°Case Study

# Decentralised Energy
## Leicester City Council

°Climate east midlands

# District Heating in Leicester

**This case study describes the District Heating (DH) scheme in Leicester City Centre and the analysis of two sample new build housing schemes to determine the technical and economic potential of connection to DH.**

## Introduction to District Heating (DH)

In the UK, DH schemes are typically relatively small and limited to specific developments or sites, areas defined by ownership (such as social housing), or re-development areas. There are some examples of larger schemes such as in Nottingham and Sheffield where these small scale systems have expanded.

Countries such as Denmark perhaps offer a better example of how large scale DH schemes can expand to cover significant areas including entire cities. Historically these countries have used DH as a means of distributing waste heat from small scale local power generation. This resulted in the widespread acceptance of DH for heat provision, and the existence of a number of smaller independent schemes. As the scale of power generation increased and the desire to improve efficiency drove the need for greater diversity on schemes, these existing smaller schemes started to merge by introducing interconnects. Without intervention, this merging process could be slow, requiring significant levels of coordination between different scheme operators. However this was overcome in Denmark through the introduction of regulation in the 1970s requiring connection in certain areas.

The model of developing smaller DH schemes which later merge into larger scheme is sensible. The high cost of building DH systems, combined (in the UK) with lack of regulation provides a barrier to the development of schemes, and often limits their scale to one which can be afforded and implemented on a specific site or area. As these smaller schemes can be demonstrated to be viable, and offer benefits to consumers, and as further investment potential is achieved, then further schemes can be developed or connected, gradually increasing the size of the overall scheme. Over time as the scheme nodes are connected, further infilling can take place resulting in very high levels of connection penetration.

## The Carbon Trust 9-step process to delivering heat networks

The graphic below tracks a Local Authorities journey through the various stages required in developing a heat network. The development phase begins with identifying opportunities and securing political buy-in, continues through to the development of technical feasibility and financial viability for prioritised schemes and concludes with the realisation of a robust and detailed delivery model. The final phases are procurement and construction leading to operation.

### District Heating in Leicester

Making reference to the process outlined above the following section details the steps that Leicester City Council went through in realising the development of a city-centre district heating and CHP scheme.

Leicester is the 10th largest city in the UK with a population of 300,000 people. There is a significant presence of public sector buildings in the city centre and close working relationships between Leicester City Council and these organisations. Since 2003 there has been an ambition to develop a city-centre heat network that would link the major heat demands in the centre and therefore provide cheap, reliable and low carbon heat.

### Step 1 - Opportunities Identification and Appraisal

Following a change in political leadership the project was re-energised in 2007 and a detailed study was undertaken which confirmed the potential of utilising existing district heating schemes

### Step 2 senior support and mobilisation

Leicester City Council (LCC) has made the reduction of Leicester's carbon footprint a priority through their One Leicester Strategy. There is a strong climate change strategy and energy planning policy with district energy at its core

A key aim is for "the provision of controllable and reliable warmth to a group of buildings at an affordable price, minimising CO2 emissions and using Combined Heat and Power via a District Heating System".

### Step 3 High level feasibility

LCC commissioned a study to carry out initial heat-mapping, identify the technical feasibility of buildings that could be connected to a city-centre heat network and determine the location of potential energy centres. This allowed them to begin conversations with potential public sector partners and understand any significant technical and organisational barriers that may impact upon the scheme.

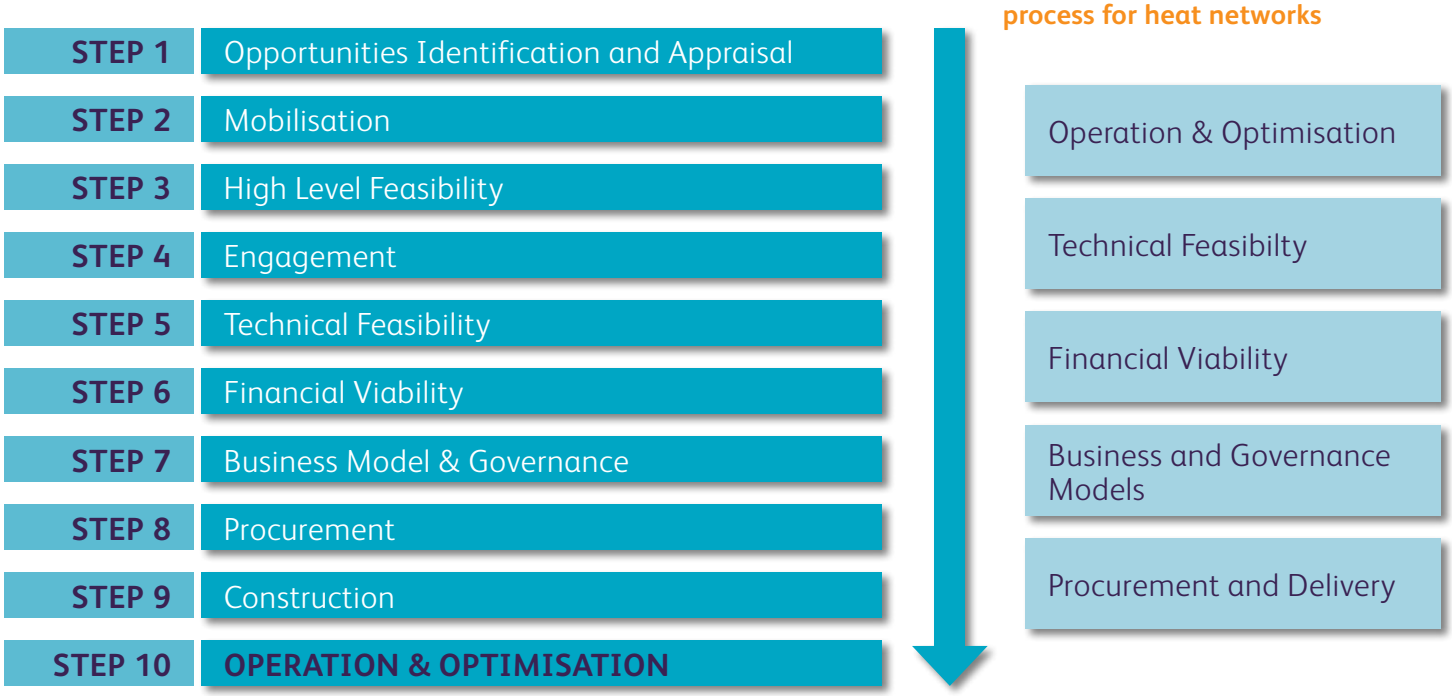
### Step 4 Engagement

LCC were keen to include as many public bodies as possible in the process to ensure scheme size and carbon/cost benefits could be maximised. The Leicester partnership included the Council, the University of Leicester and HMP Leicester.

### Step 5 Technical feasibility

Further technical feasibility work was carried out to validate the initial study, using more accurate consumption data to augment the financial and business case.

**Figure 2 Carbon Trust 9-step process for heat networks**



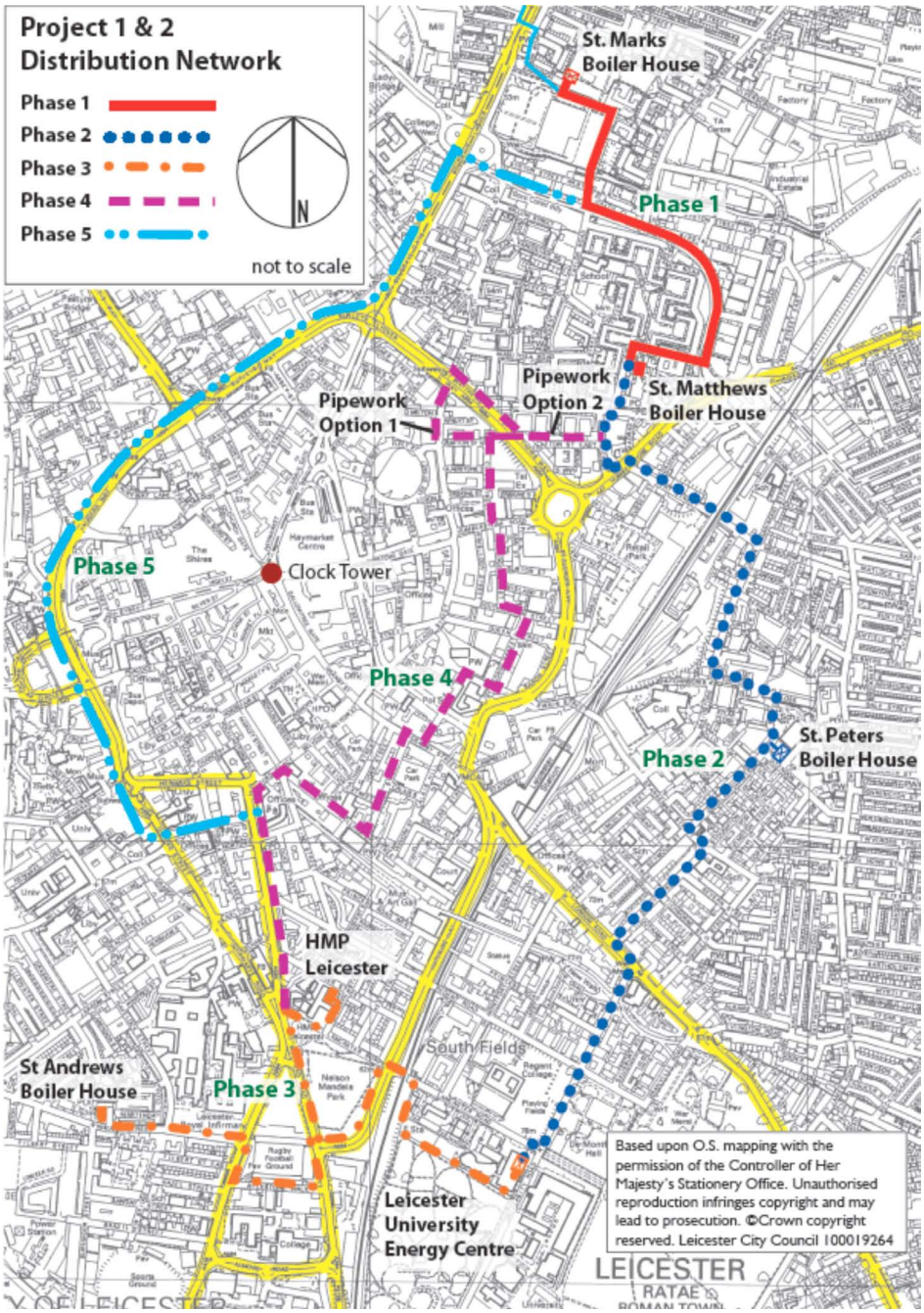



Figure 3: Feasibility study indicative phasing plan for Leicester DH scheme

St Matthew's

Adult Education College

Demontfort Hall

HMP Leicester

New Walk Museum

Leicester Town Hall

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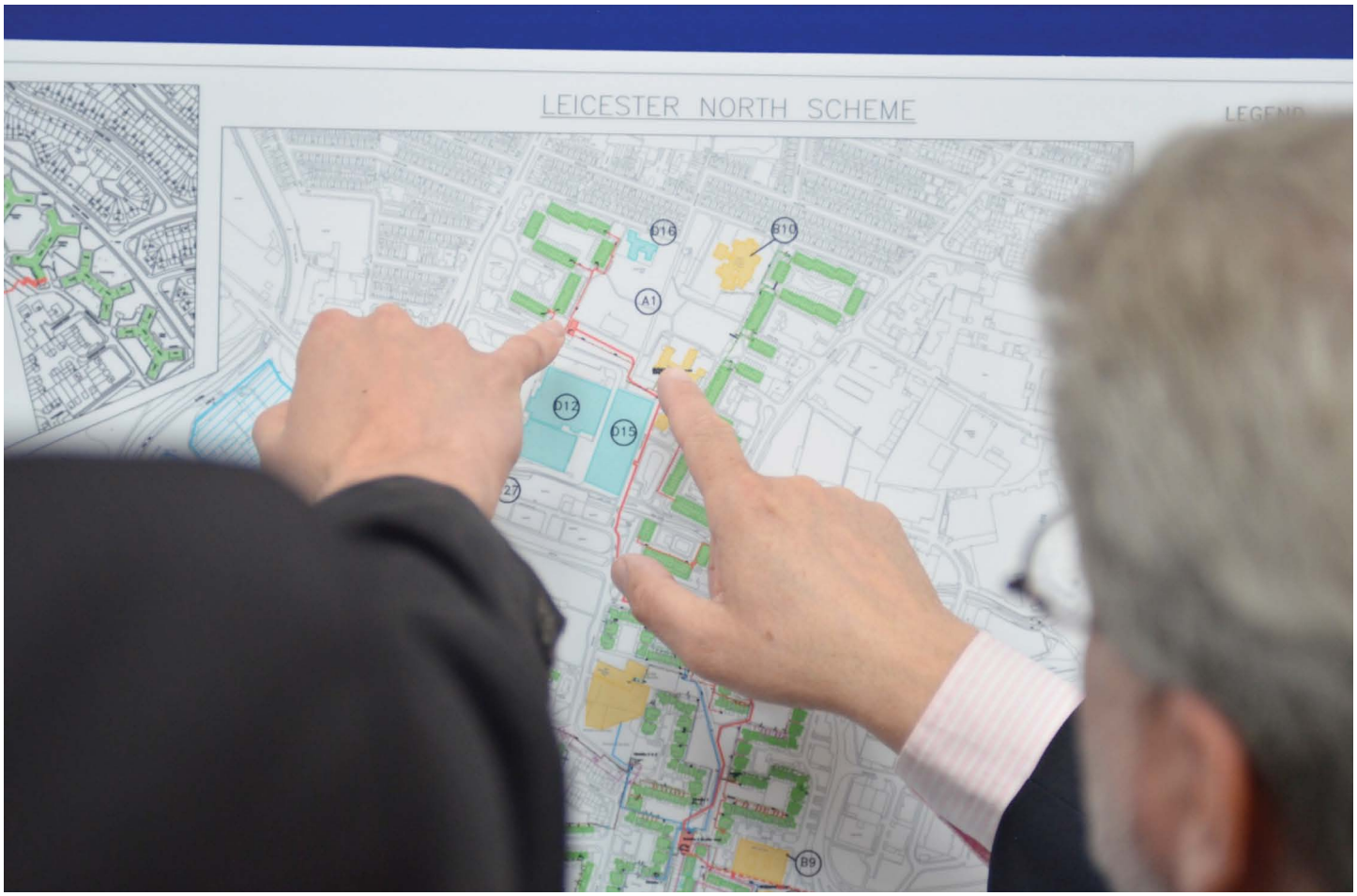



## Step 6 Financial Viability

The business case for the heat network was created giving consideration to the environmental, social and economic benefits. A detailed commercial plan which identified significant potential revenues and gave a promising payback period was determined and provided confidence for the Leicester partnership to progress to procurement.

## Step 7 Business Model & Governance

Financial officers scrutinised the proposals and recommended a third party should provide capital and stand financial risks. This reduced the potential for revenue from the scheme for the Council and devolved control to the chosen partner. However, it was felt that allowing the market to determine an optimum solution through competitive dialogue was preferable to the Council taking on risk.

## Step 8 Procurement

LCC formed a team to take procurement forward, which included a Project Director and a Project Manager. A working group was also created to include Legal, Financial, Technical and Environmental expertise, with Highways, Planning and other departments also consulted

Soft Market Testing ended in 2008 and the competitive dialogue procedure was selected.
The OJEU was issued by LCC as the "enabler" on behalf of the Leicester Partnership in August 2009 and a 12-month dialogue and evaluation process began.

In going to the market at this stage the Leicester partnership set up a number of key criteria for assessment and therefore allowed for private sector innovation. They requested that any heat network solution should provide;

- Affordable and reliable warmth
- Secure and sustainable energy supply
- Significant reduction in CO2 emissions
- Expansion potential
- No investment by LCC or any of the members of the Leicester Partnership
- A mechanism to assess the cost/ benefit of individual residential heat meters
- Confidence in a long-term partner to deliver the agreed solution – both in terms of experience and financial standing

## Step 9 construction

After 12 months of competitive dialogue the Leicester partnership opted for a 25-year energy services agreement with the potential for a 5 year extension to deliver:

- Citywide District Energy Schemes – 6 MWe of CHP and over 16 km of new network
- £15M of private sector investment into the City and adoption of existing assets
- Over 100 GWh of low carbon energy supplies for c.3000 homes, 15 administrative buildings and the University of Leicester
- Whole-life cost savings
- Expansion plans to connect prison, hospital and many other public and private sector buildings.

## Progress so far:

Broke ground 29/06/2011 – plan for 6 MWe gas fired CHP

- Phase 1 - Main works – Start June 2011, finish Summer 2012 - 7 km buried distribution network
- Phase 2 - City Centre Works – Start August 2011, finish Summer 2012 – small amount of biomass
- Phase 3 - University - start July 2011, finish Feb 2012 (OSD Apr 2012) - 3.2 MWe within University campus
- Scheme Operational start dates - July to Nov 2012
- Phases 4&5 - Plans to connect prison, hospital and many other public and private buildings

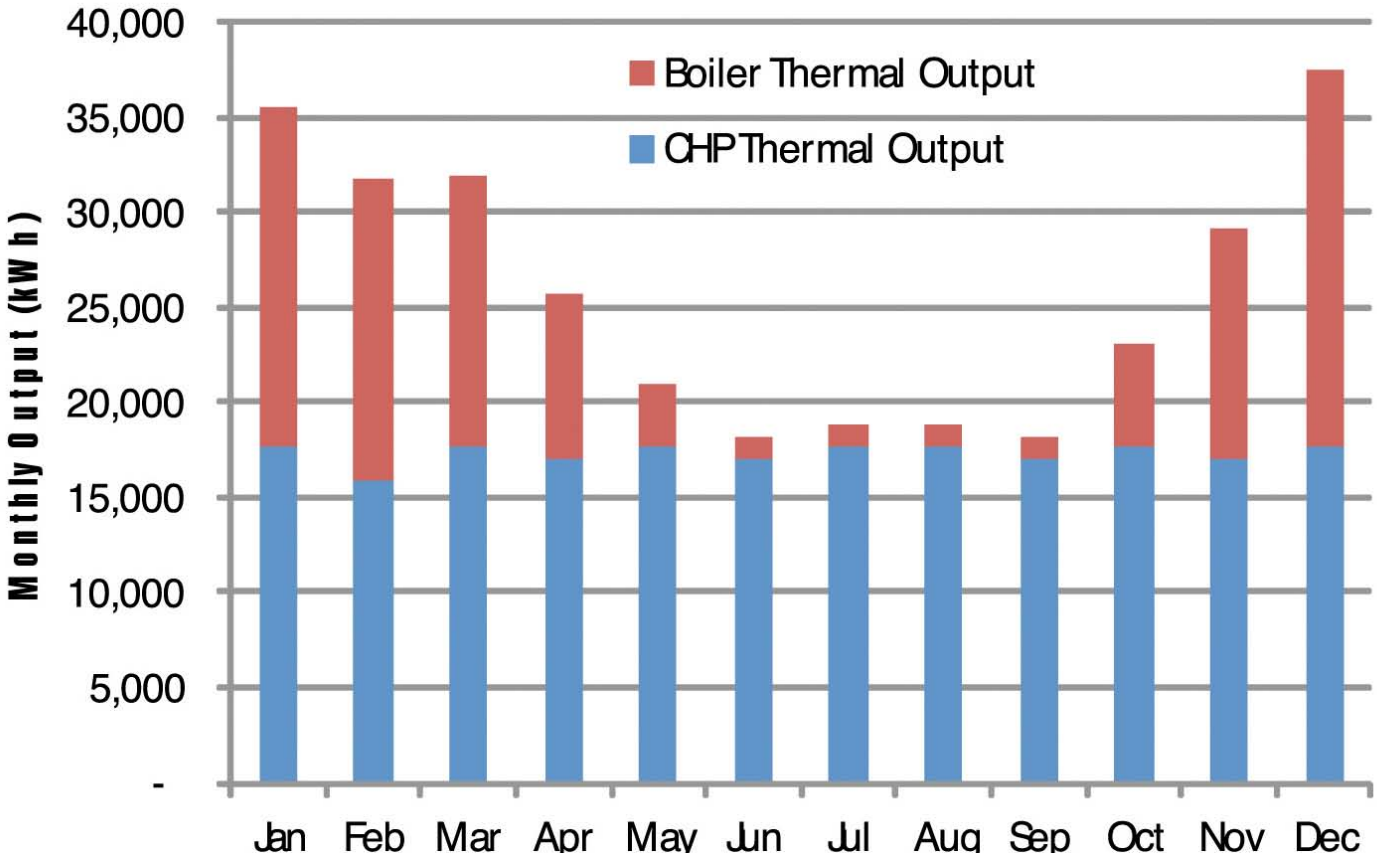
## Key lessons learnt

Political Support essential: Requires a political sponsor and champion
Project Manager: Important to have a dedicated and experienced project manager who is capable of working across council departments
Quality of Data: Competitive dialogue process moving into binding Final Bids means that information supplied to bidders should be good quality and should be checked thoroughly

## Opportunities for expanding District Heating in Leicester

The existence of a DH scheme in Leicester provides further opportunities for expansion, with the end vision of a city wide scheme.

**Figure 5: Monthly thermal load profile for a development of 100 flats. The demand in the summer months consists of hot water demand and this is used as the basis for the CHP sizing.**



The initial DH scheme provides a connection point for future satellite systems which could either connect up front or at a future point. The creation of the Leicester District Energy Company provides expertise in the city and a vehicle for helping to deliver and operate additional schemes.

New development offers one of the best opportunities for developing DH systems. From a policy perspective, planning can be used to help drive the development of systems, and updates to Part L of the Building Regulations are driving lower carbon development which will increase the need for low and zero carbon solutions such as Combined Heat and Power (CHP) and DH.

Economically, DH can be cheaper to install in newer developments by installing the infrastructure alongside the installation of other utilities, and with no disruption to existing areas. The risks of developing DH in new development are also lower, with guaranteed customer connection in speculative development.

Whilst large scale developments are best suited to CHP and DH, the majority of new development is on much smaller less strategic sites. In Leicester there are a number of smaller scale potential development sites around the city, and to represent this, two indicative typologies were selected for analysis:

- **High density city infill** - 100 flats at circa 75 dwellings per hectare.
- **Medium density urban infill** - 300 dwellings formed of 10% flats, 60% terraced housing, 20% semi-detached housing, and 10% detached housing. Densities range from 75 dwellings per hectare to 30 dwellings per hectare.

These sites are generally fairly remote from the existing DH scheme and independent of other new development sites or potential DH anchor loads. They therefore offer the opportunity for developing independent DH systems, but with limited interconnection potential in the early years.

## The application of district heating and CHP to new developments

New developments can provide a number of opportunities for CHP and DH, in particular lower cost pipe work installation, and the ability to optimise the scheme whilst

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masterplanning the site, including allocating a site for the energy centre (the building which houses the central plant). However the low thermal demand of modern development due to improved fabric efficiency driven by Part L means that the overall thermal loads are relatively small and are dominated by hot water during much of the year. This means that CHP scheme is likely to be relatively small, and therefore less cost effective than a larger scheme. Figure 1 shows the monthly load profile for a development of 100 flats, showing how the CHP is sized to operate against the hot water demand.

Technical and economic modelling of the two indicative sites suggests that in smaller developments, gas-fired CHP may be technically viable but the economics are likely to be marginal and alternative lower cost methods of saving CO2 may be preferable if technically viable. The analysis shows that typical developments of the size modelled will only support small scale CHP installations, with corresponding relatively low electrical efficiencies, and relatively high unit costs. Therefore it is important to minimise the distribution network costs by exploring opportunities for distribution within buildings, and careful site layout.

For the 100 unit development (Site 1), the CHP capacity selected is circa 25 kWe, and at this scale there are relatively few engines available. Most of them are designed as microCHP units for operation in applications such as leisure centres or single buildings where minimal additional infrastructure is required. The assumed block of flats with internal pipework is such an application, where the pipework can make use of services ducts and risers required for other services helping to keep the distribution costs low. For this reason, the Site 1 scheme is slightly more economic than the base case - individual gas boilers and photovoltaic (PV) panels to achieve the same CO2 savings - and it demonstrates that gas-fired CHP could be a more economic method of reducing CO2 emissions than PV. PV may not be a suitable alternative means of reducing CO2 anyway, due to the limited available roof area for the panels (assuming a high-rise rather than slab block).

For the larger site of 300 homes, the change to providing a DH network and connections to many individual buildings renders the scheme less economic than the base case of individual gas boilers and PV. The relatively small CHP capacity is unable to generate enough revenue (under the assumptions used) to help recover the capital investment in the heat network.

Whilst the CHP/DH systems are marginal as standalone schemes, they do provide important opportunities for future connection to larger schemes and/or a change in energy generation technology or fuel. In particular for marginal or no additional cost, they provide the future flexibility for connection into a Leicester-wide scheme at much lower cost than a future retrofit of DH, and the presence of small schemes like these across the city could help justify the extension of existing network into these developments and subsequently surrounding areas.

## Recommendations

The analysis of the deployment of CHP/DH at potential new-build housing schemes in Leicester shows that there is potential for the development of smaller DH schemes which can join together to form a larger city-wide scheme in the future. However the marginal economics of the smaller standalone DH networks on new developments means that these long term benefits need to be reinforced and the opportunities for installing DH maximised. The following recommendations have been made for Leicester and are applicable to other towns and cities in a similar position:

- Developers should be required to assess the viability of district heating and CHP. This should be based on the outline design and costing of schemes. This viability assessment should demonstrate the potential for minimising costs, through for example, examining how networks can be installed within buildings, or other low cost routes.
- Neighbouring sites and buildings should be identified and consulted with to explore the opportunities for connecting to, or creating a network with, off-site energy loads.
- The Leicester District Energy Company should be consulted strategically on the potential for involvement in smaller satellite schemes, and also on a development basis for each potential DH scheme.
- Leicester City Council needs to help facilitate discussions between developers and other stakeholders, and work strategically to identify synergies such as neighbouring development sites.

In the case of Leicester, the presence of the Leicester District Energy Company also offers opportunities to assist with the delivery and de-risking of schemes. Having an established energy company enables the use of existing arrangements and services, helping to reduce set-up and administration costs. Other advantages are in the energy purchasing power of the Leicester District Energy Company, and the potential to negotiate attractive electricity revenues. This involvement could also provide a degree of coherence for the long term strategy.

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