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MARK THROWER MANAGING EDITOR

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District heating finally comes of age in the UK

Simon Woodward, Woodward Energy Consulting Ltd

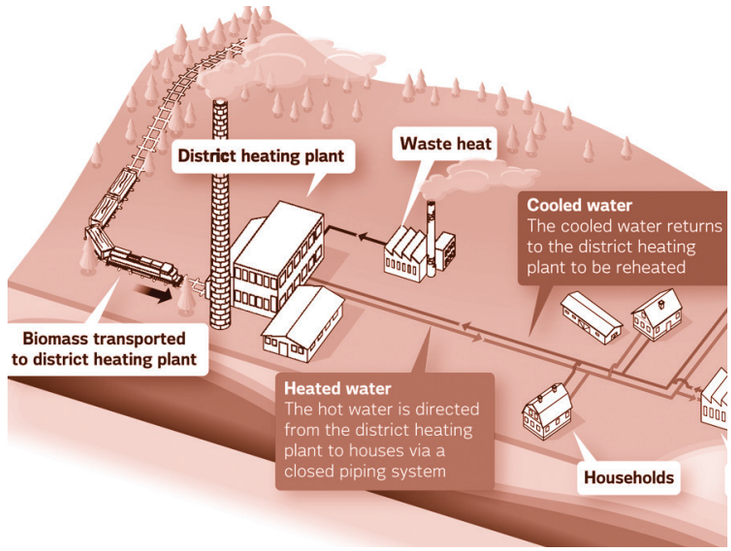
District heating can be a challenging topic as it often goes by many names, it could be district heating, communal heating, block heating, district energy etc. Essentially they are the same thing, although district energy does incorporate district cooling and the potential for private wire electricity networks, but people often use district energy when they mean only district heating. Ultimately, the above terms indicate a building or residential unit where the heat source is either not in that building or residential unit, or if it is, it also serves a number of other buildings or residential units.

Some examples could include a residential block with a heat source in the basement (hence the name block heating) or the heat source located remotely in an energy centre in the development and feeding more than one apartment block. Furthermore, it could also include a university or hospital campus with a centralised boiler house, through to a large-scale city wide network such as in Sheffield, Nottingham or Southampton.

District heating should be used where a low or zero carbon heat source is integrated into the scheme. If this is not the case, although a centralised higher efficiency boiler is located in each building or residential unit, once you have taken into account the distribution losses, any carbon benefits from the higher efficiency central plant will often be lost.

District heating is also a means to deliver energy and not a generation technology itself. That is where the real benefit of district heating comes in, because a district heating network is "technology agnostic" as multiple low or zero carbon energy sources can be incorporated. This is not only at the same time, but also at different points on the network and at stages in the life of a network.

Therefore district heating schemes should be developed to maximise the potential to deliver carbon savings for the connected buildings.



A district heating network is extremely reliable and should be treated as a long life infrastructure asset in the same way as a gas or electricity network. Historically in the 1960s and 70s installation standards were low, there were a number of poor pipe systems, and the importance of water treatment and the hydraulic design and control of networks was not understood. Consequently, this resulted in the whole sector has a very poor reputation with many systems failing and being removed.

Times have changed over the last 30 years and with a design that is well conceived, developed, installed, commissioned and operated correctly to good practice industry standards, district heating will provide a very reliable and controllable source of heat for the end consumer. The network should last for at least 50 years and in fact considerably longer. Indeed many schemes across the UK are quoting figures of 99.9 per cent+ reliability and this should be expected.

What makes a successful scheme. In answering this question it is important to define what success is. In terms of a district heating scheme it must be one where a number of "keys to success" are achieved in practice:

- it must not cost the consumers any more than the alternative localised heat source on a whole life cycle costing basis;
- the consumers receive reliable heat supplies at the correct levels at all times;
- the owner/operator recovers its expected revenues; and
- it is an efficient system which delivers greater carbon savings than via a system where each building or consumer has their own heat source.

If these are not all achieved in practice then it can be easy to dismiss the concept of district heating. Many articles written by those who are trying to stop district heating would make it appear that these "keys to success" are almost impossible to achieve. However, this is not the case, there are many schemes which achieve this, but it is a complex subject and each of these four "keys to success" need a lot of work from scheme concept through to

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long term operation to ensure that they are built into a scheme and delivered in practice. These "keys to success" will be considered one at a time.

The first thing to remember about district heating is that it is just that, it is heating and not a utility supply such as gas, where the customer needs an appliance in their building or home which then turns this gas into heat, which itself needs maintaining, repairing and replacing when it wears out or is beyond economical repair. Also, a heat network will generally have an operator who is locally or remotely monitoring or receiving alarms from the network and will promptly come to site and rectify problems which arise. This is unlike a gas network where the gas supplier is not monitoring supplies to this level and will not be aware if you lose heat from your boiler.

Therefore when you are considering whether the charges for heat supplied from a district heating scheme to a consumer offers a saving against their alternative costs it is important to make a fair comparison. You must consider all the costs the customer will not pay/save as a result of receiving these heat supplies, e.g. maintaining, repairing and replacing their own boiler. This is often overlooked by those who don't understand district heating, where they try and compare the gas tariff (and even that doesn't take into account boiler efficiency) with the price of heat.

Therefore the first key to success is to establish the cost heat consumers would otherwise pay if not connected to the district heating network and do this on a whole life cycle costing basis. The charges from the district heating network must therefore be set at or below this level otherwise the consumers will pay a premium for heat supplies. This is known as the "avoided cost" approach and must be used at all times.

No thought to charges

The alternative must never be practised which is "cost recovery" (unless the check has already been made to ensure this is lower than the avoided cost approach) because all that happens in this scenario is that the scheme is conceived and constructed without any thought being given to the charges consumers will pay. They simply have to pay the costs even if that is more than the alternative would have been. Sadly there are too many cases where the heat charges to the consumers are not the foundation of the project and are not considered until the scheme is being developed or in some cases is being commissioned!

What happens in those circumstances is that either the organisation operating the network runs at a loss or the consumers have to pick up these additional costs. Either outcome is undesirable.

In conclusion, the first key to success is to set the heat price at the outset and continually revert back to this with your detailed operational and financial modelling to ensure that the decisions made along the way in the development of the scheme ensure that this outcome can still be achieved. If it cannot then rework the scheme until it can, or if ultimately it cannot then really question why the network is being installed. Some of these ways to ensure these costs are driven down are dealt with later in this article.

The second key to success is offering reliable heat supplies at the same time as top-class customer care. One of the major points picked up by the Which? report on district heating published in 2015 was the importance of not only reliable heat supplies but also making sure that if there are problems of any nature then the customer has one person/number to call. Having this arrangement in place means that customers have confidence that their issue is being taken seriously and will be resolved.

However, queries are often not about problems with the physical supplies of heat (because it is rare these days to hear of a network that is so badly designed that the customers receive intermittent or poor quality heat supplies), but instead billing queries relating to meter readings or tariffs. Therefore, one of the critical corner stones of this key to success is to make sure that not only is there just one point of call for all customers in operation but also bills are clear and accurate.

This means that the importance of a connection in the process from conception through to long term operation is never more critical when it comes to the heat metering system. How often do we hear of the case where the metering system was never properly considered, commissioned or was even changed part way through the build. As a result either you end up with frustrated customers with poor quality bills for heat or an operator losing money because of a lack of recovery.

A few simple steps taken throughout the process to properly document the metering system and exactly what you are seeking it to achieve (i.e. prepayment or credit billing) and a robust commissioning process and a clear meter maintenance program thereafter will mitigate against these problems occurring in the first place. This issue is also linked to the third key to success, which is, is the owner/operator actually receiving the revenues it expects to receive?

Third key to success is that the owner/operator receives the expected revenues. While not a key to success for the customer, one of the most important underlying facts for a successful scheme is that the owner/operator actually gets paid for the heat they deliver. While this may seem obvious and surely should happen automatically (and therefore can hardly be considered as a key to success which needs work to make sure it happens) the fact of the matter is that it does.

It is not complicated but unless the same points outlined above with respect to the metering system to keep the customers happy are followed then it is far from guaranteed that the network owner/operator will receive their expected revenue streams.

There are many district heating systems across the UK where the metering system was never properly conceived, installed, commissioned or even operated, which culminate in poor quality meter readings/billing and therefore a lack of revenue recovery.

Therefore, the metering system cannot be a last thought to a network, but is actually a critical part of the overall system. Particularly with the introduction of the Heat Network (Metering and Billing) Regulations in December 2014 which has put a requirement to not only notify details about your system, but also install meters under certain circumstances and provide certain accurate billing information to consumers.

However, there are a number of simple steps, some of which were outlined above, to make sure this does happen which are:

- make sure that the metering plan is carried through from conception to long term operation with the aim of not only providing robust meter readings, but also as a tool in the chain of revenue recovery for the owner/operator of the network. This importantly includes making sure that every meter on the network is fully commissioned and is remotely readable and that there is a clear route in the plan to resolving meter faults;
- if there is a decision to change what is being installed, it should be ensured that this is done so in conjunction with the metering plan to guarantee that that the outcome will not prevent revenue recovery. A number of times the author has seen metering systems change in the course of a project as part of a valued engineering process with disastrous outcomes for long term revenue recovery; and
- the costs for running this system including any prepayment module (both annual and long term repair and replacement) must be factored into the costs when considering if the network owner/operator can still meet a heat price less than or equal to the avoided cost of heat. There are a number of schemes across the UK where systems have been installed without giving this consideration, the costs of running the metering system just becomes unmanageable under the agreed tariffs. This should not be the case if this issue is considered from the outset.

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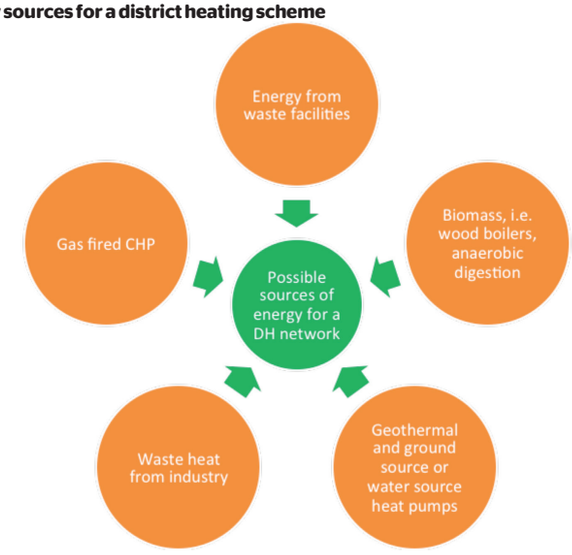
Finally, it should be ensured that a robust plan is implemented to guarantee that even with accurate meter readings that revenue recovery is ensured. This does not have to mean reaching immediately for a complex prepayment metering system solution if the network serves residential consumers (especially as you have to factor the operating, maintenance, repair and replacement of such systems into your heat costs). Instead select a system which works for your set of circumstances, be it prepayment or credit billing. Remember that credit billing with a robustly operated suspension policy for non-payment can work well and will have much lower capital and running costs.

The fourth key to success is an efficient system delivering carbon savings.

You have to ensure that you have constructed a system which not only delivers a carbon saving compared to the alternative system, with heat sources in each building or residential unit, but is also an efficient system. This second factor is not only important in increasing any potential carbon savings but is key to reducing costs and hence making sure that the heat charges can be set at or below the avoidable cost of heat.

Let us first consider heat sources. As set out earlier one of the clear benefits of a heat network is the ability to integrate a wide variety of Low or Zero Carbon (LZC) heat sources as indicated by the diagram above.

Energy sources for a district heating scheme



Key points to consider

There are many publications which talk about how to integrate these into a district energy scheme so the intention of this article is not to replicate these, but instead to focus on the key points to consider. The first key point should be to model the heat demands on an hourly basis to determine the profile of heat demand across the year. This essential piece of work will enable the LZC heat source (if not larger than the peak demand of the scheme, such as a significant amount of waste heat) to be correctly sized for the network by sizing this input against the base heat load. For example, a typical rule of thumb is that a gas fired CHP unit should run for at least 5,000 hours per year at equivalent MCR to be financially viable. Ideally the LZC source of heat should provide the energy for at least 60 per cent and preferably 70 per cent of the total annual heat sales of the scheme

It is also important to consider what heat sources are available and at what temperatures, but that is really the subject of another article in itself. Suffice to say don't leave any stone unturned. In fact consider not only the range of possible heat sources, but also which buildings could be connected to the scheme.

Imagine in the extreme if you look over the proverbial fence and if there is a hospital next door then that certainly gives options! There are too many schemes in the UK where heat sources that were a little bit too complex to be considered, or buildings which could easily have been connected were not for various reasons, to the detriment of the scheme and the building that was ultimately not connected.

Finally, make sure the scheme is designed for optimum efficiency. This will include factors such as making sure that:

- primary network losses from the heat source to each building are minimised. Good practice should be below 7 per cent and ideally 5 per cent as a percentage of the heat sales on an annual basis;
- focus is brought to secondary network losses within buildings to if possible, drive these down a further 10 per cent and no more than 15 per cent measured on the same basis as primary network losses;
- minimise parasitic pumping requirements at the energy centre to no more than 3 per cent, again as measured against the total annual heat sales;
- where possible use lower temperature networks (always with a flow temperature below 95°c) but keep in mind the potential for older existing buildings which may connect;
- ensure that there is a high temperature difference across the network to reduce pipe sizes (and pumping costs by reducing mass flow rates); and
- use variable flow systems which operate to maintain a minimum differential pressure at the index point of the network.

Yet again, it is important that all of these factors flow through the entire process from conception through to long term operation.

District heating is a complex business mixing a blend of technical, commercial and financial issues. However, with expertise and hard work you will then have the keys to a successful scheme.

Simon Woodward of Woodward Energy Consulting Ltd has spent the last 25 years developing district heating schemes across the UK ranging from Southampton, Birmingham, Leicester, Coventry, the Olympic Park and now with schemes in Sutton and Barking

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ENTRY FORM

DISTRICT HEATING

Please mark your answers on the sheet below by placing a cross in the box next to the correct answer. Only mark one box for each question. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet in ink, return it to the address below. Photocopies are acceptable.

QUESTIONS

1. Which of the following buildings would contribute most towards increasing the base heat load of a district heating scheme?
- ☐ School
- ☐ Hospital
- ☐ Office Block
- ☐ Residential Development

2. What should the realistic design heat loss for secondary networks be?
- ☐ 2 per cent
- ☐ 10 per cent
- ☐ 15 per cent
- ☐ 50 per cent

3. Which of the following important factors for the success of any project is really critical to a district heating scheme?
- ☐ Close control of capital costs
- ☐ Completion of the project on time
- ☐ Ensuring that there is a connection in the design process throughout the project from conception through to long term operation
- ☐ Regular project meetings

4. Which issue is most often overlooked in a district heating project?
- ☐ Correct sizing of CHP
- ☐ Quality of district heating pipework installation
- ☐ Hydraulic design of the network
- ☐ Commissioning and setting to work a fully operational customer heat metering system for all consumers

5. Which one of the following methods should be used to fairly set consumer charges?
- ☐ Cost avoidance
- ☐ Cost recovery with no analysis of cost avoidance
- ☐ Gas tariff only
- ☐ A gas index

6. Which one of the following is not critical to the success of a district heating system?
- ☐ Carbon reduction
- ☐ Revenue recovery
- ☐ Maximising system efficiency
- ☐ The total number of consumers

7. Which of the following sources of energy would not be widely used to generate heat for a district heating system?
- ☐ Biomass boiler
- ☐ Water source heat pump
- ☐ Energy from waste plant
- ☐ Wind turbine

8. As a rule of thumb how many hours per year of full load operation should a gas fired CHP engine exceed to be financially viable?
- ☐ 1,000
- ☐ 3,000
- ☐ 5,000
- ☐ 8,000

9. Which of the following is not a critical factor for an efficient network?
- ☐ Low temperatures
- ☐ Minimising length of pipework
- ☐ High temperature difference between flow and return
- ☐ Total boiler capacity

10. Which of the following is likely to be the most viable in terms of a connection to an existing network?
- ☐ A low density low rise housing development very close to the network where district heating is one among many options
- ☐ A school 1 km from the existing network
- ☐ A hospital 500 m from the existing network
- ☐ A retail shed 200 m from the existing network

Please complete your details below in block capitals

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