IS THERE A ROLE FOR DISTRICT HEATING IN FUTURE CITIES WITH LOW ENERGY BUILDINGS?

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ABSTRACT

The district heating sector is challenged in its traditional way of doing business by buildings increasingly more energy efficient (with low heat demand for space heating). This paper reports on work of mapping out such challenges connected to passive houses in Sweden. It should be noted that the conditions might be different in different geographical areas. To gain climate friendliness in the building sector a system perspective must be used both regarding energy and environmental issues. The levels of energy use in buildings in Sweden today and in the future are discussed together with marginal vs. average thinking regarding energy and heat production. From our findings we conclude that it is not necessarily so that electricity or natural gas should be the option of choice for hot water demand or peak loads that need to be externally covered also in energy efficient buildings. However, it will require active work by district heating companies to stay competitive. It will be increasingly important for district heating companies to communicate with their customers. It will also be important to identify new customers and new areas where heat can be utilized; the “district heating villa” in Göteborg, Sweden is an example of investigating new possibilities of heat use. The study reported in this paper has identified a number of areas where further research and development is needed for district heating to improve the future market position of district heating

INTRODUCTION

This paper is a short summary of a study commissioned by the Swedish District Heating Association in 2007. The full study is available in Swedish from the commissioner [Fröling et al, 2007]. The study is focused on Sweden and Swedish conditions. If local conditions are taken into account conclusions might be adapted to other geographical areas.

The study takes of from a provoking question to district heating companies: Is there a future role for district heating at all, in a world with energy efficient buildings? From our findings we conclude that it is not necessarily so that electricity or natural gas should be the option of choice for hot water demand or peak loads that need to be externally covered also in energy efficient buildings. However, it will require active work by district heating companies to stay competitive. There is no immediate crisis for the district heating business, but it is important for district heating companies to start to prepare for new business conditions on their markets as soon as possible.

District heat in Sweden today is mainly supplying heat in the housing sector. Thus it is important to understand the role of buildings in the energy system in order to understand and discuss the future of district heating and when we face a future with increasingly energy efficient buildings. So far the research as well as policy discussions often have been separated in a supply and delivery side and a user side. Less effort has been spent thinking of these two parts as one system. In Sweden, the use of district heating has already contributed significantly to reduce the amount of heating oil and fossil fuels used for heating purposes, especially in department buildings.

Direct electric heating of homes is used to some extent in Sweden, mainly in single family houses. This electricity use, despite political goals, shows no declining trend. Electricity used for household purposes as well as for the operation of buildings (e.g. ventilation) both show increasing trends in Sweden.

DH IN THE SWEDISH ENERGY SYSTEM

An important communication from this study is that the use of district heating in Sweden has already addressed several environmental objectives today discussed by policy makers. Policy makers are not always aware of the situation, sometimes assuming primary energy consumption always occurs inside the walls of a building. This is to a large extent the case in some large countries in Europe - e.g. Germany, France, Great Brittan, Spain and Italy, where e.g. natural gas heating is common - setting the focus of the discussion within the European Union. However, several countries in Europe have extensive district heating networks, and sometimes policy makers are not aware how this fact influences the effectiveness of different energy policies. If increased insulation decreases the utilization of waste heat available less is gained regarding climate and resource use compared to if use of natural gas is decreased.

Increased energy efficiency and environmental goals are important for the future energy use in buildings. It not

always obvious for participants in the political discussion how goals regarding energy efficiency and decreased amount of bought energy to buildings will contribute to environmental and climate goals in a system with much district heating, and including combined heat and power and a large degree of bioenergy. The Swedish energy system supplying the building sector is quite different compared to the average of the continental Europe. Conclusions valid for one area are not necessarily applicable to another area.

In an international comparison Sweden has rather low emission of green house gases arising from heating of buildings, even with a comparatively cold outdoor climate. There is also a rather weak relation between emissions of carbon dioxide and the use of energy in a specific building, due to a combination of combined heat and power and use of biofuels in district heat supply and high contribution of hydro power and nuclear power in the electricity supply. Policy initiatives aimed at lowering carbon dioxide emissions through lower energy demand in buildings will thus not have an as strong impact in Sweden as in an area where heat supply is based manly on fossil fuels.

District heating is generally a rather anonymous technology. The building industry often has low understanding of the national energy supply system, since this is outside their business area. District heating companies are seldom diligent in communicating the business idea of beneficial utilization of heat otherwise wasted. International energy statistics is often reported in a way that benefits of utilizing low grade heat is not obvious. Energy analysts and researchers using such statistics thus often do not identify such benefits if not specifically looking for them.

For the future, district heating companies must identify their new competitors on the market. In Sweden today, main competitors often are identified as direct electric heating, geothermal heat pumps or wood pellets furnaces. Future competitors might be rather different, e.g. biofuel use for transports or increased energy efficiency, competing not by delivering an alternative sources of heat but competing for the same strategic resources or delivering the service in a totally different way. District heating companies must prepare for this “new” kind of competition.

THE LEVEL OF ENERGY USE

Scenarios for future energy demand indicate challenges for the future of district heating companies. Investments in energy infrastructure and supply in the close future have an economic life reaching into a future when the energy market might have changed dramatically. The strategy for district heating companies should thus be to prepare now, not wait and try to adapt when the changes has occurred. The low degree of systems understanding and overview in the general discussion of the Swedish energy future is problematic, giving obvious risks for sub-optimization.

We can not today tell in details how the energy system in e.g. year 2050 should be designed or be sure of what level of energy use will be prevalent. Neither can individual companies decide today what the energy system will look like in 2050. Because of this, doors must be kept open both regarding energy research and the long term developing work within companies.

District heating companies have to actively work with at least two time frames in their strategic planning: a short time frame, to around 2020 and a long, to around 2050. In the short perspective it is important to recognize that nearly all technical solutions must be closely connected to and compatible within the present energy system. In Sweden, district heating supply more than 50% of the heat needed in the housing sector. New technological development will in the short time frame not be able to change this, nor contribute substantially to environmental or energy efficiency goals in EU or Sweden before 2020. In the longer run new technology and methods might contribute substantially, but we will still see remains of the energy system of today; a large part of the building stock 2050 will be buildings that are already build today. It is important to keep in mind the long time frame when building new buildings as well as when older buildings are renovated or reconstructed.

There is a notable difference between the expectancy of energy efficiency in new buildings compared to what can be actually measured in the same buildings after a couple of years of use. There are Swedish examples of this e.g. in the area Bo01 in Malmö and in the Hammarby Sjöstad area in Stockholm. Studies show several examples of substantially higher level of energy use compare to Swedish building regulations (as well as what was planned). This is a quality aspect in the building process that constructing companies need to address.

The concept of “passive houses” to some degree focus on minimizing the use of bought, commercial energy brought into a building. There is a rapid increase in interest regarding “passive houses” in e.g. Germany, Austria and the Netherlands and an increasing number of examples in Sweden. Market studies foresee that in coming years many new homes will be built as significantly more energy efficient buildings. As discussed up till now, the focus in goal has been different from that behind district heating; low net energy use in each building vs. low total input of primary energy to a larger area. This difference in focus might give rise to a market competition and even conflict, but it does not necessarily need to end there if a systems view can be more commonly used.

ENERGY USE DISTRIBUTION

Companies delivering district heat has a remarkably low knowledge of how there customers are using their product (the delivered heat). District heating companies in Sweden seldom know the split between heat for space heating and heat for tap water. There are some examples of companies around Europe actually having this kind of information, but it is rare. A better knowledge of individual customers use of space heating (preferably connected to area heated) and hot water (preferably connected to number of users) could through benchmarking give possibilities to communicate possibilities for improvement and increase customer satisfaction.

NEW APPLICATIONS FOR USE OF HEAT

To develop and offer new household applications using heat instead of electricity might be one strategy for district heating companies to meet decreasing demand of space heating. Such applications can be direct substitution of electricity (e.g. dish washers, washing machines, driers et c.) but also to be prepared to offer heat driven technical solutions for new types of customer demand. Totally heat using appliances might give a small total heat load, but replacing electricity use with district heating can still be of importance on the margin regarding e.g. climate impact if heat replaces electricity from coal power somewhere else in the European electric grid. Such substitution should at the same time be rather easy to implement. New areas of customer demand can be such as an increasing use of comfort cooling and air conditioning. Heat for cooling thus seems very interesting to develop in the near future. From a climate perspective it would be a backlash if increasing demand of indoor climate control only could be met by increasing electricity use.

In Göteborg, Sweden, a demonstration project has been brought about by Göteborg Energy AB [2]. A single family house has been converted from direct electric heating to using district heat. At the same time as many applications as possible using district heating has been installed. This includes appliances as dish washer, washing machine and dryer, as well as more comfort oriented applications as an outdoor hot tub, a small winter garden and ice melting in the driveway; the ice melting and winter garden utilizing heat in the return flow. This project can be a source of inspiration for developing market strategies.

Regarding new areas of heat use the district heating business could form alliances with business areas traditionally seen as competitors. The interest of heat driven appliances and household machines is common for district heating companies, the solar heat business and geothermal heat and heat pumps.

CONCLUDING REMARKS

There is a future for district heating also in a future with more energy efficient buildings. It will require active and diligent work by district heating companies to stay competitive, but it is not necessarily so that electricity or natural gas will be the option of choice covering hot water demand or heat peak load in energy efficient buildings. To minimize climate impact from the building sector a system perspective must be used. There is an imminent need for research and development regarding a number of areas for district heating to improve the future market position of district heating.

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