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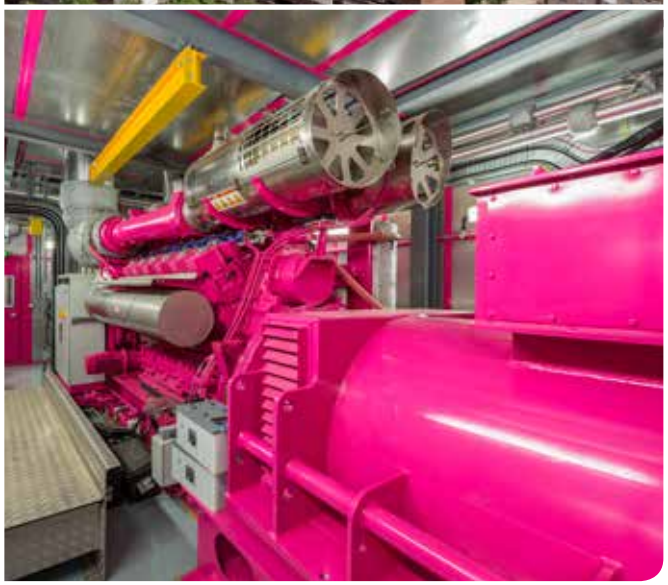
A technical guide to district heating

Robin Wiltshire, Jonathan Williams and Paul Woods



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A technical guide to district heating

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Front cover images
Left: Aerial view of one of the energy centres on the Queen Elizabeth Olympic Park (image courtesy of Cofely)
Top right: Tower block buildings connected to district heating on the Wyndford Estate, Glasgow (image courtesy of Cube Housing Association)
Bottom right: Combined heat and power engine in the energy centre at the King's Cross Central Development (image courtesy of Vital Energi)

Back cover image
Pipe system installed in Sheffield District Heating Network (image courtesy of Vital Energi)

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Preface

The fundamental idea of district heating (DH) is a pipe network that allows centralised heat sources to be connected to many heat consumers. Typically a DH network comprises three main components: one or more energy centre(s); the pipe network itself; and connections to the heat customers. In this way the system presents an overall heat demand that is the aggregate of all the individual consumer requirements. The greater size of load leads to an economy of scale and the aggregation means the load is smoother, leading to more efficient and economic operation of plant at the energy centre. It also allows heat to be provided from sources that cannot readily be used at an individual building level.

Networks also provide fuel flexibility for the future: new low-carbon and renewable sources can be integrated as soon as they become available and the network quickly provides an easy way to convert a large number of customers to these new sources.

The benefits of DH have led to a great deal of interest in the technology, and speculation and estimates of its future growth. Initial results from the heat networks model being developed by the Department of Energy and Climate Change (DECC) suggest that up to 20% of UK domestic demand might be served by heat networks by 2030, with other UK-based studies indicating 14–20% of current heat demand could be met in this way. The European Heat Road Map study estimates that about 50% of the heat demand across Europe in 2050 could potentially be served by DH, thereby opening up opportunities for extended use of sustainable and renewable energy sources for heating purposes at relatively low costs.

It is important that networks are designed carefully based on sound engineering principles with particular importance attached to securing a low return temperature for efficient operation. This guide provides technical information on DH, divided into sections on system design, component design, and operation and maintenance, with a comprehensive information and reference section.

The main driver making the business case for DH is the use of thermal energy that will otherwise be wasted. In particular, DH allows the efficient use of thermal energy from combined heat and power (CHP) plants, refuse incineration plants, waste heat from industrial processes, natural geothermal heat sources and fuels that are more easily used centrally including renewables like wood waste and residues.

The efficient use of energy together with the use of surplus and renewable sources means using DH networks can significantly reduce emissions of carbon dioxide. Integration of these sources of available waste heat means that DH produces significantly lower emissions of greenhouse and other gases compared with alternatives. It is also much easier to make sure emission targets are reached with a small number of large producers than a large number of small producers.

The use of thermal energy from CHP ranges in scale from large centralised power generation plant to smaller scale units implemented as embedded generation. While the former is common in other European countries that have implemented large town and citywide DH networks, it is the smaller plant, usually reciprocating engines, that is predominant in the UK. Such units are commonly the initial building block around which new networks can grow.

Making use of surplus energy or integrating renewable sources can increase energy security. Fuel supply reliability and flexibility is enhanced by using indigenous fuels like biomass or waste. Power grid reliability is strengthened by generating power nearer to population centres, and with CHP local demands can often still be met even when the main grid supply is interrupted if the CHP plant is configured to allow operation in island mode.

DH networks are potentially able to make use of heat from any source. In this way thermal networks can be supplied by low-carbon or zero-carbon sources, or new technologies, or waste heat sources that become available. This also means that thermal grids, once established, are able to progressively decarbonise.

From the perspective of building owners and managers, modern DH offers economic and technical benefits. It reduces operating, maintenance and capital costs associated with boilers in individual buildings, while the consumer receives energy services that the DH producer provides in the most efficient way possible.

When developed at scale, DH networks also provide competition between different heat sources and fuels and can therefore be an important element in liberalised energy markets. In large-scale integrated DH systems, all available heat sources can compete to the benefit of the consumers who are united as a bulk buyer.

1 Introduction

This guide concerns the technical aspects of district heating (DH) networks. It aims to provide a source of information for all those involved in developing new schemes or undertaking major refurbishment of existing schemes.

This publication is in large part an update of Good Practice Guide 234, *Guide to community heating and CHP*[1], focusing on the technical elements. Its scope is extended to emphasise the importance of low-carbon sources of heat other than combined heat and power (CHP), including residual heat such as from waste treatment and industrial processes, and thermal renewable energy.

Comprehensive technical information is presented, with the guide divided into sections outlining system and component design, and operation and maintenance:

- 'System design' describes the DH network as a whole; it is concerned with devising a system that is optimised but also has future expansion in mind.
- 'Component design' concentrates on the items of plant that may be selected, and also includes aspects of the heat mains and the interface between mains and customers.
- 'Operation and maintenance' outlines the principal operational and maintenance issues and procedures. It deals with detection of moisture within insulation, and covers in some detail the procedures that ensure proper water treatment.

Sources of further information are listed at the end of the guide.

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A technical guide to district heating

This guide is aimed at all those involved in the technical aspects of district heating networks. It provides a source of information for people developing new schemes or refurbishing existing schemes, focusing particularly on technical rather than financial issues. The importance of other low-carbon sources of heat including thermal renewable energy is also emphasised. Comprehensive technical information is presented, with sections outlining system and component design, and operation and maintenance.

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