

District Heating

Consultation to inform policy framework

Response by Energy Institute – Ireland Branch

General Comments

We have had in the past some relatively large district heating systems in Dublin. In Ballymun a large fossil scheme was installed in the early 1960s to serve the large social housing apartment blocks. Another scheme was installed in the Belfield campus at approximately the same time. The history and experience of both of these large schemes and any other such schemes would be worth investigating from the point of view of learning from this experience in an Irish context. This includes the design, specification, operation and maintenance aspects of these systems.

Many of the distribution difficulties encountered in early DH schemes can be addressed by the use modern “pipe-in-pipe” corrosion free pre-insulated networks and by taking advantage also of modern electronic control and metering technology to optimise the distribution network and match the supply with the varying demand. In this regard the use of inverter controlled motors on pumps is an outstanding asset in distribution systems and a major tool in improving energy efficiency.

The combination of greater dwelling and commercial building density with the higher energy rating of individual new and existing buildings has the potential to make DH schemes viable where they might not otherwise be. Therefore both of these factors should be facilitated and positively encouraged.

Clearly the source of heating and cooling for district networks needs to be either from waste heat or waste cooling sources or from renewable sources such as solar, geothermal or air and ground ambient sources in combination with heat pumps. While full dependence on fossil fuels is ruled out the use of smaller amounts of fossil fuels in combination with waste heat or a heat pump scheme should not be ruled out. Such use has a role where waste heat or heat pump boosted heat serves the major base load at lower temperatures while fossil fuels may be used to raise the temperature of the network to serve the peak load, intermittently. A fossil fuel fired CHP system may also be used in this regard with the higher temperature waste heat from the CHP system being used to raise the network temperature to its design peak while part of the power generated in the CHP engine is used to offset the power consumption of pumps and other plant associated with the scheme.

The use of rivers, lakes, canals and the sea as a source of heat in Ireland has obvious advantages. Such heat recovered at low temperature can be raised to viable temperatures using a heat pump compressor – generally supplied from renewable power (i.e. wind) or CHP source. The potential here is vast. For example the Shannon river at Ardnacrusha/Killaloe has an average flow rate of 180 m³/s. Reducing the temperature of 25% of this river water by as little as 2°C in a heat pump would yield a heat source of at least 380 MW (ignoring heat of compression). This is sufficient to heat approximately 30,000 dwellings with a BER rating of A to C. However apart from upgrading the energy rating of such dwellings to the A to C level the domestic heating systems would have to be designed to use effectively the lower supply water temperatures associated with heat pumps (35-50°C) and probably also including some use of fossil fuel or direct electric power at the main plant to raise the supply water temperature during times of peak load.

An interesting application for waste heat has arisen recently. A couple of proposed data centres could not be supplied with electrical power in the quantity required from the local power grid. There was however sufficient gas in the local gas grid to generate the power locally. In this situation a CHP plant provides an opportunity for a district heating network, proximate to the data centre and supplied from the surplus heat generated by the CHP plant. As data centres generally have high heat dissipation requirements throughout the year they are unlikely to be able to make full use of the surplus heat generated themselves. This is also an argument for siting data centres or other suitable facilities that generate surplus heat, close to centres which have a demand for heat either in domestic, commercial or industrial applications.

Response to Questions

Research

Q1: What additional research do you think needs to be carried out?

Heat for district heating which is generated by heat pump technology should be considered. The vapour compressor of the refrigeration system can be driven by electricity from renewable sources. In this case the heating can be considered renewable. The common sources of such heat in Ireland are ambient air and the ground. However in Ireland particularly, we should also consider the abundant surface water heat sources – such as the sea, rivers, canals and lakes. Such heat pump systems are generally appropriate to large scale development and would, therefore, be appropriate to a district heating application. They are known as surface water source heat pumps (SWSHP). It is desirable that a research project be undertaken into the potential of this source in Ireland. Such systems have a number of advantages over the traditional air and ground sources. These include (i) the specific heat of water is vastly greater than air (ii) heat is more readily extracted from water than from the ground (iii) the energy used in extraction is likely to be substantially less than with air and the ground and (iv) ambient water sources are generally somewhat warmer at times of high heat demand (Winter evenings) than the ground or the air, which improves the COP or energy efficiency rating. (for UK work on this heat source see *CP2 Surface water source heat pumps : Code of Practice for the UK, Harnessing energy from the sea, rivers, canals, and lakes, CIBSE, HPA, GSHPA 2016* – note the total heat capacity maps produced for rivers in the UK).

Other aspects that that could be considered for research include (i) potential for heat from waste incineration in other Irish cities – other than Dublin (ii) survey of existing industrial/commercial waste heat sources in Ireland that may have capacity for DH contribution (including data centres) (iii) the potential for electric boilers - fuelled from renewable power – as a district heat source (including a possible role in absorbing surplus renewable power as an alternative to supply shedding).

Virtually all domestic and many commercial heating systems installed in urban Ireland up to recent times are designed to use low pressure hot water supplied at a standard 82°C and returning at 70°C and generated in gas or oil boilers. Renewable heat from heat pumps and other lower temperature sources is typically available at 35-50°C, returning at approximately 10°C below these supply temperatures. Most future heating systems will have to be designed to operate effectively at these greatly reduced temperatures if advantage is to be taken of heat pumps and other low temperature sources. This requirement would benefit greatly from research into this situation with a view to providing national guidance and recommendations, underpinned by high quality analysis and investigation, all in the context of the Irish climate. The research could cover the likely performance (including energy performance) in the Irish context of (i) underfloor heating (ii) new low temperature radiators (iii) convectors (iv) hot air systems (v) response and effectiveness of controls. This work would support the development of district heating networks and more generally the development of renewable heat sources for domestic and other heating systems.

Q2: How should research be used to inform the development of district heating in Ireland?

In addition to potential case studies research could be conducted on how the few existing DH systems are performing. This should be based on known measured performance data from the data logged management system. If such a system does not exist, or is not sufficiently extensive, funding the installation of such a system should be considered. Of particular interest would be (i) the energy efficiency of the system (ii) the pattern of total heat demand and its relationship with the external ambient conditions (iii) the diversity in demand (iv) the reliability of the system and (v) the performance of the control, monitoring and metering systems.

Q3: Are there relevant existing research projects into district heating, in the Irish context, which are not referenced in this document?

Not that we know of.

Q4: Can further research contribute to encouraging areas of compact urban growth to develop district heating projects?

Research could be conducted into the potential for district cooling networks in Ireland. Such potential is likely to be highest in districts with multi-storey, high density commercial buildings (offices, retail, hotels and leisure). The potential of the Financial Services District in the North and South Docklands is an obvious example but there are others also such as the Sandyford Industrial Estate.

The current requirement for high levels of building fabric insulation is reducing heat demand and shortening the length of the heating season (currently typically November to April). However this measure if not fully considered and provided for can reduce the ability of the building to dissipate heat gain in the warmer months and hence increase the length of the cooling season, or introduce a cooling season that did not previously exist.

Where the source of heat in a DH system is a water source heat pump the potential exists to supply both heating and cooling from the same plant. This requires two separate networks. In theory a single network can supply both heating and cooling at distinct times. However, this is more likely to be successful in a continental climate with clear and distinct seasons, rather than with the heavily recidivist climate tendency experienced in Ireland.

Regulation

Q5: What elements of Article 24 of the recast Renewable Energy Directive should be implemented in the near term (i.e., by the mid-2021 transposition deadline)?

Q6: What elements of Article 24 of the recast Renewable Energy Directive should be implemented in the medium term (i.e., by 2025)?

Q7: Who should have the right to own the district heating networks?

The local authority is the obvious party. However given the likely relatively small population which would be served and the associated relatively small number of schemes other arrangements might be more viable and more effective. There would clearly be a requirement to develop and retain substantial expertise in the field, which might not be viable for all or many local authorities. A compact single national body (such as with Irish Water) might be more appropriate, more viable and effective in building up experience and expertise in a developing field. The owner of the network does not necessarily have to operate and maintain it, in fact it might be preferable to operate the system by means of a fixed term commercial contract.

Q8: Should there be a district heating market regulator?

Q9: Should there be guidelines / Codes of Practice around district heating and if so, who should be responsible for their development and implementation?

Yes. The network would presumably be installed as one of the possible external utilities for new and existing developments in the area. In order to connect developments successfully to an existing network and to facilitate uniformity in the technology there would have to be agreed standards/codes governing system components, layout, and particularly capacity and supply and return temperatures. Such codes could draw on and refer to existing codes internationally (particularly Scandinavian), as appropriate, without necessarily duplicating them. The proposed national body would clearly have a central role in developing codes and guidelines.

Planning

Q10: What changes, if any are required to existing planning and building regulations to support DH ... in particular to support high density development...?

Higher density and higher rise development is required in the many newly developing areas in Irish cities. Clearly this has to be appropriate and it is more appropriate in a “new town” context than in an area of existing architectural and planning conservation. The population of greater Dublin is similar to that of Munich, yet it covers a land area of approximately three times that of Munich.

Q11: Is there potential for the revised Building Regulations to act as a driver for district heating?

The drive to decarbonise the heating and cooling sector would be facilitated by heating and cooling district networks. The scale of such networks facilitates the viability of high quality staffing, maintenance, operation and control and therefore energy efficiency in a way that is not always possible with small, independent plant and systems. Flexibility to change and develop heating and cooling sources is also facilitated. Local diversity in load patterns between building types served from the same network (for example between office buildings and hotels) can be used to advantage by employing inverter controlled pumps and scheduling plant output to match the demand and the operating parameters. The requirement in the Building Regulations to achieve energy efficiency can be served by cooling and heating district networks with a requirement to analyse this option for new developments, where such networks are available.

Q12: Given the importance of the public sector taking a lead role in developing DH in Ireland ... what if any additional powers are required by local authorities ... to develop and operate DH networks.

See response to Q7 above.

Financing

Q13: What sources of finance are currently available to the Irish DH market?

Q14: What are the most appropriate financing mechanisms for developing DH in Ireland?

Q15: What are the most appropriate business delivery models for the Irish context?

Q16: In addition to those listed above what are the other main challenges to raising non exchequer finance...

Q17: Other than providing direct exchequer funding what incentives might Government consider ... to drive the development of DH.

We would support the suggestion that major energy users be allowed to offset their carbon taxes on energy demand by supplying waste heat to local communities.