

# Dublin Waste to Energy Project

## Brief of Evidence in relation to District Heating (Olivier Galliot, RPS Consulting)

### **Qualifications**

I am a qualified Engineer from the French National College of Toulouse with over 10 years experience in waste and energy projects. Currently, I work as an Associate with RPS Consulting Engineers, having joined them in 2004. Previously, I worked in consultancy in France investigating the potential of Combined Heat and Power (CHP) and biomass. Since joining RPS, the projects in which I have been involved include the Dublin Waste to Energy (WTE) project, the UK DEFRA new technologies assessment and the Review of the National Hazardous Waste Management Plan for the EPA. I took over as project manager for the Dublin District Heating Project 18 months ago.

### **Purpose of brief**

This brief is provided in response to submissions which state that the proposals for the implementation of District Heating in Dublin are unrealistic and for that reason, should not be mentioned in the EIS as a further potential means by which energy can be recovered from the Waste to Energy (WTE) facility that is proposed at Poolbeg. The purpose of the application to the board is not to establish the feasibility of the Dublin District Heating Project, but merely to demonstrate that feasibility studies in relation to the Project are at an advanced stage and that, on the basis of the work completed to date, the proposal to develop District Heating in Dublin is both realistic and feasible. Unfortunately, as District Heating is still at an early stage, many of the reports mentioned in this brief are not yet publicly available.

### **An introduction to the concept of District Heating**

District heating (DH) has the potential to become a new energy utility in Dublin similar to gas or electricity. Simply put, it will use water as the transport medium for heat and will involve circulating hot water in a large network through supply and return piping. In this way, competitively priced heat can be delivered to residential, commercial and institutional consumers.

District heating is a familiar and successful concept in Europe and is well developed in a number of countries including Denmark where its high up-take is demonstrated by the fact that 60% of heated floor areas are connected to District Heating. Furthermore, a large number of centralised heating plants (most of which are CHP plants) are connected to district heating networks throughout Denmark. For example, the district heating system of Aarhus, extends 50km beyond the main power station and comprises approximately 120km of major transmission lines and approximately 1,700km distribution lines, serving more than 275,000 inhabitants as well as offices, institutions, industries etc.. The annual heat production in 2004 was 3,000,000 MWh.

District heating has also been successfully implemented in the UK and a good example of one of the largest networks is the Sheffield District Heating network. This network delivers heat to buildings in Sheffield via 43km of pipeline which has been installed throughout the city. One of the pipelines, which is approximately 31km in length delivers heat to the city centre and to the Northern and Western parts of the City. The complete network consumes 135,000MWh annually.

By way of final example, since 1990 district heating has been successfully developed in Turin, Italy and is currently being extended to the city centre area.

In terms of realising the potential of District Heating in Ireland, a report commissioned by Sustainable Energy Ireland (SEI) ("The Barriers and Opportunities for District Heating in Ireland" (2002)) pointed out that the success of district heating in a given area would depend on there being a 'project

champion' to drive the project. This is true of most (if not all) district heating networks, and in many cases, the local authority provides this leadership.

Dublin City Council has recognised that it can use its position to achieve the implementation of a district heating network in the City and to this end; it appointed RPS and COWI (a Danish consultancy company) in 2003, to examine the potential for district heating in Dublin. A two-fold approach was taken as follows:

1. Take the best from Danish technical experience with district heating and apply this to the Irish situation.
2. Proactively approach developers and potential heat sources in the Dublin area with the view to explaining the benefits of district heating to the public, and to encouraging developers to consider district heating for their developments.

## **Background to District Heating in Ireland**

The potential for district heating in Ireland has been available for a long time.

The ESB examined the feasibility of district heating in the Dublin Area during 1981/1982. Whilst the outcome of this feasibility study did not ultimately result in the development of any district heating capacity in the City its findings were positively disposed to District Heating. However, at that time, the relatively inexpensive fuel costs meant that there was no compelling reason to implement district heating in Ireland.

The current energy situation in Dublin differs from that of the early 1980's in a number of important respects and it is in this context that Dublin City Council decided to investigate the potential of district heating. The relevant factors which influenced its decision are as follows:

- Energy prices have reached very high levels and are expected to continue on an upward trend.
- Dublin City has the size and concentration of large buildings to host a large district heating system. Despite the mild Irish climate, heating is necessary for several months of the year and domestic hot water is needed year round. In addition, there is a demand for cooling of hotels, offices and shopping malls during the summer season.
- The Dublin Docklands is an area of extensive development. The Dublin Docklands Development Authority is undertaking a massive programme of social, economic and physical regeneration in the area. The regeneration and growth of the docklands area will continue for at least another decade. The development is based on a Master Plan launched in 1997 and subsequently updated in 2003. The 15-year project will result in the population of the Docklands increasing by 25,000 to 42,500 by the year 2012 and the construction of more than 11,000 new homes. It will also create up to 40,000 new jobs. This scale of development and the increase in population density provides district heating with a large potential heat market and the necessary heat market for the initial phase of a citywide utility.
- The increasing number of people who are experiencing fuel poverty (17% of Ireland unable to afford the basic fuel requirement). District heating can be a competitive source of heat that is less susceptible to increases in the price of oil or gas. District heating is therefore a concept that is especially compatible with social housing developments.
- The compatibility of district heating with the Government's national objectives in terms of energy efficiency, security of supply, sustainability and competitiveness.
- Global warming is now an accepted reality that compels us all to reduce our emissions of greenhouse gases. District heating offers an effective means of reducing carbon emissions by being connected to CHP generation. This has been highlighted further in:

- The National commitment to reduce emissions of greenhouse gases including emissions of carbon dioxide. Ireland's Climate Change Strategy (2007) encapsulates our commitments and objectives in this regard.
- The Irish National Allocation Plan for CO<sub>2</sub> emissions (first tranche 2004 – 2007) now places responsibilities on emitters of carbon emissions – including power stations – to reduce their outputs, with fines imposed where they do not meet targets. This is a new development in the energy sector that will intensify efforts to reduce carbon emissions. One way in which power stations could reduce their outputs is through the supply of heat that would otherwise go to waste to district heating networks.
- The recent Energy Performance of Buildings Directive, which will affect in Ireland new and existing buildings from 2007, introduces a new system whereby buildings heated using district heating will have a higher energy rating than conventionally heated buildings. This means that developers and purchasers alike will see a tangible value in more energy efficient buildings.
- The commissioning by Sustainable Energy Ireland (SEI), of a report concerning “The Barriers and Opportunities for District Heating in Ireland” demonstrated an expression of a national strategic interest in developing CHP and district heating capacity in Ireland.
- The Dublin Docklands Master Plan (2003) also recognises the contribution to sustainable energy that CHP and the proposed WTE facility at Poolbeg can make. The opportunity to recover waste heat from utilities on the Poolbeg peninsula for meeting local heating needs via a proposed district heating network is specifically mentioned. It is also recognised that the network will be relevant as a source of heat to the entire Docklands Area and that developments would be ideally located to benefit from the system if it is built. The Dublin Docklands Development Authority (DDDA) state that all development proposals should “seek to achieve the highest levels of energy efficiency” following “established principles of green design which seek to reduce energy loss”. Combined heat and power is also supported by the DDDA who will encourage its provision in the Docklands Area.

### **Feasibility of the Dublin District Heating Project**

Dublin City Council, through their consultants RPS and COWI have been assessing the feasibility of and promoting the development of a District Heating Network in Dublin City in its own right since 2003. A large body of work has been completed for Dublin City Council since this time for the planning and development of district heating in the City.

In 2002, a feasibility study (“District Heating Feasibility Study for the Dublin Docklands Area”) concerning the potential for the use of District Heating in the Dublin Docklands Area was carried out. Although this study was never published it confirmed that a district heating scheme in the Docklands Area was feasible because of the high building and heat load density of the area. For the purposes of investigating the potential for a citywide district heating network, Dublin City Council visited the following district heating systems in Denmark and the UK in 2003:

- Sheffield WTE and District Heating system (operated by IPODEC in cooperation with Sheffield City Council)
- The Southampton City Geothermal and CHP Scheme (operated by IDEX / Utilicom)
- Copenhagen (Vestforbraending) WTE facility and district heating system

These visits demonstrated that district heating worked well and was economically feasible.

In 2006, the feasibility of installing a district heating network in the Dublin Docklands Area was updated to take into account new developments in Dublin City and the increase in energy prices. Like its 2002 predecessor, this study is unpublished. The study was based on a district heating network providing 88,000 MWh of heat to 939,000 square metres of mixed used developments at a price that

was competitive in comparison to natural gas supply. Based on the results of this feasibility study, it was recommended that Dublin City Council continues with plans to establish a district heating supply serving the Dublin Docklands Area.

As a result of positive interest from an Energy Management Company and developers, Dublin City Council has recently requested that RPS undertake a feasibility study on the potential for the implementation of a Citywide District Heating network. A funding application was made to SEI in October 2006 seeking support to carry out this work. This application was successful and funding was granted by SEI in January 2007. As a result, work on this project is currently in progress. However, preliminary results on the feasibility of a citywide project are positive.

### **Proposed Implementation Programme**

The Dublin District Heating Project will be carried out in phases, starting with a local network based on individual gas-fired boilers in the Dublin Docklands Area. Dublin City Council has in principal, already secured the agreement of one of the largest development in the Docklands Area (Spencer Dock) that they will be connected to the district heating network, proving that such a demand exists and indicating huge potential for the roll out of the district heating network.

In the future, it is envisaged that the network will be further extended to serve new and existing developments in the Docklands Area and further areas outside the Docklands area potentially including amongst others Westgate, Dolphin's Barn, Grangegorman and Merrion. Also, additional heat suppliers such as for example, the power stations in Poolbeg, the CHP facility at the Guinness brewery and other smaller heat producers will be connected to the network in order to increase the heat supply.

### **Technical and Operational Aspects of District Heating**

During the process of electricity generation, heat is produced as a by product of the combustion process. At present, this heat energy is not utilised and is effectively a waste product. However, it is possible for this heat to be transferred from the combustion flue gas to water, producing steam in the process. This steam can then be circulated in a heat exchanger to increase the temperature of water, which can then be distributed into the pipelines which form part of a district heating network.

The pipelines into which the heated water flows, are part of an insulated 'dual pipe system' (supply and return sides) that allows heat / hot water to flow to and from consumer premises. In such a system, operating temperatures of 80°C to 120°C (supply) and 40°C to 60°C (return) are typical. Although in Ireland and the UK, conventional water based heating systems typically operate with supply / return temperatures of 90°C / 70°C any water-based central heating system can be designed / adapted to operate within the higher water temperature parameters of the proposed district heating system.

Similar block heating systems, which are compatible with the district heating system outlined above, are currently in operation or under construction for the following developments:

- Dublin City Council network currently serves the needs of the Civic Offices, and provides heat to three hotels, a hostel and both private and social housing.
- Spencer Dock, Elm Park and Heuston South Quarter, the Point Village networks are under construction or in design.

In terms of technical specifications that will be directly relevant to consumer satisfaction, the district heating system proposed will include features such as individual billing and user control. Further, the system will be technologically up-to-date and capable of delivering a similar or better level of quality than existing alternative heating options. Technical specifications and general conditions for the supply of district heating to consumers have been developed by RPS / COWI on behalf of Dublin City Council. These are summarised in an information brochure, which was produced for issue to developers and other interested parties during 2003.

It is proposed that a District Heating Company be appointed to run the system. Dublin City Council published a Periodic Indicative Notice (PIN) during April, 2003 as a market sounding exercise to explore interest from the industry in becoming involved in the running and development of a new district heating system in Dublin. A number of positive responses from Ireland (e.g. Fingleton & White) and abroad (e.g. Vital Energy) were received and reported on by RPS in June 2003.

**Heat Supply Providers**

An advantage that a fully connected district heating network will have over other utilities is that it will lead to greater flexibility in terms of what primary fuel source is used because it can be connected to a variety of heat sources. This means that conventional power stations, existing Combined Heat and Power (CHP) plants, oil fired boilers / generators and solid fuel units (potentially including biomass/ wood pellets or waste) could all contribute to heating the system.

RPS has examined the possibilities for utilising and connecting existing sources of heat to a future district heating network in the City. In the course of doing so, the major CHP plants and heat sources in the City have been identified. These are illustrated in in Figure 2.



**Figure 1: Potential Sources of Heat in Dublin City**

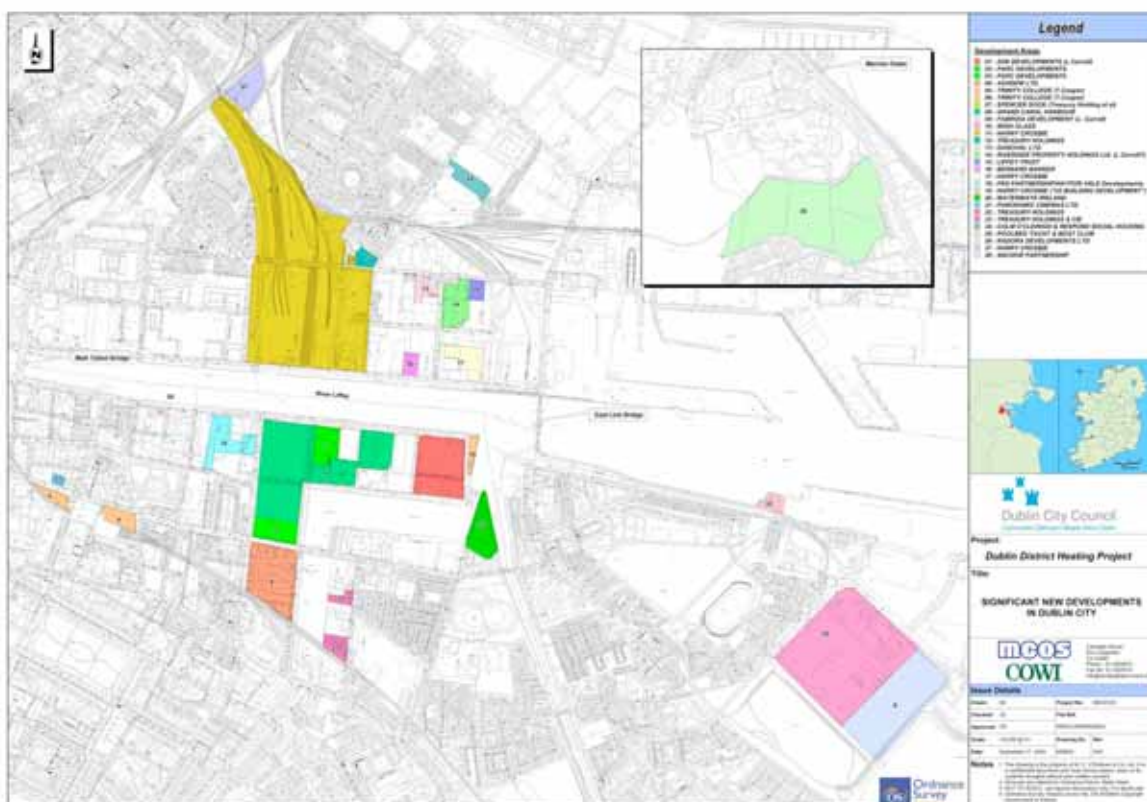
**Progress with Developers**

A key objective of the Dublin District Heating project has been to identify large new build developments which are most suited to the implementation of district heating in the City. The Docklands Area has been identified as one such area and has been targeted for the initial development of the district heating network for the following reasons:

- New developments in the area can be designed for district heating from inception – this is a huge advantage and the key to establishing this new utility.

- Combined heat and power is also supported by the DDDA who will encourage its provision in the Docklands Area. The Dublin Docklands Master Plan (2003) state that all development proposals should “seek to achieve the highest levels of energy efficiency” following “established principles of green design which seek to reduce energy loss”.
- The Dublin Docklands Master Plan sets out a detailed plan for mixed-use development and will, when completed, assist in the regeneration of the area providing significant employment opportunities and economic activity. The mixed-use nature of the area will provide a balanced heat load improving the economic and environmental benefits for the development of a district heating network.

To assist in the process of targeting suitable new build developments, RPS / COWI met with Senior Dublin City Planners (North and South) during 2003 to explain the objectives of the Dublin District Heating Project and to learn of forthcoming plans and developments in the Dublin Region. A map of target areas shown below in **Figure 1** was prepared, with the main focus being the Dublin Docklands Area.



**Figure 2: Significant Developments in the Dublin Docklands**

Since then, the approach taken has been to contact relevant developers at the earliest stage possible, and to provide them with as much information about District Heating as they need.

A brochure entitled “District Heating for Dublin” was produced for this purpose and has been issued to many developers in the City. Presentations on district heating have also been made to developers. As a result of these initiatives, detailed discussions have taken place with respect to two large building schemes in the City and early discussions have occurred with other developers, some of whom intend to develop sites in the Ringsend / Poolbeg area.

Dublin City Council has already been successful in ensuring that a number of high-density new-build developments at Spencer Dock will be designed to be compatible with the future roll-out of the district heating system in Dublin. The Spencer Dock development in the Dublin Docklands Area will comprise over 900 apartments and a number of large-scale office and retail developments. The potential heat

consumption (45,000 MWh) of this development will contribute to the successful implementation of district heating in Dublin.

Once established in this key development, RPS and Dublin City Council are confident that district heating can be propagated further and eventually connected with other future district heating compatible developments in Dublin. Spencer Dock is now under construction and the initial customer connections and a partial network are being installed in 2007 to prepare for future supply by the District Heating network. Existing large heat users in the area have also been identified and contacted with a view to discussing current operating parameters and the potential for connecting to the future DH network.

The district heating system envisaged by Dublin City Council will be capable of supplying heat to older developments and buildings in the Docklands area. However, because of practical considerations, these connections are only likely to be made when existing equipment is replaced and when the option of an existing district heating network is locally available.

A further development which has increased the interest of developers in District Heating is the implementation of the Energy Performance of Buildings Directive (EPBD). The objective of the EPBD is to increase the energy efficiency of the households and the tertiary sectors by focussing on measures to improve energy efficiency within the building, to increase energy conservation at the building envelope and on ensuring that the most sustainable and secure sources of energy for the building are utilised. Article 5 of the Directive requires the consideration of the following energy supply systems, for every building with a useful floor area of over 1,000m<sup>2</sup>:

- Decentralised energy supply systems based on renewable energy (the WTE Plant would qualify here)
- Combined Heat and Power (CHP)
- District or block heating or cooling (if available)

According to the Directive, the positive influence of the above systems will also be taken into account in the calculation of energy performance of buildings. The certificates that will arise from such performance calculations are expected to have an influence on the value of buildings.

By utilising the most energy efficient methods available at this early stage, new developments can avoid costly retro-fit and renovation expenses associated with energy efficiency requirements. Therefore, both developers and building owners can benefit now from being EPBD compliant and in seeking more sustainable energy solutions including district heating.

Finally, Dublin City Council has informed its planners and the City of Dublin Energy Management Agency (CODEMA) of the proposed district heating system. A presentation on the project was delivered at CODEMA's seminar on 19<sup>th</sup> October, 2006 attended by the Dublin City Council's Chief Planner Mr Dick Gleeson. With an energy management plan for the City under development by CODEMA, implementation of the Energy Performance in Buildings Directive in 2007, Kyoto targets for greenhouse gas emissions and rising energy costs, there is now greater impetus for the development of district heating than ever before.

## **Environmental Aspects**

A fully rolled out district heating network in Dublin will offer substantial CO<sub>2</sub> savings on an ongoing basis. In Combined Heat and Power (CHP) mode, heat supplied can replace conventional energy sources with only a relatively minor reduction of electrical power output. Every kWh of heat replaced by district heating represents a saving of natural resources and a reduction in carbon dioxide (CO<sub>2</sub>) emissions – otherwise much of this energy would be lost. District heating can therefore play a significant role in contributing to meeting Ireland's commitments under the Kyoto Protocol. When practiced on a large scale such as in Dublin, the benefits of district heating are correspondingly increased.

In the Dublin Docklands Area alone, it has been calculated that power production and district heating supplied with heat from the proposed WTE project could save over 150,000 tonnes of CO<sub>2</sub><sup>1</sup>.

### **District Heating and the Proposed Waste to Energy Project**

Dublin City Council proposes to develop a WTE facility at Poolbeg. The proposed facility in power mode only will generate approximately 60 MW<sub>e</sub>, but operated in Combined Heat and Power (CHP) mode, it will become a source of inexpensive heat for the district heating system supplying up to 150MW<sub>th</sub>. This means that at full CHP mode the WTE facility could provide heat up to 60,000 households.

The recently published *National Climate Change Strategy 2007-2012* states: "In the current process of revising the Waste Framework Directive (2006/12/EC), the European Commission is considering mechanisms, which would encourage waste to energy plants to increase efficiency to a level comparable to conventional power plants, thereby allowing the energy within the waste to be transformed into electricity and heat for beneficial use in accordance with Best Available Techniques. The government supports this approach, in the context of the waste hierarchy, which will minimise climate impacts through the sustainable management of waste".

By supplying heat to district heating, the energy recovery rates at the WTE plant could potentially increase to 80-85%, which would be superior to the traditional power plants (30-40%) and even superior to the more modern Combined Cycle Gas Turbine (55%).

With respect to the operation of the WTE facility in CHP mode, the connection of the facility to the district heating network will also reduce the requirement to discharge cooling water to the Liffey River, as some of the excess heat will be exported by the district heating system. It is expected that the quantity of water required for cooling will decrease with the increase use of heat from the WTE in the district heating system (e.g. for a heat production of 50MW<sub>th</sub>, the quantity required for water cooling would be reduced by 33%, this could increase to over 90% if 150 MW<sub>th</sub> are produced by the WTE).

Finally, given that the primary source of the heat energy produced will be waste, it would reduce Dublin City's reliance on imported fuel.

### **Conclusion**

In conclusion, I believe that it is realistic to assume that district heating can take its place in Dublin as a modern competitively priced utility and that when implemented, it will provide the most cost-effective and environmentally sustainable utility option for the City.

My opinion is based upon the fact that all work undertaken in respect of the project to date, indicates that District Heating is technically, economically and environmentally feasible in Dublin.

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<sup>1</sup> Dr Ed Porter, AWN Consulting. Calculations based only on 90 MW<sub>th</sub> heat output and 50 MW<sub>e</sub> from the WTE