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Published: April 19, 2012

Position Paper

Strategy for Energy Saving in Community- or District Heating

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1. District Heating driven by demand

The development will set focus on end-user demands, independence of fuels and the interaction of multiple heat sources. It will also highlight substations in a very important role. The substation is a key element in the ongoing transition process. The fact that it can be regulated to supply – with great accuracy – the demanded level of temperature provides the basic mechanism leading to energy saving. Only the heat really "asked for" will be accepted by the system.

> *"demand-driven" application of the district heating technology - as opposed to "production-driven".*

In a production-driven system the production plant regulates the volumes of heat delivered to residents. The residents have no technical means to regulate the heat reaching their apartments. Sometimes people need to open windows to get rid of excess heat, while they have to put on outdoor clothes when there is too little heat delivered.

In the future, the heat production increasingly has to follow the resident's actual demand of heating. There are encouraging examples from a number of countries that have started to work according to this formula. Consequently, substation functionality and performance are the key elements in order to change the operational approach from a production-driven to a demand-driven one.

Another issue is the choice between large group substations or smaller in-house substations. In general, the in-house substations turn out more economic than the group substations. Two-pipe systems with production of hot water in connection to every building will be the most economic solution.

District Heating must be considered as a total system, and as all systems it is needed to have a holistic view, i.e. to make sure you are optimising and working with the total system and not only focusing on parts of the system. For district heating it is crucial to have products and components in the system that work together in an optimal way as well as with optimal individual function.

2. The Action Plan

2.1 Two pipe systems

A modern well insulated high quality 2-pipe district heating network built according to modern installation methods which minimize material, movements and stresses in the ground , and equipped with a surveillance-system makes it possible to have constant control over the hole network against damages, so the operating costs are minimal throughout the entire service life of the district heating network.

In any two pipe system it is desired to strive for a maximised temperature difference between primary side and secondary side. When this is utilised it is possible to reduce pipe dimensions, i.e. investment costs, and also pump capacities, i.e. both investment costs as well as operational costs.

In systems where this is not utilised water flows are relatively voluminous due to the small difference in temperature in the supply- and return water. Therefore, they require relatively large pipe dimensions and relatively high pump capacity. These factors obviously increase both operational and investment costs.

2.2 Eliminating leaking pipes and waste of water

Leaking pipes and leakages in general are stealing cost and energy, not to mention water, from any given system. Eliminating leaking pipes and measuring of all "new and fresh water" that needs to be put in the system is crucial when enabling energy savings in any district heating network.

In addition to minimising leaks, an important part in minimising waste of water is to make sure that the district heating systems are working in closed circuits, i.e. it is important not to work with open systems where the hot water from within the district heating network is being consumed. This type of open systems are wasting energy as well as reducing the lifetime of the total network since it demands new fresh water being continuously being pumped into the system causing corrosion etc.

Gaining control of the situation with both leaking pipes as well as ensuring to have closed circuit systems will enable substantial energy savings in any given district heating network.

2.3 A substation in every building

Installation of modern individual consumer substations in all buildings connected to the main networks is an important factor to enable the demand driven development.The substation is a key element in the ongoing transition process, focused on energy savings. The fact that it can be regulated to supply – with great accuracy – the demanded level of temperature provides the basic mechanism leading to energy saving. Only the heat really "asked for" by the substation, i.e. only the heat needed, will be accepted by the system. The settings for each individual substation can be defined according to the wishes from the owner of the house/building.

Normally, a modern substation should be able to consider the local climate, the thermal profile of the building as well as both in-side and out-side temperature.

Consequently, substation functionality and performance are the key elements in order to change the operational approach from a production-driven to a demand-driven one. This solution will provide the possibility to measure the energy consumption for each building.

Another issue is the choice between large group substations or smaller in-house substations. In general, the in-house substations turn out more economic than the group substations. Two-pipe systems with production of hot water in connection to every building will be the most economic solution. Four pipe systems obstruct an individual based payment and use of energy.

2.4 All buildings need its own metering

The vision is that every individual household and apartment shall have an individual metering and an individual invoice that every individual can affect. A more pragmatic view aims at every building will have its own metering.

This is essential when believing that each individual wanting to control his/her own costs and also consumption. When consumption is not put into the individual household's responsibility it will not be obvious how to make a difference and there is no obvious gain.

In some countries people choose to cancel their district heating subscriptions in favour of installing individual gas-boilers. The reason for this is coming from the fact that people want to have control of their consumption, control of their costs and control of the indoor climate. This solution can also be made available when offering a demand driven district heating network. Furthermore, the district heating solution will always be more environmental friendly, i.e. less boilers giving less emissions, and it should also be more cost-efficient. This is especially valid when utilising energy that otherwise would be lost.

2.5 Connecting small district networks to the main city networks

The options to start District heating in small scale, i.e. using the term community heating, is essential both for smaller communities as well as for being able to start in small scale in larger communities.

In terms of adaptability to changes of basic fuels, district heating as well as community heating systems are flexible. They are also safe, as combustion can be located at some distance from the residential areas. Finally, the technical responsibility and surveillance will rest in the hands of a capable professional organisation. Even if it is decided to have the energy produced close to where people are living it is a “clean” technology due to the facts that there will be less emission with fewer boilers and less emissions with professionally handled boilers.

This type of development can be devised for development of one district heating area in a city. The gains generated by cost reduction can thus be used for further investment and to shorten the pay-back horizon for loans. Besides this, this heating area can be a model of “best practice” for further improvement in other districts.

2.6 A thorough analysis

A thorough investigation and analysis of options for supply of non-fossil, and preferably locally produced, fuels needs to be made in order to identify the best plan for each area.

In terms of adaptability to changes of basic fuels, district heating as well as community heating systems are flexible. Furthermore, the analysis must consider all available options for use of “waste or surplus” energy from local industries, recycling plants, garbage stations, etc. District heating offers a unique level of utilization when it comes to this kind of heat sources.

In a modern district heating system, a number of different heat sources can be set to operate in parallel – i.e. connected to integrating loops forming a comprehensive distribution network. The customer may get heat from multiple heat sources and from different directions. This improves the reliability and frequently also the economy. In a looped system, heat sources can be located in different places in the city - connected to the integrated network and supporting each other.

2.7 The individual building

For each building, as well as for each network and system, it is crucial to consider four basic actions that are vital for all energy saving actions:

- Acceptable insulation
- Radiator ad Tap water systems in balance
- Substation efficiency
- Leakage elimination

The need for substation efficiency and the elimination of leaking pipes in the distribution network are essential corner stones for energy savings and are mentioned earlier. In addition, on a building level the actions must be supporting efforts for having radiator systems and tap water systems in balance as well as making sure that there is sufficient insulation.

2.8 Essential aspects before and during planning

Making sure that District Heating with all its possibilities for saving cost, enabling energy savings, reducing emissions and in general for being a clean technology is always considered when making investment plans.

The environmental advantages attached to district heating stems from the fact that efficient district heating boilers - where it is possible to control the emissions - replace many small boilers generating uncontrolled emissions. Matching district heating with combined heat and power production – CHP - offers a unique opportunity to produce electric power at a high level of efficiency.

In addition to this, the option to use industrial waste energy from local sources will in some cases produce drastic reductions of emissions, environmental impact and cost.

2.9 A gradual transition

To strive for having a gradual transition and that the renovation and new construction plans always are based on a long term plan considering the total aspects from supply of fuels and source of energy to creating comfortable living climate for everybody.

In the current situation - where district heating is affected by under-investment as well as technical and financial shortages - the development has to be carried out in stages. A priority investment programme will be the first step. When elaborating the first steps, however, it is very important to have the long-term objectives in mind. The municipality will play an important role in this development, as the responsible body for strategic planning and as a major stakeholder. But also with an interest to make customers pay their bills with a feeling that district heating is the best alternative for them.

In a typical case, a short-term (0 – 5 years) priority investment programme - with focus set on short-term profitability - will be devised for development of one district heating area in a city. The gains generated by cost reduction can thus be used for further investment and to shorten the pay-back horizon for loans. Besides this, this heating area can be a model of "best practice" for further improvement in other districts. The long-term strategy should target the development of a fully modern district heating system with improved – i.e. demand-driven - heating service standards and enhanced independence of imported fuel resources.

Installation of substations in every building and replacement of the four-pipe systems with a two-pipe system and continuous production of hot water in every building will give a saving of gas with 30 - 50 percent, depending on the local conditions. It also gives a better in-house climate and more steady supply of domestic hot water during the entire year.

3. Keeping waste heat from going to waste

In Sweden, many district heating companies have been successful in utilizing industrial waste heat. The northern city of Luleå has one of Sweden's lowest heating costs for its inhabitants, largely thanks to the utilization of waste heat from the local ironworks/steel mill. This demonstrates fantastic opportunities for communities from a cost and financial as well as from an environmental point of view."

In many companies and industries there are untapped opportunities for using waste heat or surplus heat. Such heat can be found in many forms, whether it is steam going out into the air or hot water going out into the ocean. By utilizing the waste heat when producing district heating, the same fuel does twice the work, thereby doubling fuel efficiency.

Huge heat losses appear in the energy balance, where a lot of heat is lost in power plants, oil refineries and industrial processes. Many of these losses could be retrieved and distributed by district heating systems to heat urban buildings. District heating systems provide the necessary heat load for high-efficiency combined heat and power plants and, at the same time, enable the use of renewable energy.

4. Financing

In terms of available financing for investments, there are a number of available options. However, it is important to remember that as long as the financial solution is not a grant, i.e. "soft" money, it will be a loan and all loans require security, and come with a cost that is an interest rate.
The banks and organisations offering financial support are often found among the IFIs, i.e. such as the World Bank Group (IBRD and IFC), EBRD, EIB, NEFCO, NIB etc. There is also a current initiative called the E5P initially initiated by Sweden and today sponsored by many countries and headed by the European Bank for Reconstruction a Development, EBRD.

5. Conclusion on Energy Saving for District Heating

When the demand driven approach is used for district heating, and the main focus is on energy savings, the following steps are crucial;

First focus on modern substations, leaking pipes, insulation of the houses and on having both radiator systems and tap-water systems in balance. By doing this you will create energy savings and you will be able to identify the real need for energy.

Secondly, it is needed to analyse and identify all possible sources of heat and energy, such as surplus energy and waste-energy from industries in the area. This type of energy sources is crucial to use, and studies show that this is a big potential regarding available energy. Today, in east and west Europe we let steam (a high energy carrier) go into the air and hot water out into the oceans etc.

When these two initial actions are completed it is time to focus on the remaining need for energy and possible ways of producing this need. In this work it is important to carefully investigate and identify locally available fuels and the possibilities of using both household- and industrial waste as a fuel.

Finally, the remaining energy is what needs to be produced, and if possible by using locally available fuels. Regardless of what type of furnace, boiler or heating technology that will be used, it is important to use a Combined Heat & Power plant to ensure a high yield and to avoid energy being wasted. Furthermore, in the international community of today the incentives for, and the awareness of, choosing energy producing solutions with minimal CO2 emissions and environmental impact is high.