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Development of District Heating in Buffalo

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Trends and Aspects in District Heating

The View from Denmark

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Introduction

District heating was introduced in the United States before the expression ever had been used in Europe, namely over 100 years ago.

The major reason why the district heating development in the U.S. is so different from the parallel development in Europe seems to me to be the fact that energy systems in the U.S. were started mainly as and still are utility-owned whereas they are municipality or consumer owned in Europe meaning that the European systems are self-supporting. Furthermore for the majority of the utility-owned systems in the U.S. district heating have been a subsidiary part of the business and of secondary importance. The complex process by which district heating systems in cities with multiple ownership patterns are currently planned and financed seems to be one of the major obstacles to the further development of district heating in the United States.

In Europe district heating was introduced by the end of the 19th century. The driving force in those early days was the possibility to utilized the surplus heat in the cooling water from already operating small diesel engine power plants. Such plants would be operating in town centres mostly to supply building with electricity and the distribution networks were small and simple keeping the distribution costs to a minimum.

For some European countries, first and foremost the Scandinavian countries, there was a particular concern that specific heat and power needs should be effectively met. This led to the development at municipal—in Denmark mostly consumer owned—level of a great number of district heating systems, both heating-only as well as combined heat and power systems.

In other European countries the development of district heating has proceeded at very different rates. It seems that especially the resistance of the power plant administrations has restrained the new construction and retrofitting of combined heat and power plants. The explanation for this attitude could be that in some countries one can rely on sufficient domestic resources of coal, hydroelectric power, lignite and/or peat. Differences in climate, the penetration of central heating systems in buildings and competition from natural gas are other factors which have influenced the development of district heating.

Development Independent of Governmental Support

It is interesting to note that, with a few exceptions, district heating development has been independent of financial incentives and active government support. That means also that the development is quite different from that of the large national and regional power utilities which are characterized by centralized decision-making and planning with easy access to the European loan market.

As a consequence of the energy crisis in the early 1970's Denmark was the first country which began a total and systematic planning of its energy supply to ensure the most efficient exploitation of the energy sources available especially as no major domestic energy resources were found at that time.

As a result of this planning heat supply systems in Denmark are at the present time going through radical restructuralization. Systems for domestic natural gas supply have been taken into operation since 1982 and existing district heating systems are heavily extended and rebuilt in order to obtain a more effective utilization of the surplus heat form power stations, refuse incineration plants and various kinds of industries.

The restructuralization of the Danish heat supply systems is planned to lead to the following results:

	year 1982	year 2000
District Heating	43%	53%
Natural Gas	2%	16%
Oil Burners	51%	18%
Electricity	3%	5%
Renewables	1%	8%

As it appears one of the objectives of the energy planning is to replace individual oil furnaces by piped energy supplied by collective distribution systems for district heating or natural gas. The total investment in this large operation will amount to approximately 5 billion US$, i.e. 1,000 UD$ per inhabitant.

Goal of 70% DHC Utilization

In the year 2000 approximately 70 percent of the heating requirement in Denmark will be covered by district heating or natural gas. To meet this goal it is obvious that a nation-wide planning is required.

Many countries have shown a high degree of interest in heat planning which serves as one of the fundamental criterias for district heating development.

The question can be asked why gov-

ernments in Denmark and other European countries continue to invest in district heating development in spite of the decline in oil and gas prices. The answer to that question is that many European countries have no or only moderate access to their own fossil fuels which means that surplus heat from combined heat and power plants, incineration plants and industries is considered free from a society point of view, i.e. that this energy has to be used before the imported fossil fuels.

The Basic Principles for Price Formation

The price formation can be based on several different principles:

- The actual cost of production and supply of heat.
- The price to be paid by the buyer in the best alternative heat supply option.
- The value to the seller by alternative use of the heat available.
- Arbitrary price negotiated between the buyer and seller.

In Denmark prices generally must be based on the actual costs and reported to a Gas and Heat Price Committee in order to be valid. Although this basic principle for the price formation is clear some important questions remain:

- How are costs related to combined heat and power to be divided between the electricity consumers and the heat consumers?
- What are the actual costs related to waste heat from refuse incineration plants and surplus heat from industries?
- How are costs related to a transmission system to be divided between the individual distribution companies?

Combined heat and power production:

Generally for the first 10–15 years the heat consumers are paying only the marginal costs, thus imdemnifying the electricity consumers. In other words, for a certain grace period the total benefit of the combined production is allocated to the heat consumers. The reason for this approach is that there is really no benefit to be shared until the big investments in the transportation system are paid back. The electricity price will not be affected by the heat production in the period agreed upon and after the grace period the benefit of the combined production compared with the best alternative heat supply option is shared, mostly fifty-fifty with the result that both the electricity price and the heat price is going down on the long term.

There seems to be a growing understanding in many countries for this philosophy which is one of the major reasons for the development of district heating in Denmark.

Waste heat from refuse incineration plants:

Incineration plants could be consid-

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ered part of the refuse collection service, and thus heat consumers should pay only marginal costs related to the plant. However, this approach will not normally be applied due to conflict of interest, either between the individual municipalities involved or between the different utilities in the municipality. Instead the waste can be considered a kind of fuel, and the price can be related to the price of other fuels or to the saving in fuel expenses gained from utilization of the waste heat from the incineration plant.

Surplus heat from industries:

Obviously, private enterprises cannot be expected to engage in heat supply schemes if only the actual costs are paid. Part of the benefit must be allocated to the producer. The heat price is negotiated in each particular case, but must be reported to the Gas and Heat Price Committee.

Heat price ex transmission system:

Costs related to the transmission system are well defined. The question is how to allocate the expenses to the different distribution companies. The simplest approach is to use a pool-price so that the heat price ex transmission system is the same for all the connected distribution companies. In some cases it may be necessary to divide the construction costs for the transmission system, considering the heat demand and location of the distribution systems, thus leading to different heat prices ex transmission system.

Tariff Structure

An important question regarding pricing is the question of tariff setting. The individual district heating companies can use several tariff systems. Most companies use a tariff system with three elements:

- A connection charge paid once and for all.
- A fixed charge paid annually.
- A variable charge paid per heat unit consumed.

The connection charge covers part of the investments in the company and the costs for establishing supply to the individual consumer. Of course a low connection charge is an incentive for new consumers to join a district heating system.

The fixed costs are determined by the maximum load demand that may be imposed on the system by the consumers and thus the fixed charge is not related to the heat consumption.

The variable charge is paid according to the heat consumed.

Conclusion

The experience gained from systems built the last 3–5 years using new technology shows a high grade of fuel efficiency and appreciable cost reductions, both important factors in the argumentation which is needed to convince the decision-makers of the advantages of district heating.

The future of district heating appears bright, at least with a Europeans point of view. Investigations performed by the International Energy Agency in 1982–83 show that by the early 1990's installed heat production capacity in Europe is likely to increase with not less than 109%. The newest figures show that plans in fact have been prepared and implemented so that this objective is likely to be achieved.

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New Book on DH R&D in Denmark

The Danish Ministry of Energy has published a 64-page book covering the latest developments and applications of district heating in that country. Included in the volume are articles on the history, financing and technology of Danish district heating, as well as the use of computers to design and control DH systems.

Copies of *District Heating Research and Technology Development in Denmark* (ISBN 87-503-6536-3) are available by writing the Danish Ministry of Energy, Slotsholmsgade 1, DK-1216 Copenhagen, DENMARK.