations into differentiated solutions implemented by many multipurpose organisations.

Realising the nature and complexity of the such technological change one might find that design of public regulation instruments must be of the same nature as the technological change itself, i.e., differentiated and multipurpose. Taxes alone cannot do the job. New solutions, financing and the possibility of implementation must be available to the individual consumer. At the same time it is very important that public awareness and participation is improved. This rather radical change in technology formed a challenge to public regulation. And Local energy planning turned out to be an important instrument in making the new solutions visible to people. This again made it possible to give state support to development and implementation of new technologies. And finally acceptable that green taxes were introduced and public regulations were decided in the parliament.

The role of local energy groups.

Around 1980 a few local energy groups started discussions on not only how to introduce single energy saving and energy producing activities but to combine different activities making a village or a municipality nearly completely supplied with renewable energy. The local groups had often members of the Danish Organisation for Renewable Energy (OVE). Therefore OVE arranged the first workshops where these groups and other interested people from villages, public authorities and universities could exchange experiences and knowledge. Around 1980 the natural gas from the North Sea was introduced and in order to find the best way to use the natural gas the Danish Parliament decided that all municipalities should make their own heat plans. Economical key figures and environmental emissions were calculated for different solutions and

presented for people in each municipality. After discussing the alternatives the municipality council decided how the buildings of the different parts of the municipality should be heated (type of fuel, District heating or individual heating). The work was coordinated by the counties and finally proved by the Danish Energy Agency.

This kind of planning is called sector planning and the procedure in the Danish planning system is always that a draft plan is elaborated and primarily discussed in the municipality or county council, then discussed at public meetings and finally political decided by the council.

Members of the Organisation for Renewable Energy (OVE) participated in this public process but were not satisfied with the quality of the plans because only fuel for heating was included. They therefore made own instruments for elaboration of energy plans for villages and municipalities including also electricity consumption. This initiative resulted in a number of local plans for smaller geographical areas.

Around 1990 these ideas were incorporated in the national energy planning and municipalities and utilities got the job to implement the new technologies (primarily CHP plants and windmills). Thus the local energy planning for municipalities in Denmark has now been replaced by accounting systems (green accounts) showing how far the municipalities are in converting from fossil fuel to renewables and how far they are in reducing CO₂-emissions.

In front of that work are two islands heading for 100% renewable energy supply Ærø (7.500 inhabitants) and Samsø (5.000 inhabitants). Samsø is now more than 100% supplied with renewable energy and Ærø is half the way. They are thus realising the ideas born in 1980 where people started to discuss how to supply hole societies with renewable energy.