

District Heating and Cooling: An Implementation Technology for the 21st Century.

The IEA's Committee on District Heating, Cooling and Combined Heat and Power has been concerned that the integrative technology of district heating and cooling is being overlooked by decision makers in both the IEA, the EU Commission and by the United States DOE. There are myths and misconceptions based, in part, on poorly maintained systems in the Central and Eastern European countries that cloud the real fact that, where based on waste heat utilization these systems are more efficient than the direct use of natural gas. District Heating and Cooling consist of pipe networks that enable other technologies such as combined heat and power to realise its potential by recycling or reusing waste heat. The concept of using a pipe network to also distribute cooling services is being implemented in many countries. This means that district heating is no longer of importance to only northern latitude countries.

This policy paper and its companion background paper have been produced by the Committee in order to encourage policy makers to consider the important role district heating can play in assisting countries to meet their Kyoto targets.

What is District heating and cooling?

**District Energy
is
A Second Hand
Business.**

The fundamental idea of district heating is a piping network that allows multiple energy sources to be connected to multiple energy sinks. The existence of the network enables complex and environmentally optimum energy solutions to be developed. The ability to assemble heat load enables renewable fuels such as biomass and sources such as geothermal to be used in a cost-effective way. In the EU, some countries, in particular Scandinavian countries, show a significant penetration of district heating of up to 80% of the heat market. However, district heating has only a small fraction of the total heat market of the EU. Therefore the potential is large and varies in each country depending on past national policies. The market share of district heating in the CEE countries is much higher. In the United States and in other countries where cooling is important, district cooling networks are increasing in importance. The technical possibility of using waste heat and thermal storage to produce economic cooling services is getting a lot of attention.

Myths and Misconceptions

Transnational Gas vs. Local Municipal Networks

District heating is not competitive with distributed systems.

Where the national policy context recognises the environmental benefit associated with district heating, building owners are receptive to a long-term energy supply system that is fuel flexible. This insulates them from the impact of market price shocks. However, district heating systems are, by their nature local solutions, and have limited ability to raise capital and to absorb early losses. National or regional gas and power networks, with much larger capital bases can often forward price or discount new gas or power developments and thus appear more competitive compared to district heating. There has been a tradition of national policies that also tend to favour large-scale energy supply alternatives, rather than local initiatives.

Fuel Cells and Coal Plants on The same network

District heating systems are yesterday's technology

District heating, as a technology concept, is a significant presence in many countries. There is continued effort to lower the installation costs of the pipe network using new techniques. Increasingly district heating will no longer be using fossil fuels but waste from power plants, municipal waste and biomass. The use of geothermal energy, a renewable resource, can be facilitated by heating and cooling networks. Network systems are **required**, in order to maximise the environmental benefit of the new power technologies such as fuel cells, and high efficiency gas turbines.

District Heating in the CEE is an Opportunity to Increase CHP

District heating systems in Central and Eastern Europe are a sinkhole for investment.

The poor performance of district heating systems in the CEE countries is due to the centralised imposition of a single design concept. The major technical innovation of pre-insulated pipes could not be used, as it was Western technology that could not be imported. Significant efforts are now being made by many parties to bring the networks up to the required technical standard. The expansion of the gas system in some cases does not consider the full environmental advantage of using the premium fuel to first produce power, and then use the refurbished district heating network to supply buildings with the rejected waste heat. Policy makers need to recognise these networks as a national environmental asset rather than as liabilities.

Coherence Issues

Because district heating systems are a facilitative technology, it impacts on many policy and technical areas that need to be understood in the preparation of national and supranational policies.

**Urbanisation:
Cities are where
the energy
problems are**

District heating is the most effective in areas of high building density. The trend to worldwide urbanisation offers a growing market, particularly in emerging countries and in the area of district cooling. The network technology supports urban design that uses space well and can be served by energy efficient transit systems. Where network systems use waste heat, the requirement to super insulate buildings may not be the optimum use of capital. However, in common with other urban environmental issues such as mass transit, identifying whom pays and who benefits from the environmental improvement that district heating creates is a complex issue.

**Competition:
The Issue of
Market Power**

Transnational and regional gas networks are both a competitor and an ally of district heating solutions. National and international gas distributors have much more market power than district heating systems that are by their nature local and often municipal in structure. On the other hand, availability of a clean burning fuel enables small scale CHP and small block central networks to be competitive. The trend towards distributed power will increase the focus on small scale district heating systems that will be as efficient as large scale electric power plants.

**Market:
Impediments to
new system
development**

Market solutions have a predilection for short-term investments. District heating systems tend to be capital intensive with low operating costs. Their environmental product, in the form of energy efficiency, is not currently priced in the marketplace. Starting new district heating systems is institutionally challenging. This is because many stakeholders are involved and significant initial investments have to be made without the certainty of a large customer base. In addition, there may be unintended policy decisions such as Directive 92/77/EEC which requires that VAT be applied on district heating supply even if the energy source is waste heat.

**Environment:
The policy
driver**

Greenhouse gas abatement will be among the important policy driving forces in the next century. District heating can be described as a piping network solution that connects thermal discharges to thermal needs and has the potential, when combined with CHP, of significantly reducing greenhouse gas emissions.

Current Policy Initiatives are promising, but have a Missing Link.

Combined Heat and Power

**Who is
developing the
heat load?**

On a worldwide basis, there is a growing realisation that distributed generation will become increasingly important. Electrical demand continues to grow worldwide and the ability of gas networks to deliver clean burning fuel to the urban centres, where the power is required, will drive local power generation. However, at the present time, the promise of CHP mandates the fact that a heat sink is required for the low-grade thermal energy given off as part of the generating cycle. The problem is that as industry becomes more electrically intensive, large industrial heat sinks for low-grade energy are increasingly hard to find. Urban

buildings are a more stable long-term partner for CHP plants and district heating is a vital key component that is being overlooked in the drive to increase CHP power production.

Biomass Fuels

What happens when natural gas gets too expensive to burn?

In the longer term, recently issued policy papers¹² indicate that biomass fuels will have to play the majority role in any renewable energy future. There is little recognition that district heating systems in several countries are already supplying urban centres with heat from waste burning CHP plants. These are in fact prototypes of the kind of plants that would convert future fuel crops into low-grade heat. However, the crucial importance of network solutions appears missing from almost all present analysis of the new and renewable technology solutions.

Conclusions and Recommendations

As policy initiatives, such as the European Union's Action Plan on Combined Heat and Power, the UK CHP initiative and the US CHP Challenge are developed, it is mandatory that district heating be considered as part of the solution and not neglected. Although CHP is currently the prime candidate for energy supply to district heating system, the network's ability to use many heat sources including ones with renewable fuel sources is of great national strategic value.

It is very important that policy makers are aware that market forces may drive solutions that may be shorter term than is optimum for society and discriminate against high capital technologies such as district heating. Of particular concern is the fact that national and transnational energy market supply forces may be counterproductive to society when they impact local urban energy networks. The design of suitable tax and fiscal mechanisms that correctly price environmental advantages such as the use of waste heat should be encouraged. Finally, the IEA Executive Committee is more than willing to provide information to future IEA policy discussions in order that the technology's potential is recognised and then disseminated to national governments that have the responsibility of reducing greenhouse gas emissions.

Approved IEA Executive Committee for the Implementing Agreement on District heating and Cooling including the Integration of CHP. 33rd meeting San Diego 4 November 1999.

¹ New and Renewable Energy: Prospects for the 21st Century DTI Consultative Paper

² Energy for the Future: Renewable Sources of Energy. White paper for a Community Strategy and Action Plan COM(97) 599 26/11/97