

**Resident Opinion on the use of  
Waste Process Heat for District  
Heating in Neath Port Talbot,  
Wales**

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## **Abstract**

District heating can recycle waste heat generated from industrial production processes and use it to provide local buildings with heating and hot water. By recycling waste heat, district heating can reduce greenhouse gas (GHG) emissions from the heating sector and lower the cost of energy bills for consumers.

In Neath Port Talbot in Wales, the Council is investigating the possibility of implementing a district heating scheme in the local area which uses waste process heat from Corus, a local integrated steelworks, to meet local residential and commercial heat demand. Neath Port Talbot Borough Council and Corus are attempting to secure funding from the European Regional Development Fund (ERDF) in order to proceed with the scheme.

In order to inform the planning process, this study investigated residents' opinions of the proposal to implement a district heating scheme in the local area, which makes use of waste process heat from Corus to provide local buildings with heating and hot water using. Postal questionnaires were distributed to 3000 Neath Port Talbot residences and 312 responses were received. Quantitative analysis of the data was used to discern participants' opinions of the proposed development.

The findings show that resident opinion of the proposal is largely positive and there is a high willingness to accept district heating among Neath Port Talbot residents, which is likely to facilitate, rather than impede the planning process.

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## **Declaration**

No portion of the work referred to in the dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

## CHAPTER 1: INTRODUCTION

### 1.1 Background

The UK process industry includes a large and diverse range of manufacturing sectors such as the steel, biotechnology, petrochemical, pharmaceutical, polymer, plastic and commodity chemical industries. As a result of their production processes, these industries produce large amounts of waste heat each year. District heating can make use of this heat by distributing it to nearby residential, commercial and public buildings in order to meet local demand for heating and hot water. By recycling the waste heat from process industries, district heating can reduce the need to burn fossil fuels in order to provide buildings with heating and hot water (Werner, 2004) and can therefore reduce greenhouse gas (GHG) emissions from the heating sector and lower the cost of energy bills for consumers.

District heating is common in many European countries and supplies a substantial proportion of the total heat demand in some countries such as Denmark and Finland; approximately 60% and 49% respectively. However, it has achieved limited uptake in the United Kingdom (UK) where it currently provides approximately only 2% of the total heat demand (Davies and Woods, 2009).

However, in recent years, interest in the development of waste heat fuelled district heating schemes within the UK has increased. In order to contribute to international action to mitigate global climate change, the UK has made a commitment to reduce national GHG emissions by 34% by 2020 (as part of the European Union (EU) target to reduce GHG emissions by 20% by 2020), and 80% by 2050, from 1990 baseline levels (Foxon *et al.*, 2010). The UK Low Carbon Transition Plan (2009) identified that in order to achieve such ambitious targets, emissions reductions would need to be made in every sector. Notable policy documents such as Warm Homes, Greener Homes: A Strategy for Household Energy Management (HM Government, 2010) and the Heat and Energy Saving Strategy (HM Government, 2009b) have identified the

contribution that district heating could make to reducing GHG emissions from the heating sector.

However, any proposal to implement a district heating scheme within a local area should take into consideration the opinions of the local residents that it will affect. To the researcher's knowledge, no study has to date investigated resident opinion on the use of waste process heat for district heating in a UK context, either where waste process heat is already being used or where there is potential to use it.

## **1.2 Shape and scope of the study**

This study aims to address the lack of empirical evidence on public/resident opinion on the use of waste process heat for district heating. The study investigates resident opinion on the use of waste process heat for district heating in the local authority area of Neath Port Talbot in Wales, where waste process heat from Corus, a local integrated steelworks, could potentially be used to provide buildings in the area with heating and hot water. As opinions tend to become more realised in 'live' contexts such as this one, where a real development has been proposed (Shackley *et al.*, 2004), the results of the study are likely to be highly relevant to the planning process.

Questionnaires will be used to investigate resident opinion on the use of waste process heat for district heating. Postal questionnaires will be distributed to residences in Neath Port Talbot with accompanying franked return envelopes to enable the residents to reply.

The chief purpose of the questionnaire is to determine to what extent residents are supportive of the idea of using waste process heat to provide their homes and businesses with heating and hot water. In particular, the questions will focus on any key issues or concerns which residents may have about entering into a district heating scheme as consumers, such as the long-term costs involved, the potential contractual lock-in, or perceptions of disruption relating to technology

installation such as laying pipes in the street and fitting heat exchangers in homes and businesses.

### **1.3 Research and Funding Context**

This study investigates resident opinion on the use of waste process heat for district heating in Neath Port Talbot, Wales. The study forms part of a wider research project administered by the University of Manchester section of the Tyndall Centre for Climate Change Research (Tyndall Centre) on consumer, industrial and expert opinion on the use of waste process heat for district heating in the UK. The University of Manchester is part of the Process Industry Thermal Energy Management Network (PROTEM), an interdisciplinary research network which is funded by the Engineering and Physical Sciences Research Council (EPSRC) and comprises various stakeholders including academic organisations, government bodies, non-governmental organisations (NGOs) and industrial organisations.

Process industries such as steel manufacturing are highly energy intensive and substantially contribute to the UK's annual GHG emissions. Improving the energy efficiency of manufacturing plants and optimising thermal energy management is therefore essential in order to reduce energy demand from the process industry and lower its GHG emissions. In recognition of this, PROTEM was established in 2009 in order to promote and disseminate research in process industry energy utilisation to an internationally recognised high standard and support the transfer of knowledge to all process industry stakeholders (PROTEM Network, 2009).

The collaborative nature of the research projects undertaken by PROTEM reflects the fact that often the appropriate knowledge, opportunity and motivation to improve the thermal energy efficiency of any manufacturing plant or company may result from external as well as internal sources (PROTEM Network, 2009). The research undertaken by the University of Manchester on consumer, industrial and expert opinion on the use of waste process heat for district heating is part of a larger PROTEM research project on non-technical barriers to the use

of waste process heat in the UK. The results will be used by PROTEM to inform their research and position on district heating. However, this study is concerned with consumer opinion only as it investigates the opinions of residents of Neath Port Talbot, Wales using a postal questionnaire.

Neath Port Talbot Borough Council is one of fifteen local authority areas which make up the West Wales and the Valleys region. This region has been awarded approximately £1 billion in funding from the European Regional Development Fund (ERDF) as part of the European Union Structural Funds Programming Round 2007-2013 in order to progress the sustainable and competitive development of the region's economy. This will include addressing climate change, improving transport and regenerating the region's most deprived areas (Welsh Assembly Government, 2009).

Corus is an integrated steelworks located in the town of Port Talbot which produces approximately 4.7 million tonnes of steel a year. As a result of its large scale manufacturing processes, Corus currently produces large quantities of waste process heat. Corus and Neath Port Talbot Borough Council are attempting to secure funding from the ERDF in order to implement district heating technology which will use waste process heat from Corus to meet local residential and commercial heat demand.

The results of this study will therefore be used by PROTEM, Corus (Port Talbot Works) and Neath Port Talbot Borough Council. PROTEM will use the results to inform their research and position on district heating. Corus and Neath Port Talbot Borough Council will use the results directly in their bid to secure funding from the ERDF.

#### **1.4 Structure of the study**

This chapter has introduced the background information to this study and has provided a framework for the research and policy context. Chapter 2 further contextualises the study through a literature review. Chapter 3 outlines the aims and objectives of the study and describes the methodology used in the research

process. Chapter 4 provides some background information to Neath Port Talbot and discusses the size and demographics of the participant sample. Chapter 6 provides a discussion of the findings of the study and outlines some suggestions for subsequent research. Chapter 7 concludes the study.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 What is district heating?

In district heating systems, a centralised source of heat is used to provide buildings within proximate distance with heating and hot water. The heat is transported as hot water or steam to local buildings via a network of pipes. Hot water pipes transport the heat from the source to the buildings and cold water pipes return cooler water for re-heating. The heat is transferred for use in conventional heating systems by heat exchangers, which are installed in residential, commercial or public buildings (HM Government, 2009b). Figure 2.1 shows an example of a heat exchanger used in district heating. District heating systems differ from conventional heating systems, which rely on the provision of fuel to the building, and the subsequent combustion of the fuel to produce heat (Davies and Woods, 2009).

Essentially, the idea of district heating is to satisfy heat demand by using local heat resources or fuel that would otherwise be wasted (Werner, 2004). District heating systems can therefore make use of any process that generates enough heat, and occurs close enough in proximity to the buildings that require heating and hot water. Compared to decentralised energy systems, district heating systems can make use of a wider range of energy sources (Ghafghazi *et al.*, 2010), including waste heat from industrial processes, biomass energy, geothermal energy, waste incineration, nuclear energy and fossil fuels. However, this study is concerned only with the use of waste process heat as a fuel source for district heating.

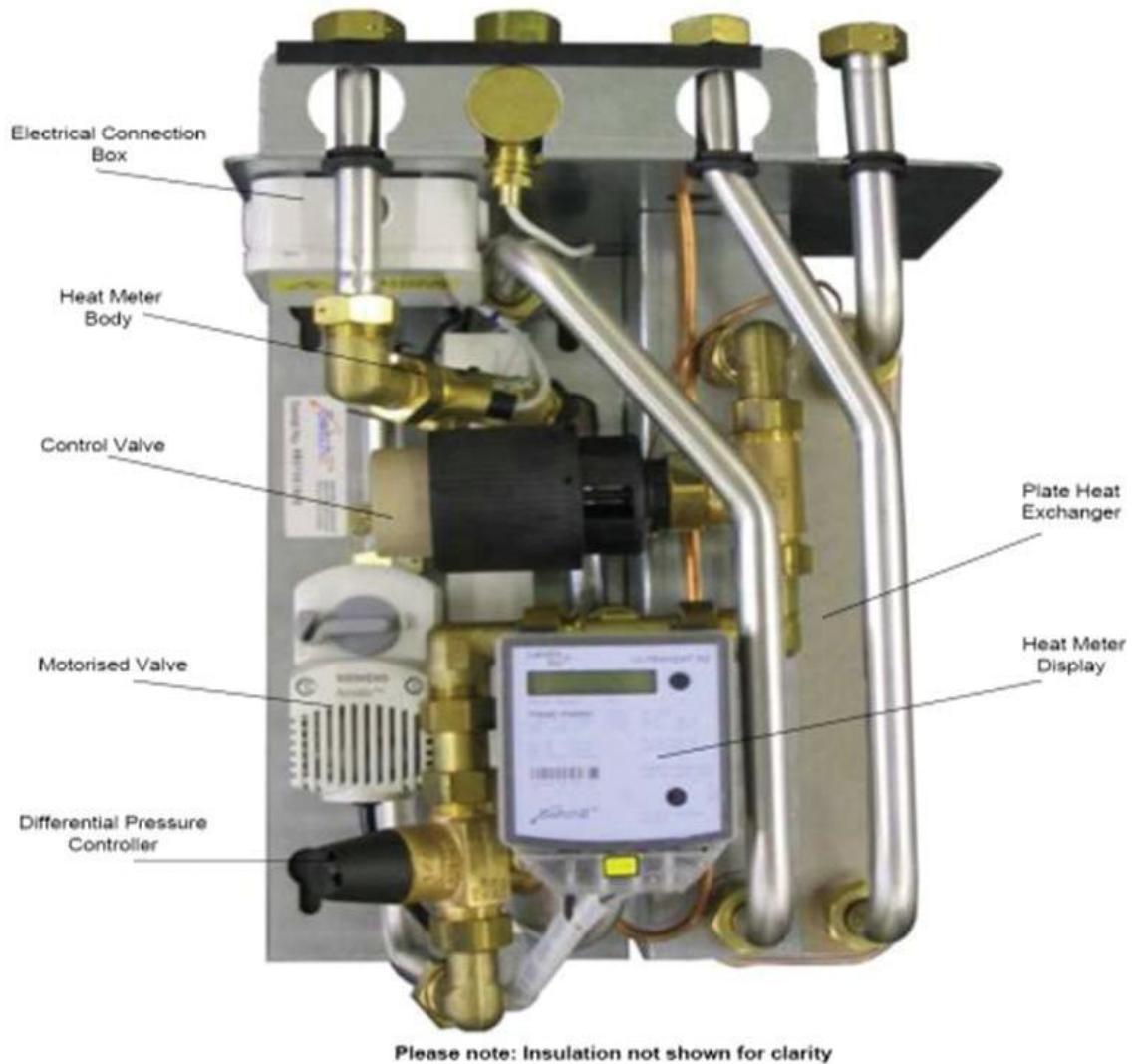


FIGURE 2.1: Diagram of a heat exchanger used in a district heating scheme  
Source: HM Government (2009b)

According to Werner (2004) there are three obligatory elements of a competitive district heating system: a suitable cheap source of heat; a market demand for heat; and the pipes as a connection between the source and demand. As heat is lost when hot water is transported through pipes, the distance between the heat source and demand must be short enough so that enough heat reaches the consumers to make the system commercially viable, i.e. all three elements must be local.

## **2.2 Historical context of district heating**

District heating is by no means a new idea. The concept of using a common heat source to heat several buildings dates back to Roman times (Pierce, 1995). However, the first known modern district heating system was established in the village of Chaudes-Aigues in France as early as the 14<sup>th</sup> century and is still in operation today. Tax records dating back to 1332 indicate that hot water, provided by a geothermal heat source, was distributed via wooden pipes to several nearby houses (Werner, 2004).

The first large commercial district heating system was developed in New York by hydraulic engineer Birdsill Holly in 1877. Following his success, several commercial systems were established in North American cities throughout the 1880s, using steam coal as a fuel source. By the 1920s and 1930s, district heating systems were being developed in several cities throughout Europe, largely as a response to the high cost of fuel following World War One. These included Hamburg, Kiel, Leipzig, Berlin, Copenhagen, Paris, Utrecht, Zurich, Reykjavik, St. Petersburg and Moscow (Werner, 2004).

## **2.3 Market penetration of district heating across Europe**

Today, there are several thousand district heating systems in operation throughout the world (Werner, 2004), although diffusion of the technology is regionally variable. For example, district heating is prominent in many European countries. It provides approximately 60% of the total heat supply in Denmark, and 49% of the total heat supply in Finland (Davies and Woods, 2009). Market penetration is also high in countries including Sweden, Poland, Estonia, Latvia, Lithuania, Romania, Belarus, the Czech Republic and Russia (Werner, 2004).

As the costs of installing district heating networks are high, they are often only commercially viable in areas with high heat densities (where demand for heat is high in proportion to the size of the area) such as city centres and dense urban areas (Koehler, 2009; Ericsson, 2009). For this reason, district heating is often employed to a greater extent in large cities, even in countries where market

penetration at the national scale is lower. For example, the Austrian city of Vienna relies on district heating for 36% of its total heat demand. However, across Austria as a whole, it accounts for only 18% (Davies and Woods, 2009).

In contrast to many of its European counterparts, the deployment of district heating in the UK has been far more limited. In 2009, less than 2% of the UK's total heat demand was provided by district heating, mainly through small schemes in cities including London, Nottingham and Sheffield. However, the technology has been in operation in the UK since 1950, when the first scheme was established in Pimlico, London using waste heat from a power station to supply heat to newly constructed flats (Davies and Woods, 2009). Countries' differential responses to the 1970s oil price shocks may in part explain the variation in uptake of district heating. Davies and Woods (2009) have observed that while sudden increases in the price of crude oil gave many European countries an incentive to invest in energy efficient systems such as district heating, the UK was able to rely on its indigenous gas reserves in the North Sea, which provided it with a relatively cheap fuel source.

#### **2.4 Waste process heat as a fuel source for district heating**

Figure 2.4 shows a diagram of a district heating network in which waste process heat from an industrial plant is used to heat water which is then distributed to local residential houses via a network of (red) pipes. Cold (blue) pipes return the cooler water. By using waste process heat to provide buildings with heating and hot water, district heating can reduce the need to burn fossil fuels in order to meet heat demand and can therefore significantly increase the overall energy system efficiency (Werner, 2004). As such, district heating has the potential to play a significant role in reducing GHG emissions, and consequently contribute to climate change mitigation. As waste heat, which would otherwise be dissipated to the atmosphere, is used as a fuel this can also lower production costs and significantly reduce energy bills for consumers (providing that the network is large enough in order to offset high initial investment costs).

Therefore, at the national scale, the diffusion of district heating technology in countries where it is currently used little or not at all may provide an opportunity to conserve energy, mitigate climate change, secure supply of energy (Ghafghazi *et al.*, 2010) and address fuel poverty by reducing energy bills for consumers (HM Government, 2009b).

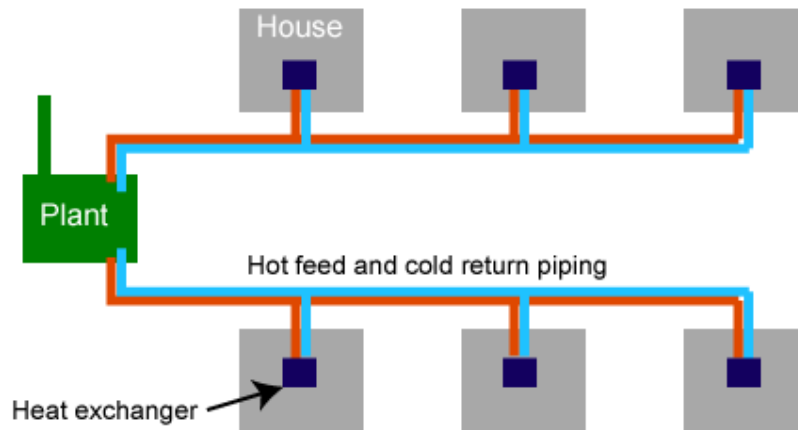


FIGURE 2.4: Diagram showing a district heating network fuelled by waste process heat from an industrial plant

Source: [http://www.greenspec.co.uk/images/energy/\\_district.gif](http://www.greenspec.co.uk/images/energy/_district.gif)

## 2.5 Policy context

An exhaustive body of literature exists on the impacts of anthropogenic climate change, both observed and anticipated, on bio-physical systems globally, and the predominately negative consequences of this for human societies (e.g. IPCC, 2007). In the past two decades, as scientific confidence in the causes, effects and consequences of global climate change has increased, the climate change issue has become ever-more prominent within the international policy arena. Scientific consensus on the need to urgently and substantially reduce global GHG emissions in order to prevent and mitigate the most dangerous impacts of climate change is widespread across a range of disciplines. Given that 80% of global primary energy is currently provided by carbon intensive fossil fuels (Meadowcroft, 2009), the International Energy Agency has proposed that

‘nothing short of an energy revolution’ is required in order to achieve this (International Energy Agency, 2008; p3).

As the impacts of climate change become more concrete, and the trend for international action continues, nations will increasingly be required to develop appropriate strategies to respond to climate change in order to ‘display their credentials on this front’ internationally, as well as to their own citizens (Meadowcroft, 2009; p3). The UK demonstrated its credentials in this way by passing the Climate Change Act in November 2008. This set legally binding, long-term targets to reduce national GHG emissions by 34% by 2020 (as part of the European Union (EU) target to reduce GHG emissions by 20% by 2020), and 80% by 2050, from 1990 baseline levels (Foxon *et al.*, 2010). The UK Low Carbon Transition Plan (2009) identified that in order to achieve such ambitious targets, emissions reductions would need to be made in every sector.

In the UK, heat generation for homes, businesses and industrial processes is heavily reliant on carbon intensive energy sources. Approximately 70% of the UK heat demand is provided by natural gas, compared with only 0.5% from renewable sources. The remaining heat demand is mostly met by oil and electricity. As a result, heat generation accounts for 47% of the total GHG emissions of the UK (Davies and Woods, 2009).

In view of the high proportion of emissions attributable to heat generation, there is substantial scope to significantly reduce national GHG emissions by decarbonising the supply of energy and improving energy efficiency within the heating sector. Using waste process heat for district heating is one method of decarbonising the heat supply. There is considerable potential for this in the UK due to the country’s large process industry.

In addition, reducing reliance on fossil fuels will also be important for ensuring the energy security of the UK. This is particularly relevant as indigenous fuel supplies in the North Sea have declined in recent years, leading the UK to become progressively more dependent upon imported fossil fuels and international energy markets (HM Government, 2009b).

Additional benefits of district heating include lower energy bills for consumers, compared to conventional heating systems. By lowering fuel costs, district heating could contribute to efforts to reduce fuel poverty. According to the Department of Energy and Climate Change, a household in the UK is considered to be in fuel poverty if it needs to spend more than 10% of its income on fuel to maintain a satisfactory heating regime (this is usually 21 degrees for the main living area and 18 degrees for other occupied rooms). The latest fuel poverty estimates in 2007 indicate that there were approximately 4 million households in fuel poverty in the UK, of which approximately 3.25 million were classified as vulnerable households (houses which include the elderly, children and the long term sick and disabled). 2007 was also the third consecutive year in which the number of households in fuel poverty in the UK increased, as a result of rising energy prices (Department of Energy and Climate Change, 2009).

## **2.6 District heating as an idea of environmental reform**

Technologically-orientated environmental policies which aim to reduce GHG emissions through the development and expansion of renewable energy technologies, nuclear power, and 'clean' fossil fuels provided by Carbon Capture and Storage (CCS) technology, are heavily influenced by theories of ecological modernisation, the central premise of which is effectively encapsulated by Buttel's (2000; p62) somewhat paradoxical observation that: "solutions to the problems caused by modernization, industrialization, and science can only be solved through more modernization, industrialization, and science."

Thus, ecological modernisation theorists conceive technology and science in terms of their actual and potential role in solving and preventing environmental problems, as well as their role in creating them. In particular, they emphasise the importance of socio-technological approaches which incorporate the potential impact on the environment into the planning stages of technological development (Mol, 2000) and the ensuing mutually reinforcing environmental and economic benefits which this can produce (Christoff, 1996).

In fact, much of the core ecological modernisation literature has focused on the trajectories of environmental reform in the private sector, and the manufacturing industries in particular, which have resulted in increased efficiency and reduced waste and pollution (Buttel, 2000). In particular, several authors have acknowledged the role of environmental reform, particularly in terms of encouraging the re-use of materials and resources, including the use of ‘waste heat’ for heating and power generation, in the improved environmental performance of northern European countries such as the Netherlands, and Germany (Christoff, 1996). Mol (2001; p56) argues that from the mid-1980s onwards, the long established trend of parallel economic growth and environmental disruption in industrialised nations such as Germany, Japan, the Netherlands, Sweden, Denmark and the United States, was disturbed. He refers to this as the ‘decoupling or delinking of material flows from economic flows’ and argues that in certain countries and industries environmental reform led to a reduction in absolute terms of GHG emissions or resource consumption, in spite of continued economic growth in financial or material terms.

## **2.7 The role of the public in the transition to a sustainable energy system**

The preceding sections of this chapter have identified the potential role which district heating could play in the UK’s transition to a low carbon energy system. Several policy documents including the UK Low Carbon Transition Plan (2009) have explored the contribution which the public could make to the evolution of a low carbon energy system and have highlighted the need for higher levels of public engagement in decision making.

This focus can be considered within the wider context of governance trends during the past two to three decades which have witnessed an authoritative shift in focus from government to governance. This has been characterised as the ‘hollowing out’ of the state and the re-distribution of its functions outwards to non-state actors (Bulkley, 2005; p883). According to Stoker (1998; p21) the governance shift has essentially led to a “change in the long-standing balance between the state and civil society,” whereby the resources and responsibilities of

the state have been reduced, leading citizens, voluntary groups and the private sector to take on more active roles within the governance regime.

This has important implications for governance of energy and the environment as it highlights how non-state actors such as industries, and more significantly for this study, the public, can actively contribute to the implementation and uptake of low carbon technologies such as district heating. Devine-Wright (2007) uses the concept of 'energy citizenship' to conceptualise the public as active stakeholders in the evolution of the energy system, rather than as socially and psychologically detached from it. He argues that if the public are to accept technological changes towards a more sustainable energy system, greater levels of public involvement in energy decision-making are necessary, as this will create better conditions for agreement about a new development. He contends that this type of thinking has become integral to UK government energy policy, a notion which is supported by Walker and Cass (2007; p458) who argue that the perception of the public as merely 'end-of-wire' captive consumers in the energy system is for the most part outdated. They maintain that "a far more embedded and multidimensional conceptualisation of the roles, engagements and potentiality of 'the public' within the energy system of the UK" will be necessary in order to meet the challenges of a sustainable transition.

Engaging the public in decisions about energy provision can result in several useful benefits. Ghafghazi *et al.* (2010) argue that public involvement in the early stages of the planning process of a new development is necessary in order to inform the public about the development; to reflect public opinions in any decisions made; and to give the public opportunities to raise concerns about any impacts which may have been overlooked. Heiskanen *et al.* (2005) also argue that it can identify the conditions necessary for consumer adoption of the technology, particularly in relation to any key factors which may facilitate or obstruct the adoption. In addition, if public involvement is delayed or overlooked this can sometimes lead to strong opposition from community associations, public pressure groups, NGOs and the media at the final stages of the planning process (Ghafghazi *et al.*, 2010). In view of this, any proposal to

implement a district heating system within an area must take due consideration of local opinion in that area.

Indeed, Nye *et al.* (2010) note that in addition to the more technologically-orientated literature on the decarbonisation of the UK energy system, a substantial literature on ‘transitions in socio-technical systems’ is also emerging which places greater emphasis on the social context and implications of this. This socio-technical perspective considers technological systems to co-evolve alongside social institutions. Technologies are thus shaped by the social, cultural and economic contexts in which they develop, and as they do so they in turn influence these contexts (Foxon, 2002). Therefore, any proposal for technological change, such as the introduction of a district heating system, must adequately take into account the social context in which the technological system operates. Circumstantial factors such as consumer expectations, regulatory factors governing the introduction of the technology and the initial market system can therefore alter the path of technological development and the extent to which innovation and diffusion of the technology is successful (Foxon, 2002). In particular, Shove and Walker (2007) have emphasised the active role of consumers, arguing that consumers are in fact central, rather than peripheral, to the innovation process.

Furthermore, an increasingly recognised concept in terms of explaining energy consumption is that of the ‘citizen-consumer’ which Clarke (2007; p1) describes as a “peculiar hybridised and hyphenation combination of citizen and consumer.” Central to this is the conflict between the roles and relationships which the ‘citizen’ and the ‘consumer’ are located in. Clarke (2007; p1) considers the citizen to be “an egalitarian figure, located in a republican imaginary of liberty, equality, and solidarity.” Citizenship is constructed through vertical relationships between citizens and the state which are both mutually productive and obligatory as the functions of the state enable the conditions for citizens to lead their lives, while this power is provided by the consent of citizens. The horizontal relationships that exist between citizens are based upon egalitarian principles. However, the consumer is located in the marketplace and defined by economic relationships. Personal desire is therefore the driving force for

consumers as they choose how their own well-being will best be served. However, all consumers are equal in that they all possess the capacity to make these choices.

## **2.8 Public opinions of energy technologies in response to environmental change**

Although little is known about public opinions of district heating in the UK, numerous studies have examined public opinions and acceptance of other low carbon energy technologies, such as renewable energy technologies and nuclear power, in relation to global environmental change. Research on public attitudes of climate change in the UK indicates that awareness of climate change is widespread and the public generally comply with the need to mitigate GHG emissions through the deployment of alternative energy solutions, such as renewable technologies (McGowan and Sauter, 2005).

However, although the public may support the diffusion of low carbon energy technologies at the national level, this does not always translate into support for a new development at the local scale. Such local opposition has typically been explained in terms of ‘nimbyism - Not In My Back Yard’ opposition or perceived threat or disruption to place attachment (Devine-Wright and Howes, 2010).

The majority of studies interpret public responses to technological change in terms of psychological concepts of attitudes or sociological concepts of habits. Upham *et al.* (2009; p12) describe attitudes as “hypothetical constructs that refer to an individual’s evaluation of, or orientation towards, an ‘attitude object’ (ie, thing, idea, person, group, action, self, etc),” which form either through direct experience with the attitude object or indirectly through exposure to information about it. Attitudes are often described in terms of their intensity (i.e. strong or weak) and direction (i.e. positive or negative). While they are useful for predicting how individuals will respond in certain contexts, they are also dynamic, subject to influence by various factors and can change according to

situational contexts. For this reason attitudes are not always consistent with behaviour (Upham *et al.*, 2009).

In contrast, sociological ‘practice theories’ emphasise the role of socially learned habits and practices in shaping social norms, such as those relating to energy consumption. ‘Practice theories’ argue that habits and practices, socially learned within particular socio-technological systems, are instrumental in shaping social norms. They focus on behavioural responses rather than cognitive processes, and therefore place less emphasis on agency and individual capacity to act (Upham *et al.*, 2009). From this perspective, residents’ current habits and practices in relation to heat consumption, rather than their attitudes as such, will be influential in determining their opinions and acceptance of district heating.

## **CHAPTER 3: METHODOLOGY**

### **3.1 Research questions**

- To what extent do participants support the concept of using waste process heat for district heating to mitigate climate change and reduce heating bills in the UK?
- To what extent would participants be willing to take part in a district heating scheme, should one be implemented in Neath Port Talbot?
- What aspects relating to heating and hot water supply would need to be incorporated into a successful district heating scheme in Neath Port Talbot, in order to satisfy consumers' expectations and demands?
- How favourably or unfavourably do participants perceive key features of district heating schemes, such as disruption from technological installation and contract lock-in, and is this likely to facilitate or impede the uptake and diffusion of district heating in Neath Port Talbot?

### **3.2 Aim**

- To investigate resident opinion on the use of waste process heat for district heating in Neath Port Talbot.

### **3.3 Objectives**

- To design a questionnaire comprising a number of questions which assess participants' opinions and understandings of various aspects of district heating schemes.
- To distribute the questionnaire to 3000 residences within the Neath Port Talbot area.

- To carry out quantitative data analysis on the responses received, and use the results to deduce participants' opinions on the issues explored throughout the questionnaire.
- To outline the implications of the findings for the planning processes and funding bid of Corus and Neath Port Talbot Borough Council and to consider areas of further research.

### **3.4 Research design**

Residents of Neath Port Talbot were targeted as the participants of the study, as there is potential to implement a district heating scheme in this area using waste process heat from Corus as a heat source.

Participants were targeted by distributing postal questionnaires to 3000 Neath Port Talbot residences (individual residences received one questionnaire each). 312 responses were received and therefore the participant sample was self-selected. Response bias is likely to have been present as respondents may have been particularly interested or concerned about the questionnaire subject, or may have had more time available to complete the questionnaire than other residents. Additionally, participants were targeted by geography only and the participant sample was not stratified to demographic quotas such as gender, age and social class as this was considered to be too costly and time consuming. For these reasons, the sample cannot be considered to be representative of the Neath Port Talbot population as a whole.

However, in order to ensure that the sample was as representative as was possible, a large number of participants were required. A postal questionnaire was chosen to investigate resident opinion as this was considered to be the most appropriate and cost and time effective method of targeting a large number of Neath Port Talbot residents. A large target population was necessary in order to

increase the number of questionnaire responses that were received and ensure the robustness of the data.

Web-based Qualtrics software was used to create the questionnaire. The questionnaire was designed in consultation with contacts at Corus and Neath Port Talbot Borough Council. The involvement of both Corus and Neath Port Talbot Borough Council was sought from the outset of the questionnaire design. As both Corus and Neath Port Talbot Borough Council will use the results of the questionnaire to inform their planning processes and in their attempt to secure funding from the ERDF, it was essential that the questions were written in such a way as to address their areas of interest and concern relating to resident opinion of district heating.

The questionnaire included 15 questions, all of which were close-ended and the majority of which used 5-point Lickert scales to elicit participants' responses. Participants were presented with either a statement or a potential situation and were then asked to specify the extent to which they were in agreement or in favour of the statement/situation by choosing one of five response options.

For example, participants were presented with a statement such as 'District heating sounds like a good idea in principle,' and were asked to indicate the extent to which they agreed with it by choosing one response from a number of options on a 5 point Lickert scale such as 'Strongly agree,' 'Tend to agree,' 'Neither agree nor disagree,' 'Tend to disagree,' and 'Strongly disagree.' Consistent response options (2 positive, 1 neutral and 2 negative) were used throughout the questionnaire in order to minimise confusion for participants. For each question a sixth response option, 'No opinion/Don't know' was included which participants could choose if they had no knowledge or opinion on the subject of the question. This is different from the neutral option which indicates a participant's lack of a positive or negative response to a question. Lickert scales are frequently used in survey questionnaires and were chosen in this instance as they allow distinct responses to be obtained from participants (Clason and Dormody, 1993). They therefore produce quantitative data which can be readily subjected to analysis in order to aid interpretation of the results.

Multiple choice questions were also used to obtain information about the participants such as their age, gender or household/business tenure situation, which also produced quantitative data.

Each question was phrased carefully in order to minimise social desirability response bias. This occurs when participants answer questions according to how they think they should answer in relation to social or moral norms, rather than according to what they truthfully think (King and Bruner, 2000). For example, being concerned about the environment may be perceived as a social or moral norm. Therefore, participants may respond to questions about their environmental credentials by claiming to be more environmentally concerned than they are in reality. Minimising social response bias therefore produces results which more accurately reflect participants' true opinions. Simple language was also used in order to ensure that the questionnaire was comprehensible to participants with low literacy levels and for purposes of succinctness.

Some of the questions contained sub-divisions whereby participants were required to respond to a number of options. In order to minimise randomisation bias, which occurs when participants' responses reflect the order that options are presented in a list rather than their actual opinions, the order of the sub-divisions was randomised for some questions (Q5 and Q6), using the Qualtrics randomisation button. However, it was not used for all the questions as in some cases it was considered that this would reduce the coherence of the question.

Prior to finalising the questionnaires, a pilot study was carried out in Port Talbot town centre on the 16<sup>th</sup> and 17<sup>th</sup> of July 2010. A shorter version of the questionnaire was used which contained similar questions to the postal questionnaire and 3-point Lickert scales to elicit participants' responses. 29 participants were selected via convenience sampling (whereby any participants that agreed to take part in the study were sampled). The pilot study was carried out for two reasons. Firstly, in order to broadly establish the level of support among residents for the implementation of a district heating scheme in Neath Port Talbot; and secondly to determine whether the questions used were

comprehensible to participants. The main findings of the pilot study showed that residents were largely supportive of the idea of implementing a district heating scheme in the area, using the waste process heat from Corus. However, on the whole, residents expressed a need to know more about the scheme before they would be willing to commit to it. The study also demonstrated that participants largely understood the language and the concepts of the questionnaire. For this reason it was not considered necessary to make any modifications to the postal questionnaire.

On 26<sup>th</sup> July 2010 the finalised questionnaires were delivered by hand to residences in Neath Port Talbot. Each questionnaire was accompanied by a franked return envelope addressed to the University of Manchester's Business School, in order to enable the participants to reply. The questionnaires and accompanying return envelopes were contained in an envelope printed with the following text:

Win £50 Amazon or Argos vouchers.  
Short questionnaire  
From Neath Port Talbot Borough Council,  
Corus & University of Manchester

The questionnaire began with a short passage which introduced the subject of the questionnaire to the householder and contextualised the purpose of the study. It also explained that the returned questionnaires would be entered into a prize draw to win £50 Amazon or Argos vouchers. The intention of this was to provide householders with a financial incentive to complete and return the questionnaires in order to increase the number of responses and reduce response bias (i.e. over-representation of participants who were particularly concerned about the questionnaire subject). The passage was also intended to assure householders of the legitimacy of the study by acknowledging the involvement of the established organisations Neath Port Talbot Borough Council, Corus and the University of Manchester.

The data from the questionnaire responses was analysed using Statistical Package for the Social Sciences (SPSS) (version 16.0). As the study produced a large quantity of data (312 participants' responses to 15 questions), statistical analysis was not carried out on the data, as it was considered that this would be too time consuming and beyond the scope of the study. Descriptive statistics were used to analyse the data, as this was deemed sufficient to identify the principal trends, from which the conclusions were deduced.

## CHAPTER 4: NEATH PORT TALBOT

### 4.1 Background information

The following chapter provides some background information and key statistics on Neath Port Talbot. The reference periods of the statistics vary, but in some cases they are outdated by several years (the year of reference is indicated in brackets). These statistics are therefore intended to provide an indication, rather than an exact description, of current trends in Neath Port Talbot.

Neath Port Talbot County Borough is located in Wales (a country that is part of the United Kingdom), on the South West coast. It is approximately 441 square kilometres (km<sup>2</sup>) in size and comprises both urban and rural settlements. The main towns are Neath, Port Talbot and Pontardawe. The region has an industrial history; it is well known for steel manufacturing and many areas also have their origins in coal mining. Figure 4.1.1 shows a map of Wales. The shaded area represents Neath Port Talbot County Borough. Figure 4.1.2 shows a map of Neath Port Talbot.



FIGURE 4.1.1: Map of Wales

Source: Welsh Assembly Government (2008)

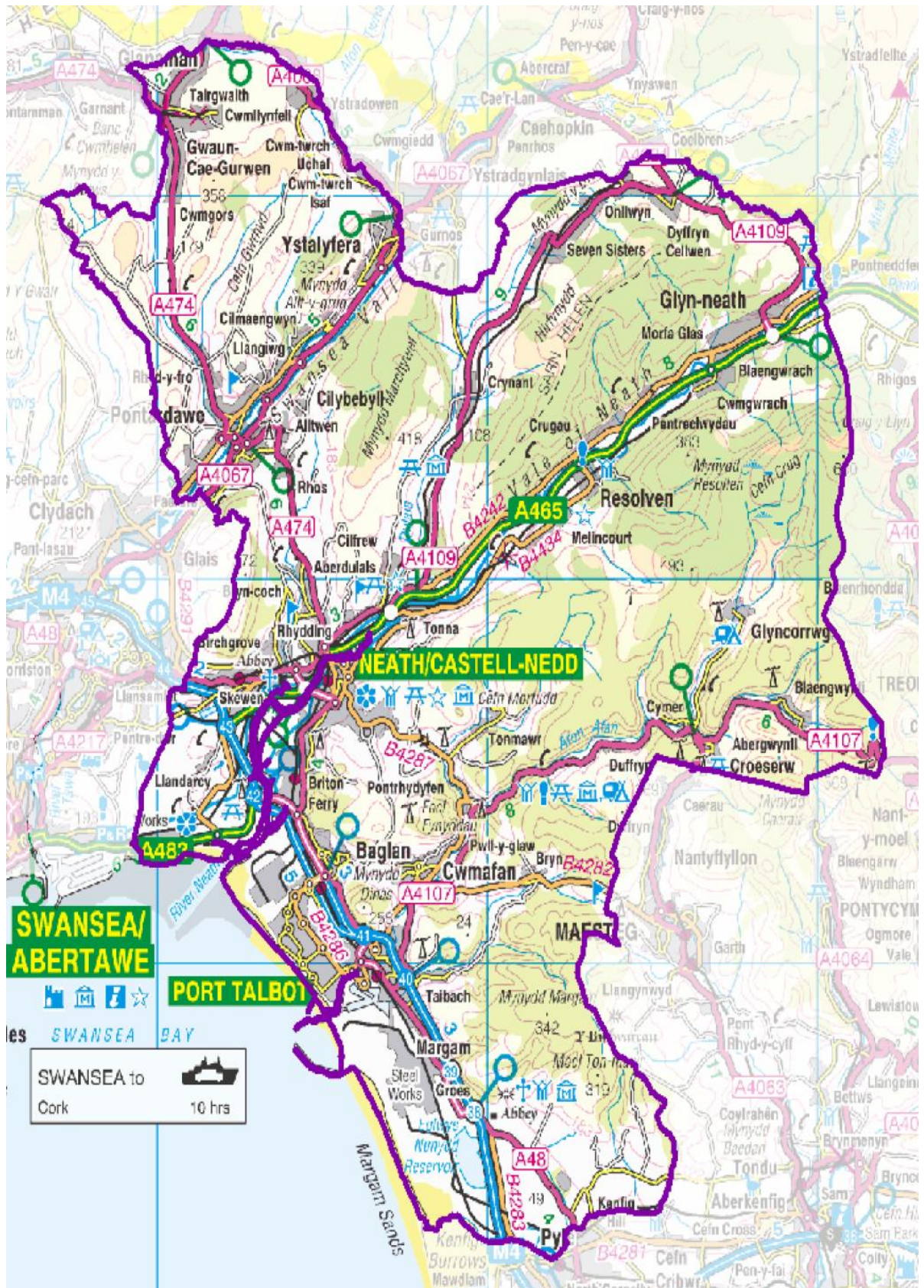


Figure 4.1.2 Map of Neath Port Talbot Local Authority

Source: National Assembly for Wales Finance and Statistics Team (2008)

Steel production has been integral to the local economy of Neath Port Talbot for over a century. Today, the steelworks is operated by Corus, which is the second largest producer of steel in Europe. The Port Talbot Works is one of Corus's four integrated steelworks in the UK. With approximately 3600 employees, Corus is Neath Port Talbot's largest industrial employer and produces around 4.7 million tonnes of steel a year.

The economy of Neath Port Talbot is heavily reliant on the manufacturing sector, which provides approximately 21.9% of jobs in the area. This compares to 13.4% for Wales as a whole (2006). Approximately 70.6% of the working age population of Neath Port Talbot is economically active and 2.2% claim Job Seeker's Allowance, compared to 75.1% and 2.2%, respectively, for Wales (2006). The median gross annual pay for full-time employees is £22,298, compared to £21,586 for Wales (2007). There are approximately 57,609 households in Neath Port Talbot, of which 71.3% are owner occupied. 71.3% of households are also owner occupied across Wales (2001). The median house price is £94,000, compared to £132,500 for Wales (2006). The population density is approximately 311 people per square kilometre, compared to 143 people per square kilometre for Wales (2006) (National Assembly for Wales Finance and Statistics Team, 2008).

The Welsh Index of Multiple Deprivation (WIMD) provides a measure of deprivation for areas of Wales. Small areas known as Lower Super Output Areas (LSOAs) are scored for levels of deprivation across 8 domains: income and employment; education, skills and training; health; access to services; housing; physical environment; and community safety. In addition, each LSOA is also given an overall level of deprivation. Of the 91 LSOAs in Neath Port Talbot, 68% scored higher levels of overall deprivation, compared to the Wales average, and 19% fell within the 10% most deprived LSOAs in Wales (Welsh Assembly Government, 2008). Figure 4.1.3 shows the ranks of overall deprivation for LSOAs by local authority, relative to the median rank for Wales. The length of the lines indicates the spread of ranks in each authority and the blue box indicates the spread of the middle 50% of ranks in each authority. The line across the middle represents the median rank for Wales. The chart shows that there are

more high ranking LSOAs in Neath Port Talbot (positioned fourth from the left) relative to the national average.

**Overall Level of Deprivation for each local authority compared with the median (middle) rank for Wales.**

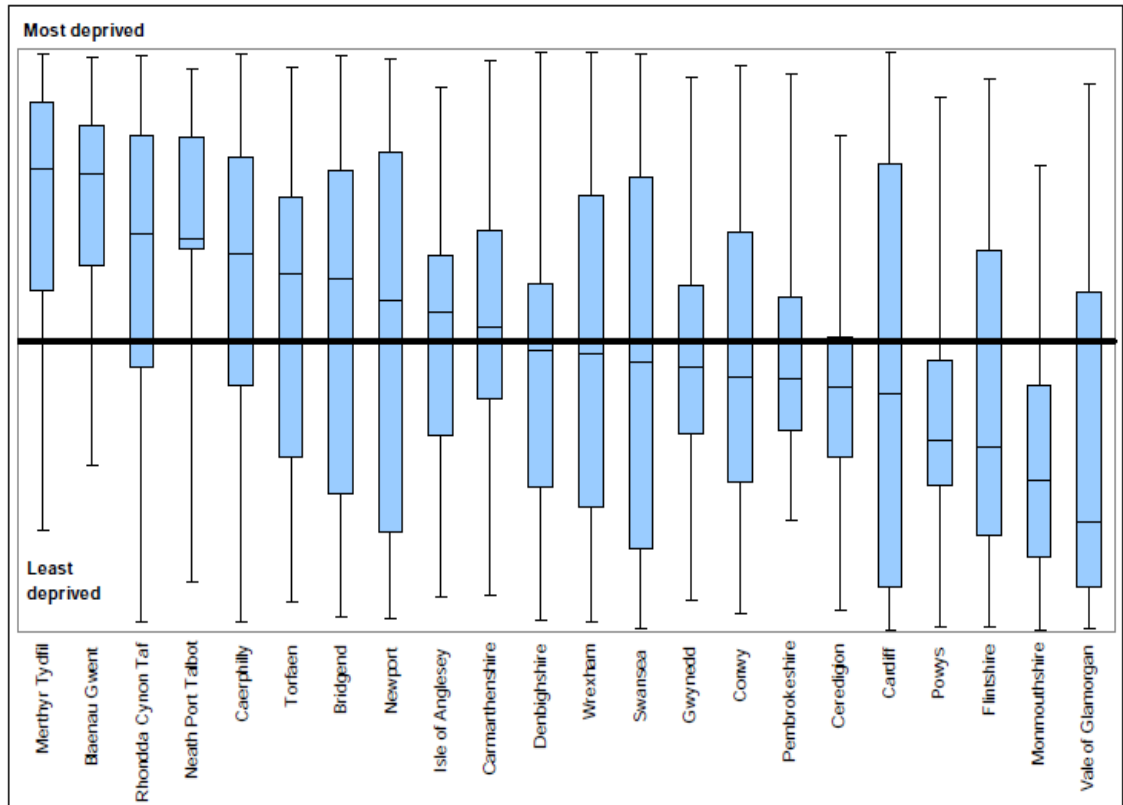


FIGURE 4.1.3: Graph showing the overall level of deprivation for Neath Port Talbot local authority in comparison to the median for Wales

Source: Welsh Assembly Government (2008)

#### 4.2 Size and demographics of participant sample

Of the 312 participants, 151 were male (49.7%) and 153 were female (50.3%), giving a near-even gender split. This is shown in Figure 4.2.1 and Table 4.2.1. 8 participants (2.6%) did not disclose their gender.

The most recent Census data shows that in 2001 the population of Neath Port Talbot was 134468, of which 64968 (48.3%) were males and 69500 (51.7%)

were females. This is shown in Table 4.2.2. This indicates that the gender split of the participants in this study is comparable to that of the population of Neath Port Talbot, and that there is no significant gender bias. Figure 4.2.3 shows the gender distribution of the participants compared to the gender distribution of the Neath Port Talbot population in the 2001 Census, by percentage.

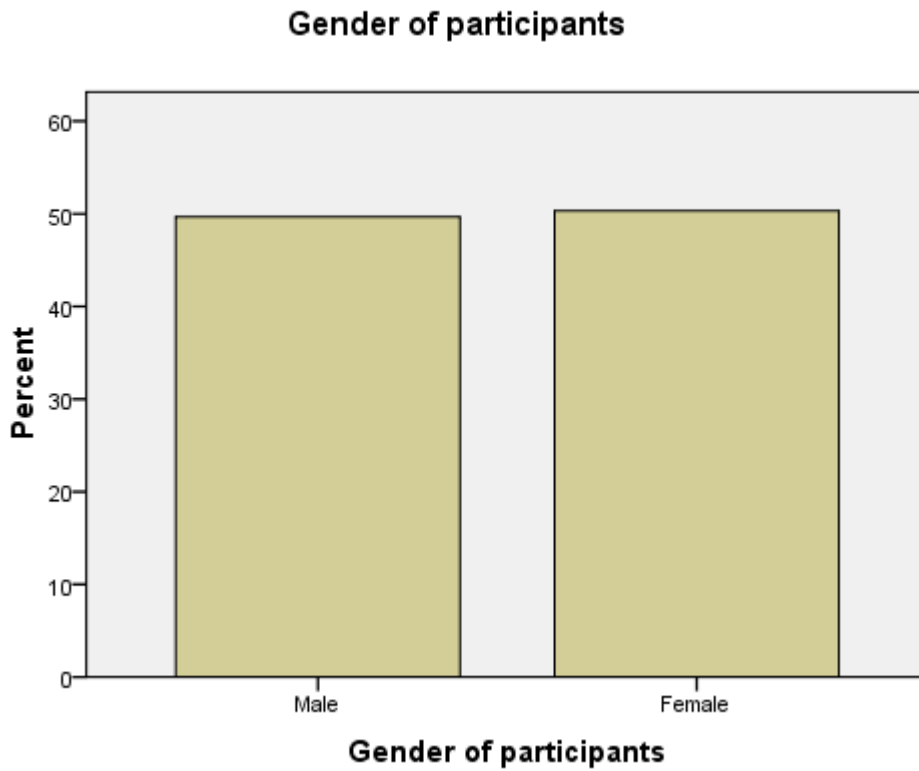


FIGURE 4.2.1: Bar chart showing gender split of participants

**Gender of participants**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	151	48.4	49.7	49.7
	Female	153	49.0	50.3	100.0
	Total	304	97.4	100.0	
Missing	System	8	2.6		
Total		312	100.0		

TABLE 4.2.1: Table showing gender split of participants

<b>Age Range</b>	<b>Total</b>	<b>Males</b>	<b>Females</b>
<b>0 - 4</b>	7236	3683	3553
<b>5 - 9</b>	8362	4349	4013
<b>10 -14</b>	8949	4597	4352
<b>15 -19</b>	8440	4268	4172
<b>20 -24</b>	6747	3463	3284
<b>25 -29</b>	7314	3518	3796
<b>30 -34</b>	8980	4360	4620
<b>35 -39</b>	9974	4881	5093
<b>40 -44</b>	9805	4808	4997
<b>45 -49</b>	8921	4448	4473
<b>50 -54</b>	9719	4816	4903
<b>55 -59</b>	8179	4012	4167
<b>60 -64</b>	7204	3559	3645
<b>65 -69</b>	6544	3162	3382
<b>70 -74</b>	6249	2831	3418
<b>75 -79</b>	5427	2187	3240
<b>80 -84</b>	3594	1302	2292
<b>85 -89</b>	1878	545	1333
<b>90 and over</b>	946	179	767
<b>Totals</b>	134468	64968	69500

TABLE 4.2.2: Population characteristics of Neath Port Talbot (2001 Census data)

Source: Office of National Statistics (2001)

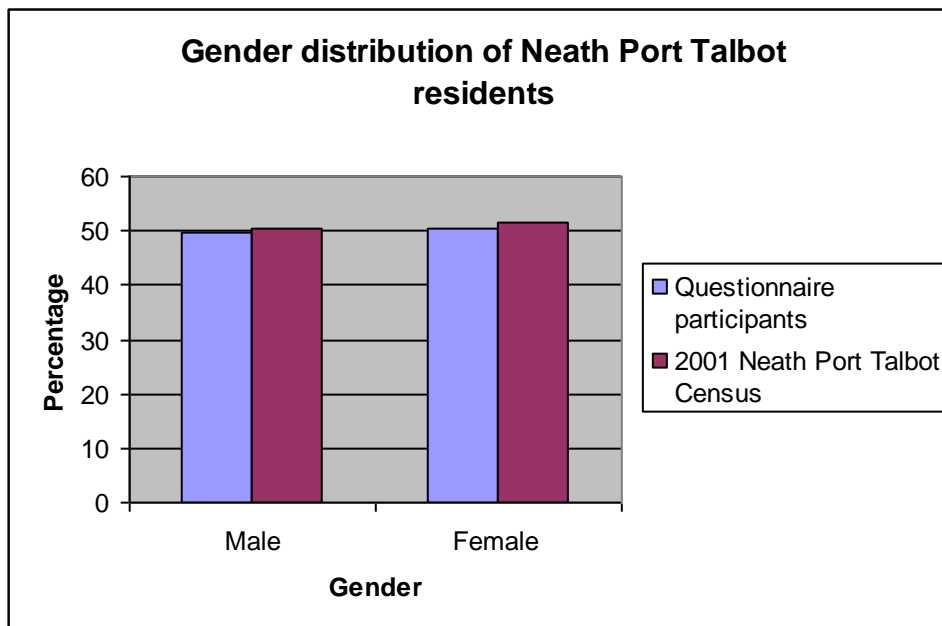


Figure 4.2.3: Graph showing the gender distribution of participants compared to the gender distribution in the 2001 Neath Port Talbot Census, by percentage (data adapted from Table 4.2.2 for comparability purposes)

The age distribution of the participants is shown in Figure 4.2.4 and Table 4.2.4. The percentage of participants in each age group was as follows: 15-24 (1.5%); 25-34 (6.8%); 35-44 (13.2%); 45-54 (17.7%); 55-64 (27.8%); 65-74 (22.9%); and 75+ (10.2%). 1 participant (0.3%) did not disclose their age. The age distribution by frequency of the Neath Port Talbot population from the 2001 Census data is shown in Table 4.2.2. Figure 4.2.5 shows the age distribution by percentage of the participants compared to the age distribution of the Neath Port Talbot population in the 2001 Census. It clearly shows that participants aged 15-24 and 25-34 are significantly under-represented; participants aged 35-44 are slightly under-represented; participants aged 45-54 are well represented; participants aged 55-64 and 65-74 are significantly over-represented; and participants aged 75+ are well represented. Thus, there is a significant sample bias towards older age groups, which may be reflected in the findings of the study.

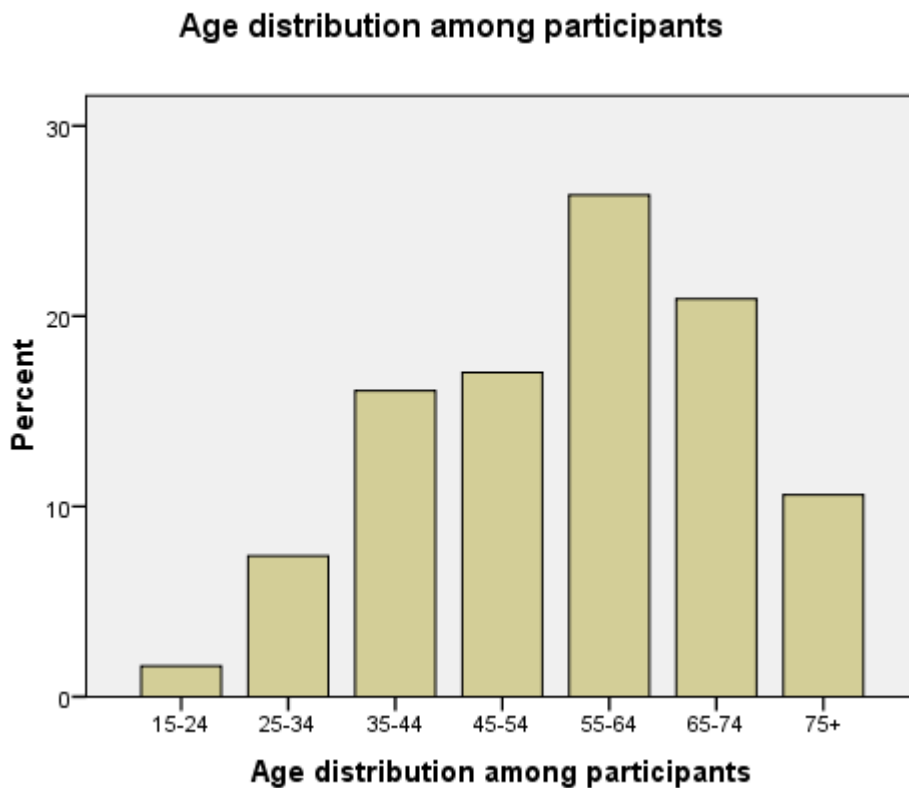


FIGURE 4.2.4: Bar chart showing age distribution among participants

**Age distribution among participants**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15-24	5	1.6	1.6	1.6
	25-34	23	7.4	7.4	9.0
	35-44	50	16.0	16.1	25.1
	45-54	53	17.0	17.0	42.1
	55-64	82	26.3	26.4	68.5
	65-74	65	20.8	20.9	89.4
	75+	33	10.6	10.6	100.0
	Total	311	99.7	100.0	
Missing	System	1	.3		
Total		312	100.0		

TABLE 4.2.4: Table showing age distribution among participants

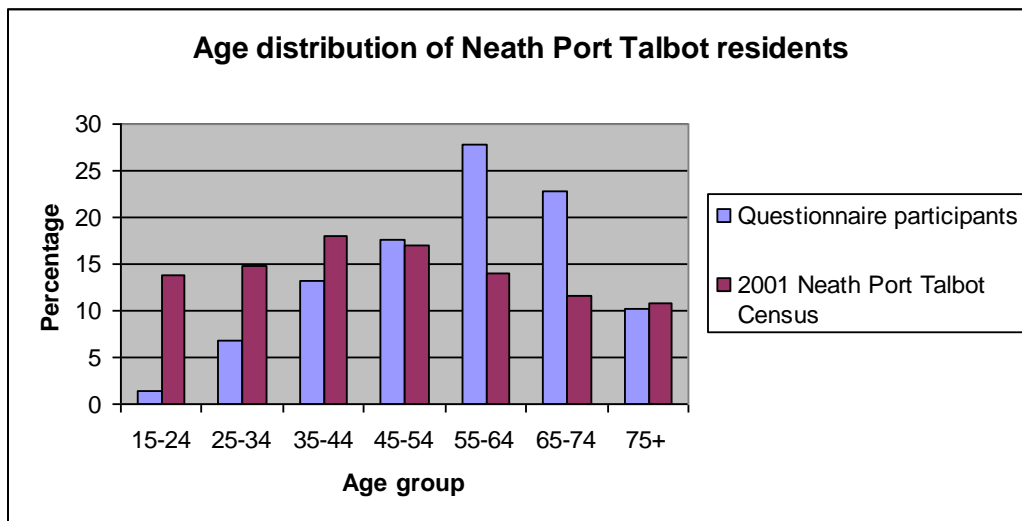


FIGURE 4.2.5: Graph showing the age distribution of participants compared to the age distribution in the Neath Port Talbot Census, by percentage (data adapted from Table 4.2.2 for comparability purposes)

This study surveyed approximately 0.23% of the Neath Port Talbot population (312 of 134468 residents). The participant sample is therefore too small for the results to be considered to adequately represent the views of the local area as a whole. Nonetheless, it is likely to provide some valuable insights into local resident opinion.

## **CHAPTER 5: RESULTS**

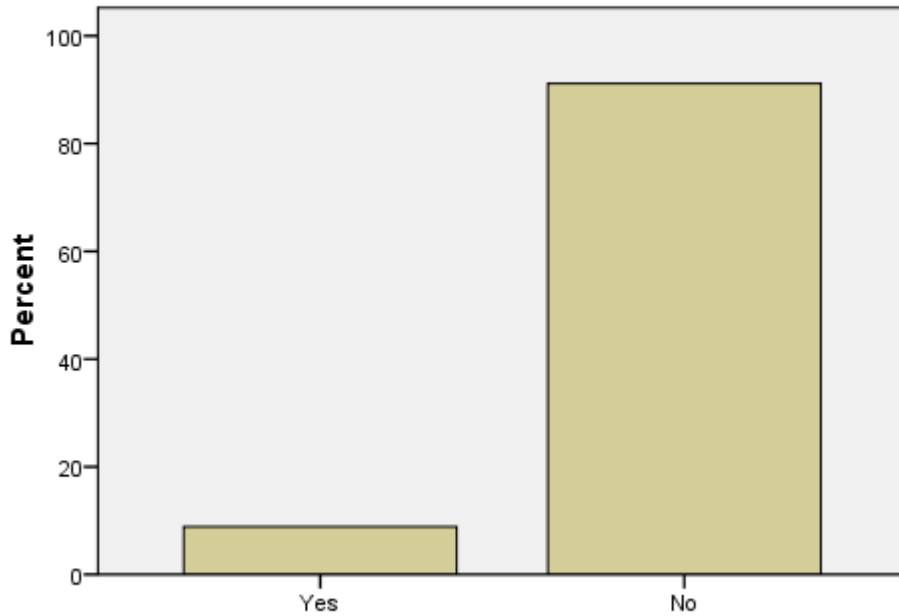
The following section provides a description of each of the 15 questions in the postal questionnaire and the results which were obtained for each question. The full questionnaire can be viewed in the Appendix.

The results were collated from 312 questionnaire responses. However, some participants did not answer every question so some questions have data missing. The results tables for each question show how many participants answered the question (valid total) and how many did not (missing data). The percentages quoted in the text refer to ‘valid percent’ which excludes the missing data. For clarity, the missing data is not shown in the bar charts.

### **5.1 Question 1**

Participants were asked if they had previously heard of district heating. The intention of this was to ascertain the level of awareness of district heating technology amongst participants. Prior knowledge of district heating was very low as only 27 out of the 305 participants who responded to this question (8.9%) had previously heard of district heating, as Figure 5.1 and Table 5.1 demonstrate.

**1. Had you heard of 'district heating' before receiving this survey?**



**1. Had you heard of 'district heating' before receiving this survey?**

FIGURE 5.1: Bar chart showing participants' responses to Question 1

**1. Had you heard of 'district heating' before receiving this survey?**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	27	8.7	8.9	8.9
	No	278	89.1	91.1	100.0
	Total	305	97.8	100.0	
Missing	System	7	2.2		
Total		312	100.0		

TABLE 5.1: Results table showing participants' responses to Question 1

## 5.2 Question 2

Participants were presented with a short passage (see appendix) which was intended to provide them with some information about district heating and enable them to answer the remaining questions. Participants were then presented with the following statements about district heating and were asked to indicate the extent to which they agreed with each one:

2a) *'It (district heating) sounds like a good idea in principle.'*

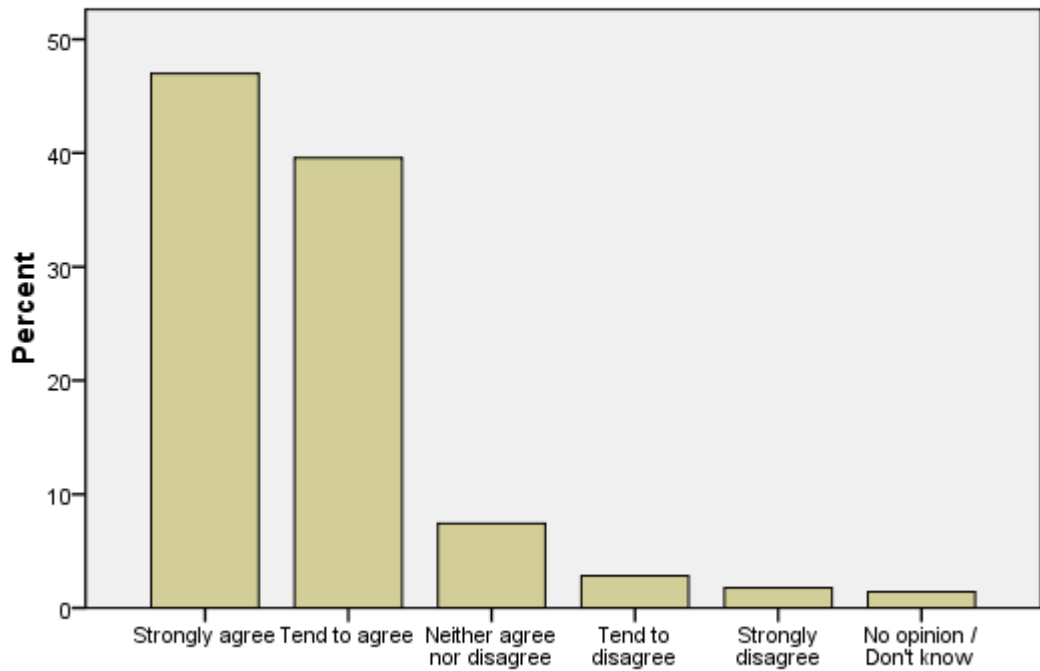
2b) *'It sounds like a good idea but I'd need to know more about it (district heating).'*

2c) *'I'm not sure that I quite understand what district heating involves yet.'*

These three statements were intended to assess participants' initial support for the conceptual idea of district heating; the extent to which they felt they would need further information about district heating, as prospective consumers; and the extent to which they felt that they currently understood the concept of district heating, respectively.

As can be seen from Figure 5.2.1 and Table 5.2.1, 86.6% of participants agreed with the statement 'It sounds like a good idea in principle' (47% strongly agreed; 39.6% tended to agree). Therefore, participants' initial perceptions of district heating, as a concept, were very positive. A minority of only 4.6% of participants disagreed with the statement (1.8% strongly disagreed; 2.8% tended to disagree), so the proportion of participants that perceived district heating negatively was very low. In fact, nearly 19 times as many participants indicated positive, rather than negative, responses towards district heating. A small percentage of participants neither agreed nor disagreed with the statement (7.4%) or indicated 'No opinion/Don't know' responses (1.4%) and can thus be considered to hold indifferent or ambivalent attitudes towards district heating.

**Q2a. District heating sounds like a good idea in principle**



**Q2a. District heating sounds like a good idea in principle**

FIGURE 5.2.1 Bar chart showing participants' responses to Question 2a

**Q2a. District heating sounds like a good idea in principle**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	133	42.6	47.0	47.0
	Tend to agree	112	35.9	39.6	86.6
	Neither agree nor disagree	21	6.7	7.4	94.0
	Tend to disagree	8	2.6	2.8	96.8
	Strongly disagree	5	1.6	1.8	98.6
	No opinion / Don't know	4	1.3	1.4	100.0
	Total	283	90.7	100.0	
Missing	System	29	9.3		
Total		312	100.0		

TABLE 2.1.1: Results table showing participants' responses to Question 2a

Figure 5.2.2 and Table 5.2.2 show that 86.5% of participants agreed with the statement ‘It sounds like a good idea but I’d need to know a lot more about it’ (51.1% strongly agreed; 35.3% tended to agree), which indicates that a very large majority of participants felt that they did not possess sufficient knowledge and information about district heating, and they would need much more information before they felt able to make a decision about entering into a district heating scheme. A total of only 3.8% of participants disagreed with the statement (1.5% strongly disagreed; 2.3% tended to disagree), which indicates that the proportion of participants who felt that they had received adequate information about district heating in order to commit to it, was very low. A small percentage of participants neither agreed nor disagreed with the statement (8.3%) or indicated ‘No opinion/Don’t know’ responses (1.5%).

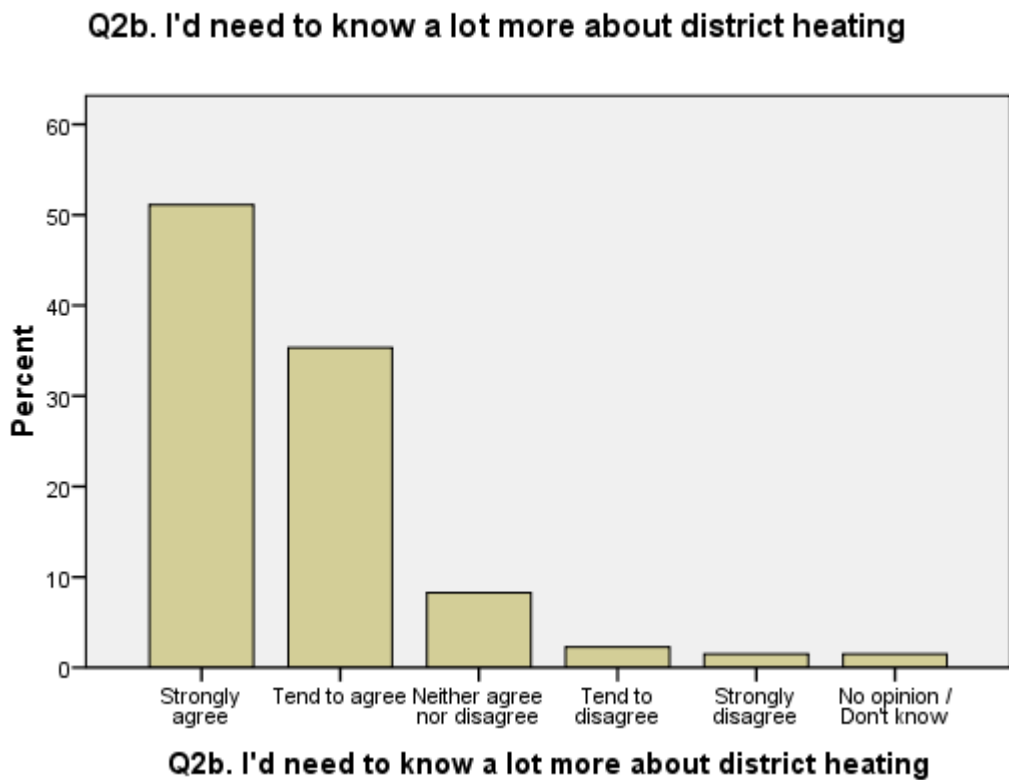


FIGURE 5.2.2: Bar chart showing participants’ responses to Question 2b

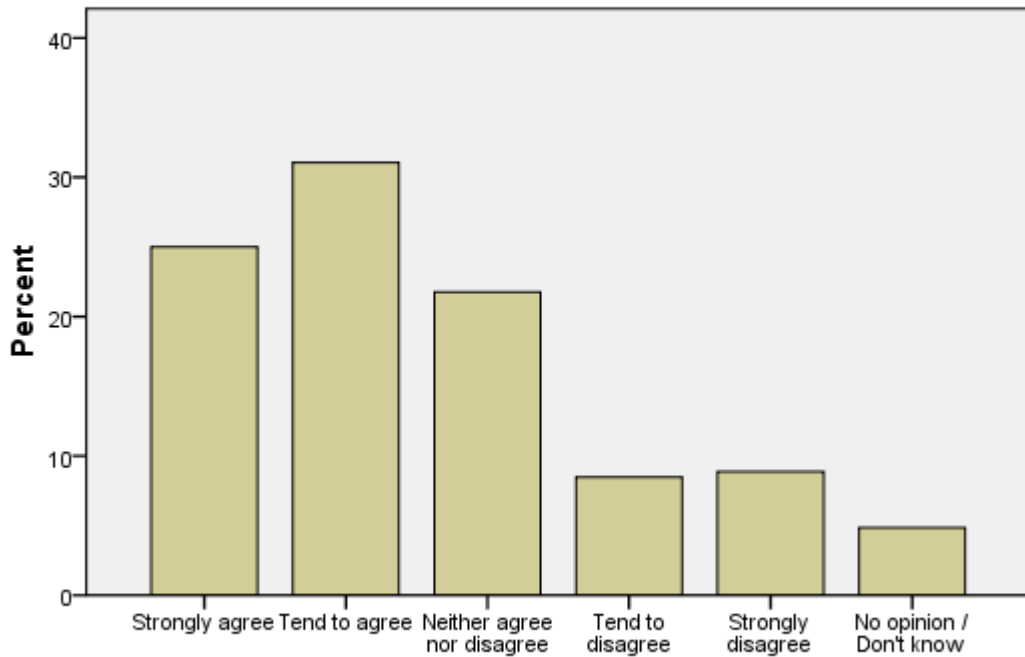
**Q2b. I'd need to know a lot more about district heating**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	136	43.6	51.1	51.1
	Tend to agree	94	30.1	35.3	86.5
	Neither agree nor disagree	22	7.1	8.3	94.7
	Tend to disagree	6	1.9	2.3	97.0
	Strongly disagree	4	1.3	1.5	98.5
	No opinion / Don't know	4	1.3	1.5	100.0
	Total	266	85.3	100.0	
Missing	System	46	14.7		
Total		312	100.0		

TABLE 5.2.2 Results Table showing participants' responses to Question 2b

Figure 5.2.3 and Table 5.2.3 show that 25% of the participants strongly agreed and 31% of participants tended to agree with the statement 'I'm not sure that I quite understand what district heating involves yet.' Therefore, over half of the participants (56%) felt that they did not adequately understand the conceptual idea of district heating. The percentage of participants who strongly disagreed or tended to disagree with this statement was fairly low; 8.9% and 8.5% of participants respectively. Therefore, only 17.4% of participants considered themselves to have a sufficient level of understanding of district heating. In addition, a significant proportion of participants neither agreed nor disagreed with the statement (21.8%) and a further 4.8% indicated 'No opinion/Don't know' responses.

**Q2c. I'm not sure that I quite understand what district heating involves yet**



**Q2c. I'm not sure that I quite understand what district heating involves yet**

FIGURE 5.2.3: Bar chart showing participants' responses to Question 2c

**Q2c. I'm not sure that I quite understand what district heating involves yet**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	62	19.9	25.0	25.0
	Tend to agree	77	24.7	31.0	56.0
	Neither agree nor disagree	54	17.3	21.8	77.8
	Tend to disagree	21	6.7	8.5	86.3
	Strongly disagree	22	7.1	8.9	95.2
	No opinion / Don't know	12	3.8	4.8	100.0
	Total	248	79.5	100.0	
Missing	System	64	20.5		
Total		312	100.0		

Table 5.2.3: Results table showing participants' responses to Question 2c

The results of Questions 1 and 2 indicate that despite very low levels of prior knowledge of district heating, participants were highly supportive of the conceptual idea of using waste process heat for district heating. However, there was clearly a high feeling of uncertainty regarding district heating among participants; participants' self-rated level of understanding of the overall concept was fairly low and a very high proportion of participants indicated that before making a decision about district heating, they would require much more information about it.

### **5.3 Question 3**

Participants were asked to consider four features which are characteristic of district heating schemes: temporary street disruption for pipe laying; installation of a small heat exchanger in the home/business; being tied into a heating/hot water contract for 12 months; and being tied into a heating/hot water contract for 24 months. The participants were asked to indicate the extent to which they would view each of these features favourably, based on the assumption of an annual heating bill reduction of 10-20%. The intention was to determine participants' willingness to accept disruption from technology installation (pipe laying and heat exchanger installation), as well as their willingness to accept contract lock-in, in return for reduced heating bills.

Figure 5.3.1 and Table 5.3.1 show that over half of the participants (57.8%) viewed temporary street disruption for pipe laying very favourably or favourably; 19.9% and 37.9% respectively. It was viewed unfavourably or very unfavourably by a mere 8% and 4.7% of participants, respectively, totalling 12.7%. Therefore, over four times as many participants responded favourably, rather than unfavourably, to temporary street disruption, which indicates a fairly high willingness to accept it in return for reduced heating bills. 26.9% of participants also indicated a neutral response. Therefore, a fairly substantial proportion of participants were somewhat indifferent to the prospect of temporary street disruption.

### Q3a. Perceptions of temporary street disruption

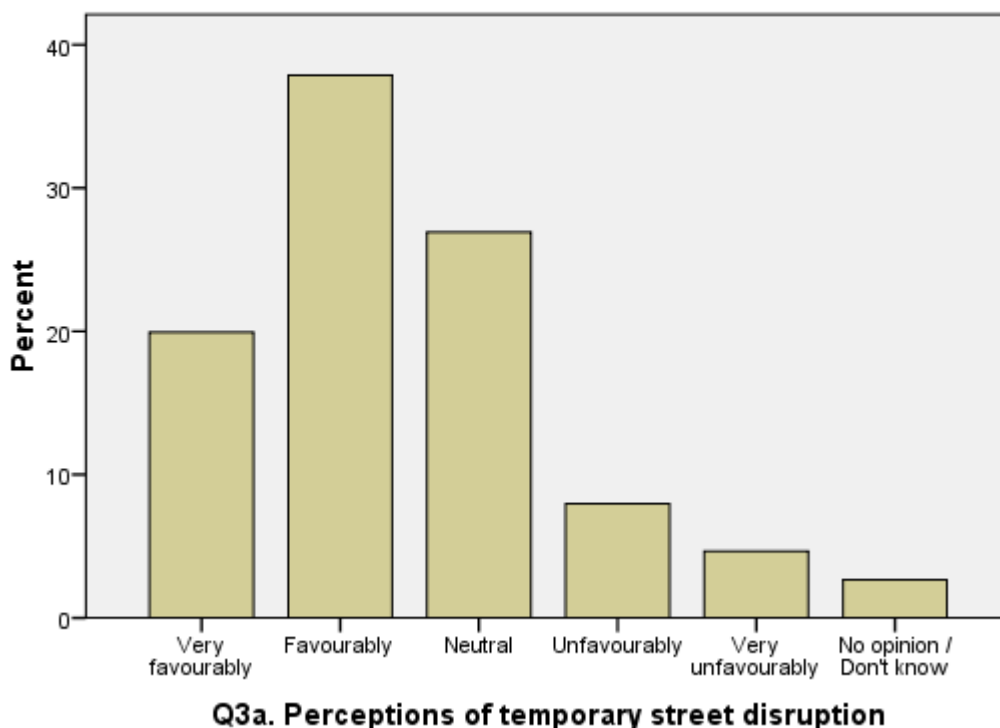


FIGURE 5.3.1: Bar chart showing participants' responses to Question 3a

### Q3a. Perceptions of temporary street disruption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	60	19.2	19.9	19.9
	Favourably	114	36.5	37.9	57.8
	Neutral	81	26.0	26.9	84.7
	Unfavourably	24	7.7	8.0	92.7
	Very unfavourably	14	4.5	4.7	97.3
	No opinion / Don't know	8	2.6	2.7	100.0
	Total	301	96.5	100.0	
Missing	System	11	3.5		
Total		312	100.0		

TABLE 5.3.1: Results table showing participants' responses to Question 3a

As Figure 5.3.2 and Table 5.3.2 show, installation of a heat exchanger in the home/business was viewed very favourably by 24.4% and favourably by 41.1% of participants, totalling 65.6%. It was viewed unfavourably by 6% and very unfavourably by 4.7% of participants, totalling 10.7%. Thus, six times as many participants responded favourably, rather than unfavourably, to the prospect of having a heat exchanger installed in their home or business, which suggests that there is a fairly high willingness for participants to accept this disruption in return for reduced heating bills. In addition, a substantial proportion of participants (19.7%) indicated a neutral response, which suggests that they were largely indifferent to it. Participants perceived having a heat exchanger installed in their homes/businesses slightly more positively than temporary street disruption for pipe laying.

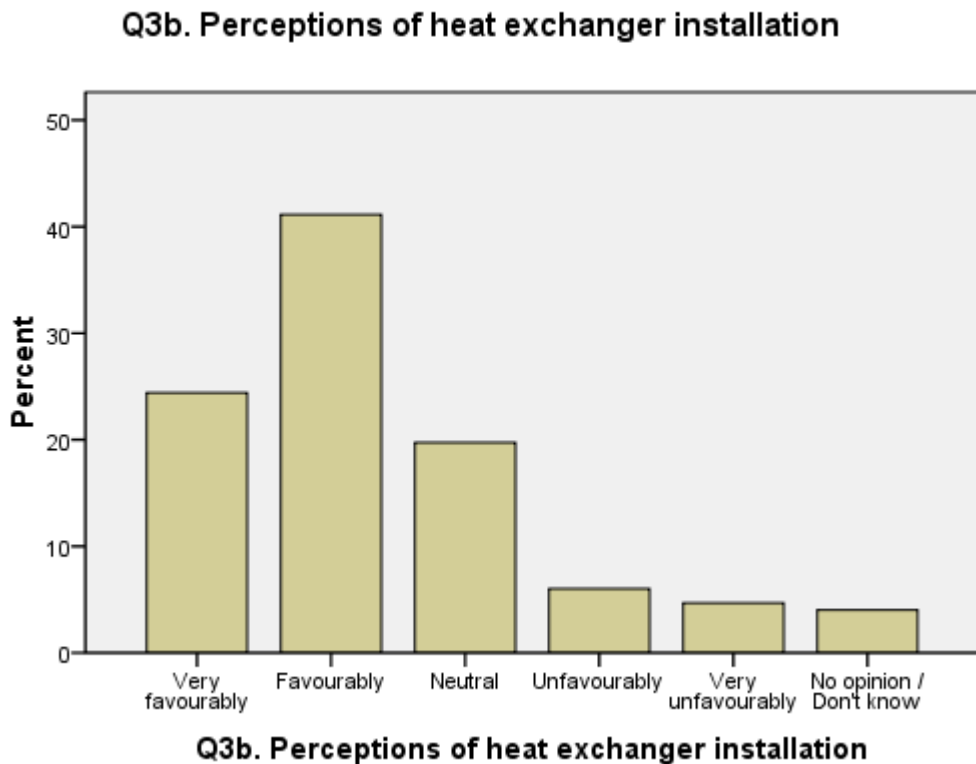


FIGURE 5.3.2: Bar chart showing participants' responses to Question 3b

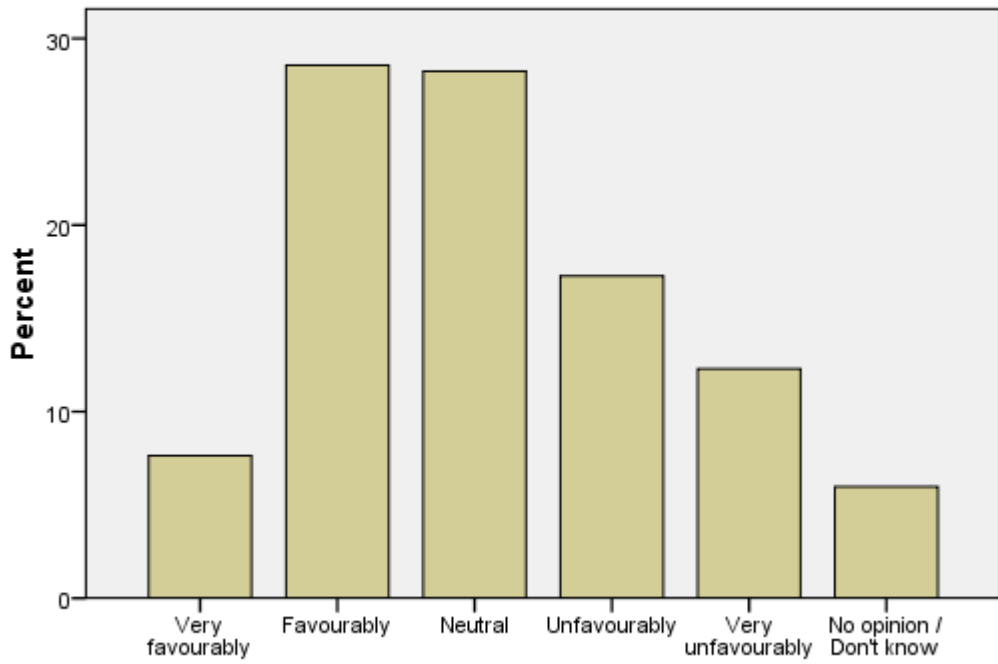
**Q3b. Perceptions of heat exchanger installation**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	73	23.4	24.4	24.4
	Favourably	123	39.4	41.1	65.6
	Neutral	59	18.9	19.7	85.3
	Unfavourably	18	5.8	6.0	91.3
	Very unfavourably	14	4.5	4.7	96.0
	No opinion / Don't know	12	3.8	4.0	100.0
	Total	299	95.8	100.0	
Missing	System	13	4.2		
Total		312	100.0		

TABLE 5.3.2: Results table showing participants' responses to Question 3b

As Figure 5.3.3 and Table 5.3.3 show, being tied into a 12 month heating/hot water contract was viewed very favourably or favourably by 7.6% and 28.6% of participants respectively, totalling 36.2%. It was considered unfavourably or very unfavourably by 17.3% and 12.3% respectively, totalling 29.6%. A substantial number of participants also considered it neutrally (28.2%) and 6% indicated 'Don't know/No opinion' responses. Although significantly more participants indicated favourable rather than unfavourable perceptions of being tied into a 12 month contract, the gap between the two poles is much smaller than it is for either temporary street disruption or heat exchanger installation. This indicates that although participants' perceptions of being tied into a 12 month contract are weakly positive, they are much less willing to accept contract lock-in compared to disruption from technology installation, in return for reduced energy bills.

**Q3c. Perceptions of 12 month contract lock-in**



**Q3c. Perceptions of 12 month contract lock-in**

FIGURE 5.3.3: Bar chart showing participants' responses to Question 3c

**Q3c. Perceptions of 12 month contract lock-in**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	23	7.4	7.6	7.6
	Favourably	86	27.6	28.6	36.2
	Neutral	85	27.2	28.2	64.5
	Unfavourably	52	16.7	17.3	81.7
	Very unfavourably	37	11.9	12.3	94.0
	No opinion / Don't know	18	5.8	6.0	100.0
	Total	301	96.5	100.0	
Missing	System	11	3.5		
Total		312	100.0		

TABLE 5.3.3: Results table showing participants' responses to Question 3c

The duration of the contract also had a substantial influence on participants' perceptions. Figure 5.3.4 and Table 5.3.4 show that being tied into a 24 month contract was regarded unfavourably by 31.3% and very unfavourably by 25.8% of participants. Therefore, more than half of the participants (57.1%) indicated negative responses towards being tied into a 24 month contract, which is almost twice the number that indicated negative responses towards being tied into a 12 month contract. In addition, being tied into a 24 month contract was rated very favourably by 4% and favourably by 8% of participants, which gives a total of only 12%. Three times as many participants indicated favourable responses towards being tied into a 12 month contract. Willingness to accept a 24 month contract lock-in, in return for reduced heating bills was therefore very low among participants and participants were much more willing to accept contract lock-in for the duration of 12 months.



FIGURE 5.3.4: Bar chart showing participants' responses to Question 3d

**Q3d. Perceptions of 24 month contract lock-in**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	11	3.5	4.0	4.0
	Favourably	22	7.1	8.0	12.0
	Neutral	65	20.8	23.6	35.6
	Unfavourably	86	27.6	31.3	66.9
	Very unfavourably	71	22.8	25.8	92.7
	No opinion / Don't know	20	6.4	7.3	100.0
	Total	275	88.1	100.0	
Missing	System	37	11.9		
Total		312	100.0		

Table 5.3.4: Results table showing participants' responses to Question 3d

The results of Question 3 indicate that although participants perceived temporary street disruption slightly less favourably than they perceived heat exchanger installation, willingness to accept disruption due to either of these technological installations was fairly high (based on the assumption of a 10-20% annual heating bill reduction). Compared to technological disruption, participants were much less willing to accept being tied into a heating/hot water contract for either 12 or 24 months, although this effect was also much more pronounced for the latter option.

#### **5.4 Question Four**

Participants were asked to indicate the extent to which they agreed with the following three statements:

*4a) 'I'd be willing to accept district heating in return for a 10-20% cut in my heating bill.'*

*4b) 'I would not be willing to accept district heating.'*

4c) *'I'm still unsure – I would need to know exactly what was being offered.'*

The intention was to assess participants' willingness to accept district heating in general (rather than their willingness to accept specific aspects relating to district heating schemes) and to assess to what extent participants felt they would need further information about district heating before they could consider accepting it.

As Figure 5.4.1 and Table 5.4.1 show, a large majority of participants (75.1%) agreed that they would be willing to accept district heating in return for a 10-20% cut in their heating bills (33.8% strongly agreed and 41.3% tended to agree). In addition, 2.7% tended to disagree and 3.1% strongly disagreed, giving a total of only 5.8%. This indicates a high willingness to accept district heating among participants.

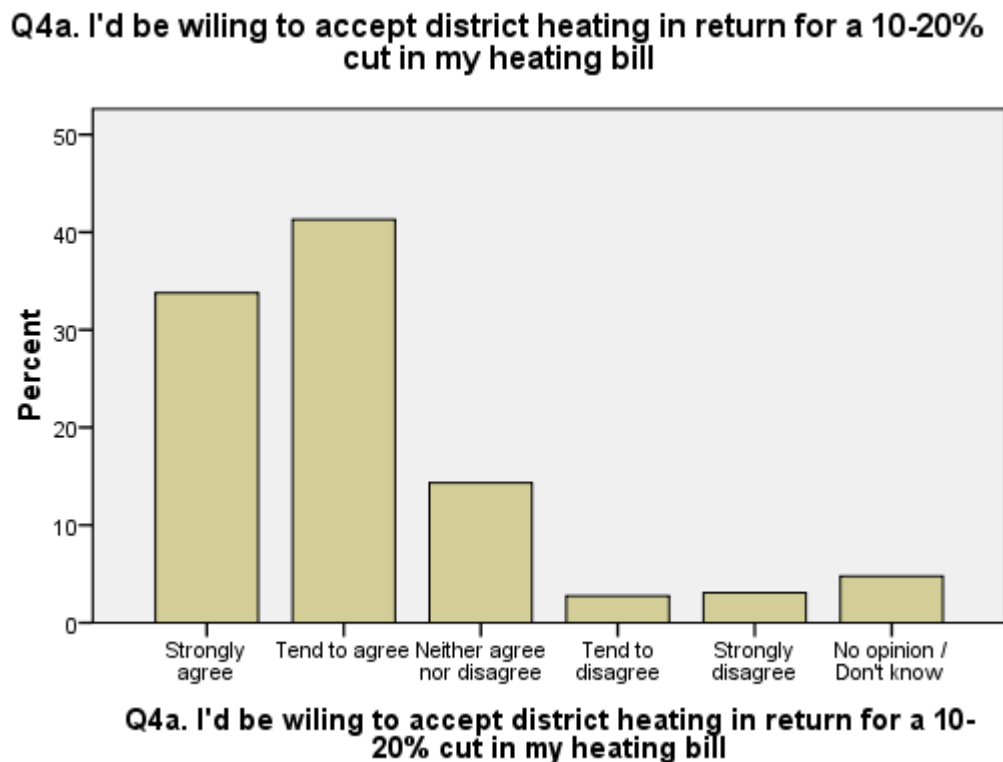


FIGURE 5.4.1: Bar chart showing participants' responses to Question 4a

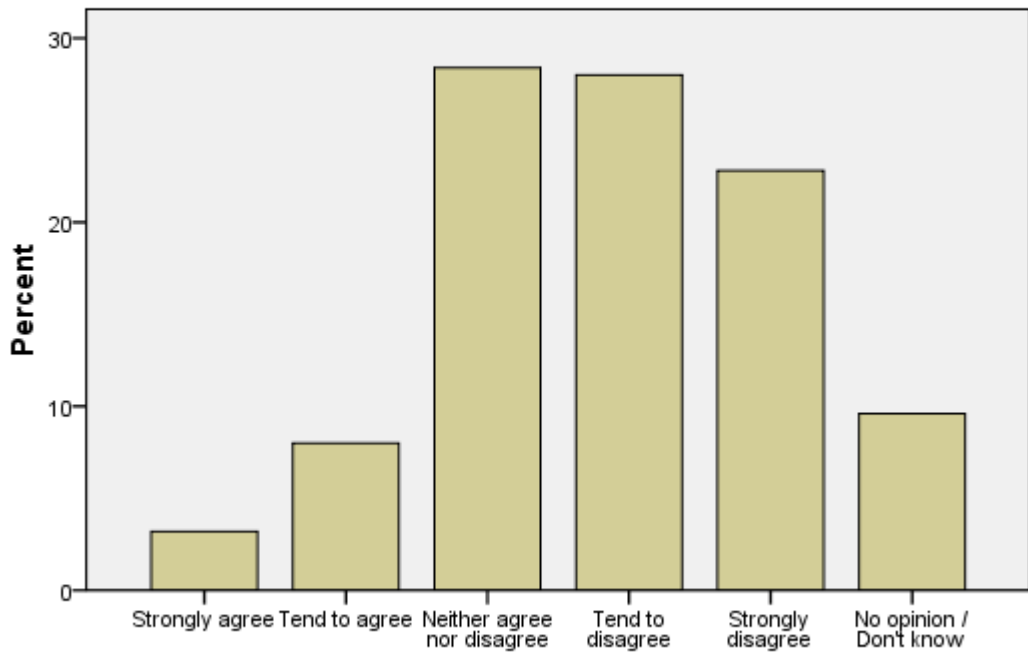
**Q4a. I'd be willing to accept district heating in return for a 10-20% cut in my heating bill**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	99	31.7	33.8	33.8
	Tend to agree	121	38.8	41.3	75.1
	Neither agree nor disagree	42	13.5	14.3	89.4
	Tend to disagree	8	2.6	2.7	92.2
	Strongly disagree	9	2.9	3.1	95.2
	No opinion / Don't know	14	4.5	4.8	100.0
	Total	293	93.9	100.0	
Missing	System	19	6.1		
Total		312	100.0		

Table 5.4.1: Results table showing participants' responses to Question 4a

Figure 5.4.2 and Table 5.4.2 show that 3.2% of participants strongly agreed and 8% tended to agree with the statement 'I would not be willing to accept district heating,' giving a total of 11.2%. However, the percentage of participants who tended to disagree or strongly disagreed with this statement was much higher; 28% and 22.8% respectively, totalling 50.8%. A substantial number of participants also neither agreed nor disagreed with this statement (28.4%) and a significant minority indicated 'No opinion/Don't know' responses (9.6%). As the number of participants who would not be willing to accept district heating is very low, and over four times as many participants indicated that they would be willing to accept it, this implies an overall low level of resistance towards district heating among participants.

**Q4b. I would not be willing to accept district heating**



**Q4b. I would not be willing to accept district heating**

FIGURE 5.4.2: Bar chart showing participants' responses to Question 4b

**Q4b. I would not be willing to accept district heating**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	8	2.6	3.2	3.2
	Tend to agree	20	6.4	8.0	11.2
	Neither agree nor disagree	71	22.8	28.4	39.6
	Tend to disagree	70	22.4	28.0	67.6
	Strongly disagree	57	18.3	22.8	90.4
	No opinion / Don't know	24	7.7	9.6	100.0
	Total	250	80.1	100.0	
Missing	System	62	19.9		
Total		312	100.0		

TABLE 5.4.2: Results table showing participants' responses to Question 4b

Figure 5.4.3 and Table 5.4.3 show that a large proportion of participants (62.8%) agreed with the statement ‘I’m still unsure - I would need to know exactly what was being offered,’ (31.6% strongly agreed; 31.2% tended to agree). This clearly indicates a high feeling of uncertainty among participants regarding what district heating actually involves, and a need to know more about the consumer conditions of district heating prior to accepting it. Much smaller numbers of participants tended to disagree (5.6%) or strongly disagreed (5.6%) with the statement, which therefore implies that only 11.2% felt sure of their position on district heating. Additionally, 20.3% of participants neither agreed nor disagreed, indicating a fairly high level of indifference among participants.

**Q4c. I'm still unsure - I would need to know exactly what was being offered**

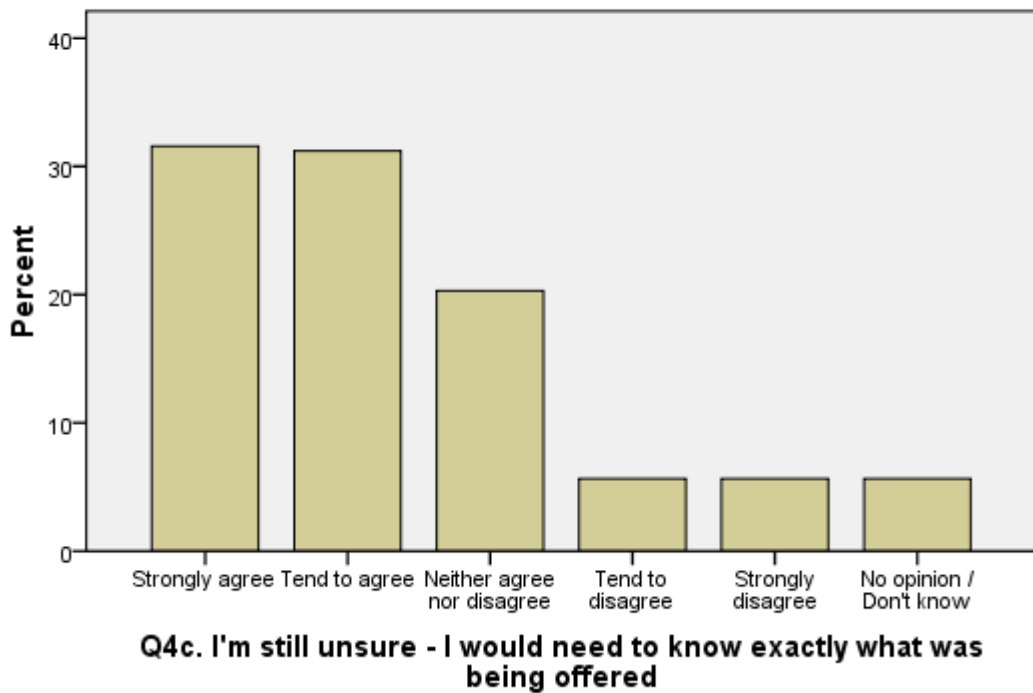


FIGURE 5.4.3: Bar chart showing participants’ responses to Question 4c

**Q4c. I'm still unsure - I would need to know exactly what was being offered**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	84	26.9	31.6	31.6
	Tend to agree	83	26.6	31.2	62.8
	Neither agree nor disagree	54	17.3	20.3	83.1
	Tend to disagree	15	4.8	5.6	88.7
	Strongly disagree	15	4.8	5.6	94.4
	No opinion / Don't know	15	4.8	5.6	100.0
	Total	266	85.3	100.0	
Missing	System	46	14.7		
Total		312	100.0		

TABLE 5.4.3: Results tables showing participants' responses to Question 4c

The results of Question 4 indicate that participants' willingness to accept district heating, in return for an annual heating bill reduction of 10-20%, was high, although a significant minority demonstrated moderate or strong resistance towards it. In correlation with the results of Question 2, high levels of uncertainty and a need for further information were also evident.

### 5.5 Question 5

Participants were asked to consider a number of aspects relating to heating and hot water. These were: reputation of the supplier; contract flexibility (being able to leave a contract without penalty); cost; degree of control over the heat supply (e.g. ability to adjust the thermostat); reliability of the heat supply; and environmental impact. Participants were asked to indicate the extent to which they considered each of these aspects to be important. The intention was to determine which aspects relating to heating and hot water were considered by consumers to be most important.

As Figures 5.5.1-5.5.6 and Tables 5.5.1-5.5.6 show, all of the aspects relating to heating and hot water can be considered to have a high degree of importance for

consumers, as they were all rated as either very important or important by a large majority of participants. The percentage of participants who indicated a very important or important rating was 87.5% for reputation of the supplier (66% very important; 21.5% important); 94.4% for contract flexibility (73.4% very important; 21% important); 96.6% for cost (84.6% very important; 12.1% important); 93.7% for degree of control over the heat supply (74.3% very important; 19.3% important); 97% for reliability of the heat supply (83.7% very important; and 13.3% important); and 85.8% for environmental impact (55.7% very important; 30.1% important). Much smaller numbers of participants indicated neutral, unimportant, very unimportant or 'No opinion/don't know' responses for all of these aspects.

Based on these ratings it is possible to crudely assume that participants considered reliability of the heat supply to be the most important aspect, followed by cost, contract flexibility, degree of control over the heat supply, reputation of the supplier and environmental impact. However, as the difference between some of these ratings is very small it is not considered to be significant (for example, there is a 0.4% difference between participants' ratings for reliability and cost). Therefore, this ranking order is questionable.

Additionally, of the 85.8% of participants who considered the environmental impact of the heat supply to be very important or important, significantly more participants chose the latter option instead of the former, in comparison to the ratings for the other aspects. More participants also rated the environmental impact of the heat supply as neither important nor unimportant or as unimportant, in comparison to the other aspects. This indicates that the environmental impact of the heat supply is considered by consumers to be the least important aspect.

The results of Question 5 indicate that although the participants considered all of the aspects relating to heating and hot water to be important, participants considered the environmental impact of their heat supply to be significantly less important than the cost, reliability, contract flexibility, degree of control over the heat supply or reputation of the supplier.

### Q5a. Perceived importance of supplier reputation

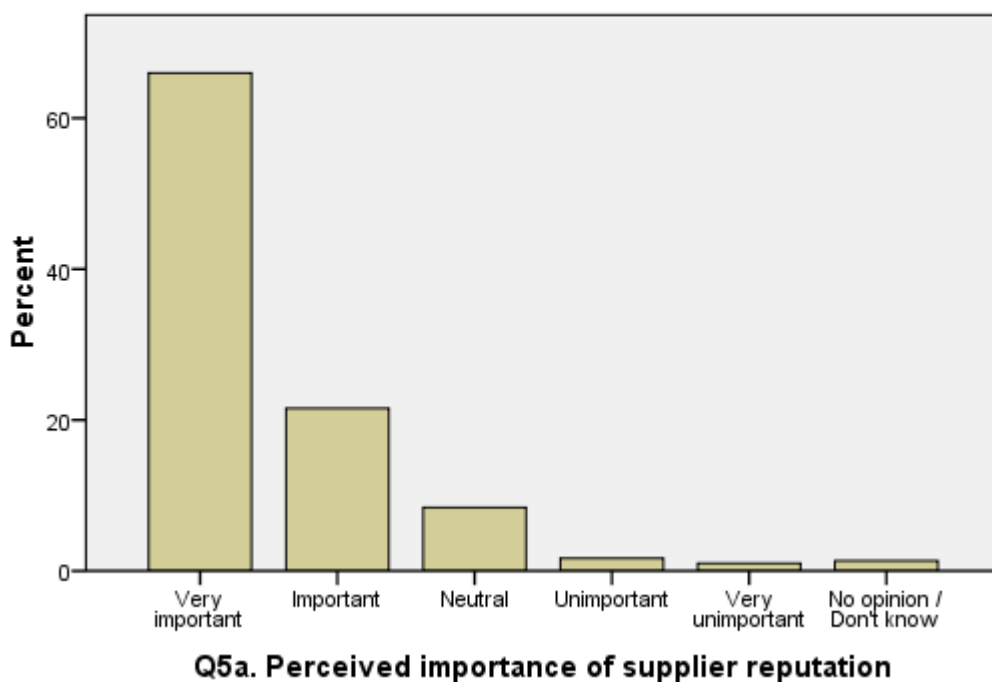


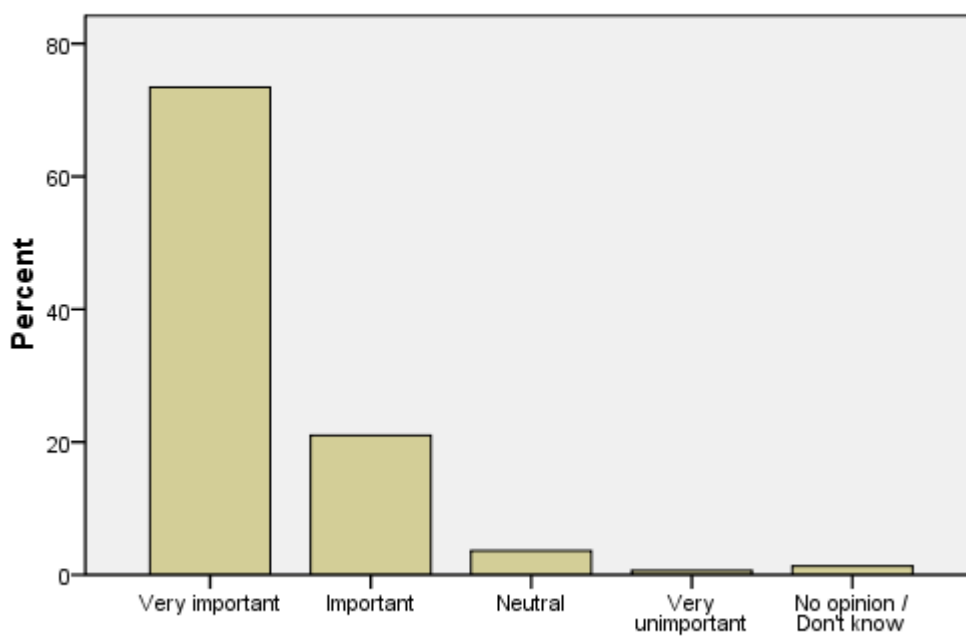
FIGURE 5.5.1: Bar chart showing participants' responses to Question 5a

### Q5a. Perceived importance of supplier reputation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	196	62.8	66.0	66.0
	Important	64	20.5	21.5	87.5
	Neutral	25	8.0	8.4	96.0
	Unimportant	5	1.6	1.7	97.6
	Very unimportant	3	1.0	1.0	98.7
	No opinion / Don't know	4	1.3	1.3	100.0
	Total	297	95.2	100.0	
Missing	System	15	4.8		
Total		312	100.0		

TABLE 5.5.1: Results table showing participants' responses to Question 5a

**Q5b. Perceived importance of contract flexibility**



**Q5b. Perceived importance of contract flexibility**

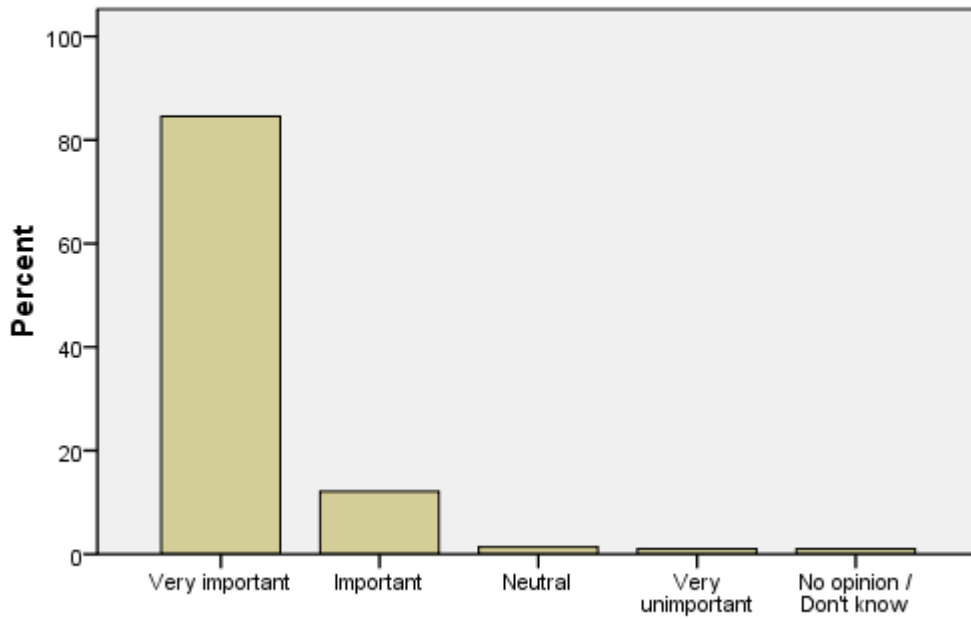
FIGURE 5.5.2: Bar chart showing participants' responses to Question 5b

**Q5b. Perceived importance of contract flexibility**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	224	71.8	73.4	73.4
	Important	64	20.5	21.0	94.4
	Neutral	11	3.5	3.6	98.0
	Very unimportant	2	.6	.7	98.7
	No opinion / Don't know	4	1.3	1.3	100.0
	Total	305	97.8	100.0	
Missing	System	7	2.2		
Total		312	100.0		

TABLE 5.5.2: Results table showing participants' responses to Question 5b

**Q5c. Perceived importance of cost**



**Q5c. Perceived importance of cost**

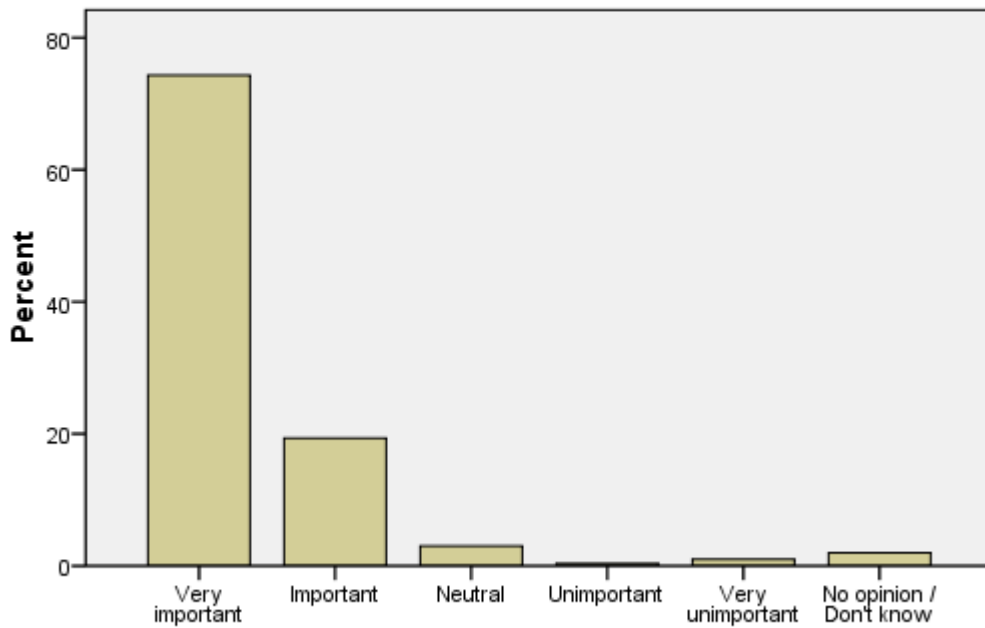
FIGURE 5.5.3: Bar chart showing participants' responses to Question 5c

**Q5c. Perceived importance of cost**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	252	80.8	84.6	84.6
	Important	36	11.5	12.1	96.6
	Neutral	4	1.3	1.3	98.0
	Very unimportant	3	1.0	1.0	99.0
	No opinion / Don't know	3	1.0	1.0	100.0
	Total	298	95.5	100.0	
Missing	System	14	4.5		
Total		312	100.0		

TABLE 5.5.3: Results table showing participants' responses to Question 5c

**Q5d. Perceived importance of control over heat supply**



**Q5d. Perceived importance of control over heat supply**

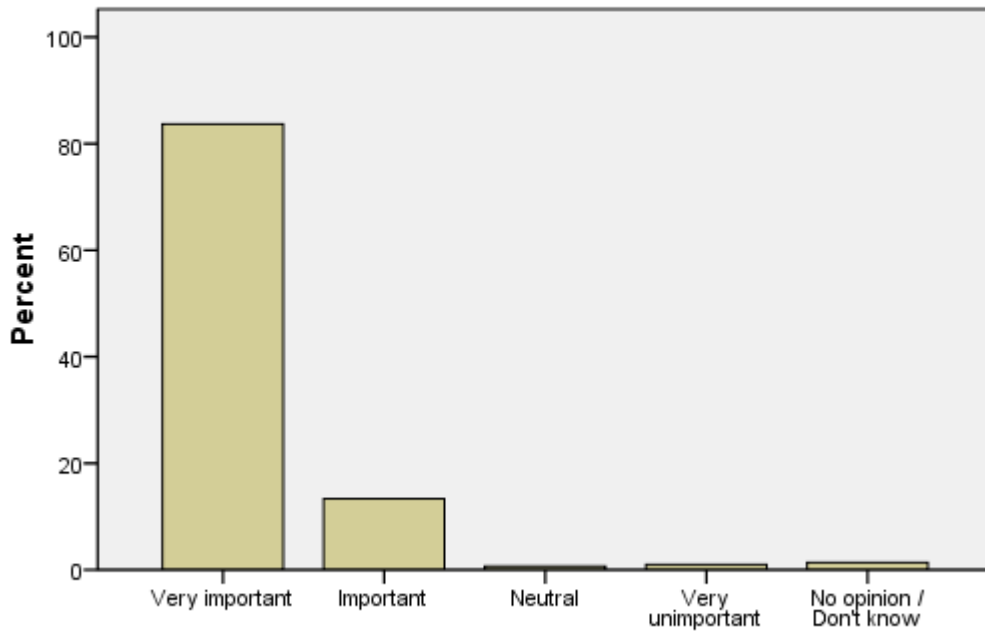
FIGURE 5.5.4: Bar chart showing participants' responses to Question 5d

**Q5d. Perceived importance of control over heat supply**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	223	71.5	74.3	74.3
	Important	58	18.6	19.3	93.7
	Neutral	9	2.9	3.0	96.7
	Unimportant	1	.3	.3	97.0
	Very unimportant	3	1.0	1.0	98.0
	No opinion / Don't know	6	1.9	2.0	100.0
	Total	300	96.2	100.0	
Missing	System	12	3.8		
Total		312	100.0		

FIGURE 5.5.4: Results table showing participants' responses to Question 5d

**Q5e. Perceived importance of reliability of heat supply**



**Q5e. Perceived importance of reliability of heat supply**

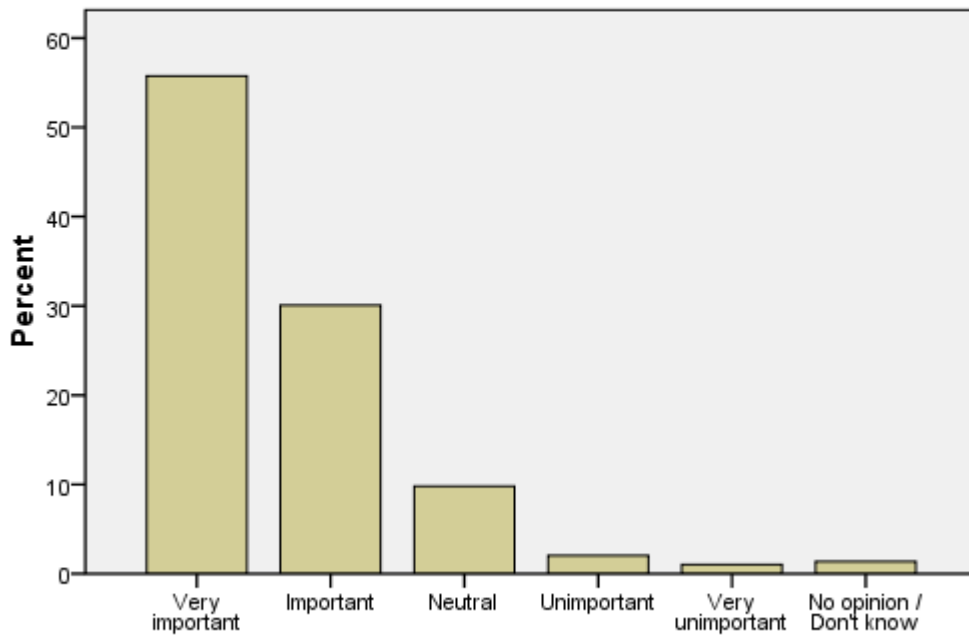
FIGURE 5.5.5: Bar chart showing participants' responses to Question 5e

**Q5e. Perceived importance of reliability of heat supply**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	251	80.4	83.7	83.7
	Important	40	12.8	13.3	97.0
	Neutral	2	.6	.7	97.7
	Very unimportant	3	1.0	1.0	98.7
	No opinion / Don't know	4	1.3	1.3	100.0
	Total	300	96.2	100.0	
Missing	System	12	3.8		
Total		312	100.0		

TABLE 5.5.5: Result table showing participants' responses to Question 5e

**Q5f. Perceived importance of environmental impact**



**Q5f. Perceived importance of environmental impact**

FIGURE 5.5.6: Bar chart showing participants' responses to Question 5f

**Q5f. Perceived importance of environmental impact**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	165	52.9	55.7	55.7
	Important	89	28.5	30.1	85.8
	Neutral	29	9.3	9.8	95.6
	Unimportant	6	1.9	2.0	97.6
	Very unimportant	3	1.0	1.0	98.6
	No opinion / Don't know	4	1.3	1.4	100.0
	Total	296	94.9	100.0	
Missing	System	16	5.1		
Total		312	100.0		

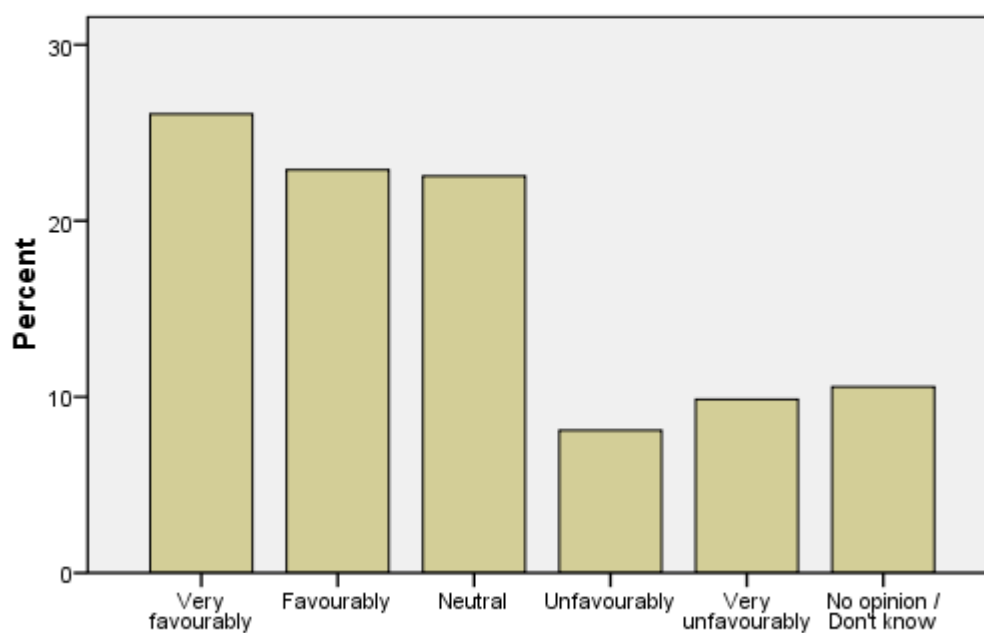
TABLE 5.5.6: Results table showing participants' responses to Question 5f

## 5.6 Question 6

Participants were asked to consider a number of different sources which can be used to supply the heat for district heating. These were: a waste incinerator; a coal or gas power station; a nuclear power station; biomass energy; and waste heat from industries. Participants were asked to indicate to what extent they would consider each of these heat sources favourably as part of a district heating scheme (assuming that the sources were already in place). The intention was to determine how participants' perceptions of the use of waste process heat for district heating would differ from that of other sources of heat.

Figure 5.6.1 and Table 5.6.1 show that the proportion of the participants who considered waste incineration as a very favourable or favourable source of heat for district heating was 26.1% and 22.9% respectively, totalling 48.9%. It was considered unfavourably or very unfavourably by 8.1% and 9.9% of participants, respectively, giving a total of 18%. A significant number also indicated neutral (22.5%) or 'No opinion/Don't know' responses (10.6%). Therefore, in spite of a significant minority that demonstrated resistance, perceptions of waste incineration were fairly high among participants.

### Q6a. Perceptions of waste incinerator as heat source



**Q6a. Perceptions of waste incinerator as heat source**

FIGURE 5.6.1: Bar chart showing participants' responses to Question 6a

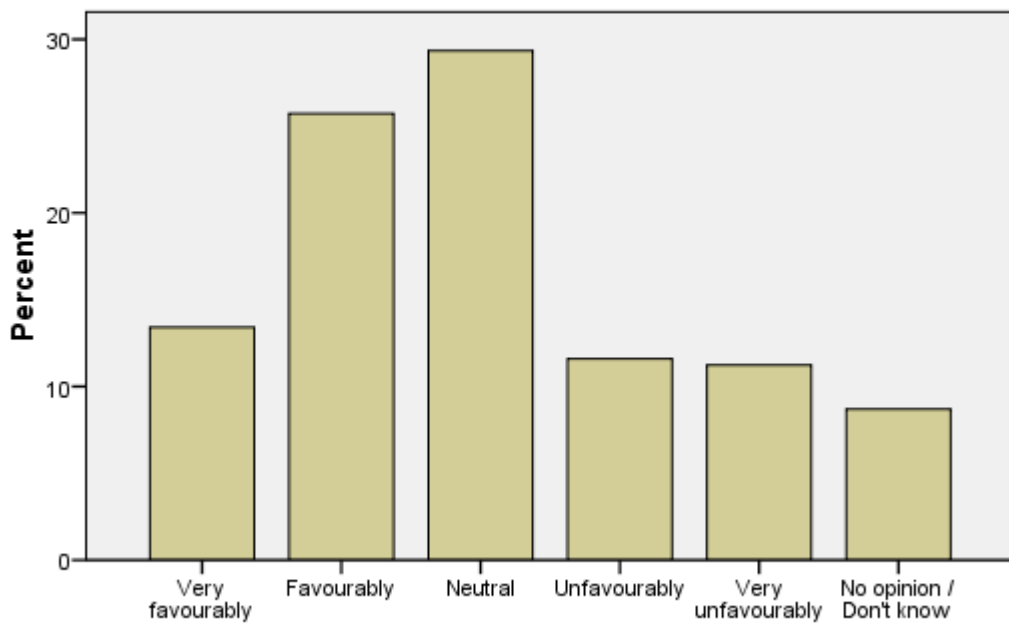
### Q6a. Perceptions of waste incinerator as heat source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	74	23.7	26.1	26.1
	Favourably	65	20.8	22.9	48.9
	Neutral	64	20.5	22.5	71.5
	Unfavourably	23	7.4	8.1	79.6
	Very unfavourably	28	9.0	9.9	89.4
	No opinion / Don't know	30	9.6	10.6	100.0
	Total	284	91.0	100.0	
Missing	System	28	9.0		
Total		312	100.0		

TABLE 5.6.1: Results table showing participants' responses to Question 6a

Figure 5.6.2 and Table 5.6.2 show that coal and gas power stations were perceived as very favourable or favourable sources of heat by 13.4% and 25.7% of participants respectively, totalling 39.1%. This is significantly higher than the number of participants who rated them unfavourably or very unfavourably (11.6% and 11.2% respectively) which totals 22.8%. A substantial number of participants also rated coal and gas power stations neutrally (29.3%) and 8.7% of participants indicated ‘No opinion/Don’t know’ responses. Therefore, despite highly mixed responses, there is a trend towards weakly positive perceptions of coal and gas power among participants.

**Q6b. Perceptions of coal or gas power station as heat source**



**Q6b. Perceptions of coal or gas power station as heat source**

FIGURE 5.6.2: Bar chart showing participants’ responses to Question 6b

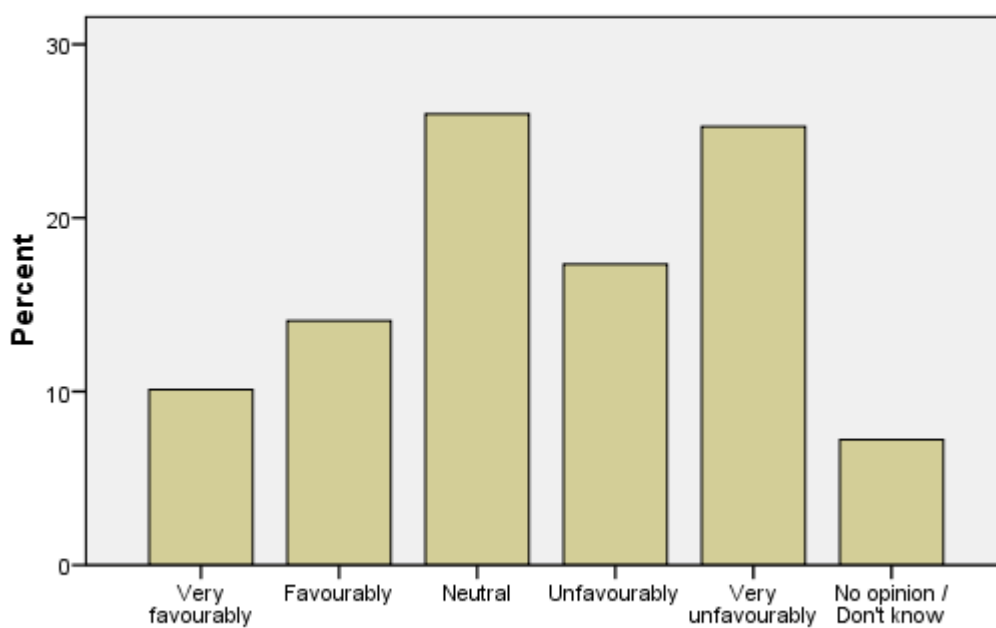
**Q6b. Perceptions of coal or gas power station as heat source**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	37	11.9	13.4	13.4
	Favourably	71	22.8	25.7	39.1
	Neutral	81	26.0	29.3	68.5
	Unfavourably	32	10.3	11.6	80.1
	Very unfavourably	31	9.9	11.2	91.3
	No opinion / Don't know	24	7.7	8.7	100.0
	Total	276	88.5	100.0	
Missing	System	36	11.5		
Total		312	100.0		

TABLE 5.6.2: Results table showing participants' responses to Question 6b

Figure 5.6.3 and Table 5.6.3 show that nuclear power was considered very favourably or favourably by 10.1% and 14.1% of participants respectively, totalling 24.2%. However, nuclear power was considered unfavourably and very unfavourably by 17.3% and 25.3% of participants, respectively, totalling 42.6%. Therefore nearly twice as many participants rated it unfavourably rather than favourably. A large number of participants (26%) indicated neutral responses and 7.2% stated 'No opinion/Don't know' responses. Therefore, despite the fact that a substantial number of participants regarded nuclear power positively, it was rated negatively by significantly more participants. Of these, a large proportion considered it to be very unfavourable.

### Q6c. Perceptions of nuclear power station as heat source



**Q6c. Perceptions of nuclear power station as heat source**

FIGURE 5.6.3: Bar chart showing participants' responses to Question 6c

### Q6c. Perceptions of nuclear power station as heat source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	28	9.0	10.1	10.1
	Favourably	39	12.5	14.1	24.2
	Neutral	72	23.1	26.0	50.2
	Unfavourably	48	15.4	17.3	67.5
	Very unfavourably	70	22.4	25.3	92.8
	No opinion / Don't know	20	6.4	7.2	100.0
	Total	277	88.8	100.0	
Missing	System	35	11.2		
Total		312	100.0		

TABLE 5.6.3: Results table showing participants' responses to Question 6c

Figure 5.6.4 and Table 5.6.4 show that the percentage of participants who considered biomass energy as a very favourable or favourable heat source was 11.9% and 20.5% respectively, giving a total of 32.4%. The proportion of participants who considered it unfavourably or very unfavourably was 10.4% and 11.5% respectively, giving a total of 21.9%. A large proportion of participants also indicated neutral (30.9%) and ‘No opinion/Don’t know’ (14.7%) responses, which suggests that participants’ knowledge of biomass energy is limited. Therefore, despite highly mixed responses, there is a trend towards weakly positive perceptions of biomass energy, among participants.

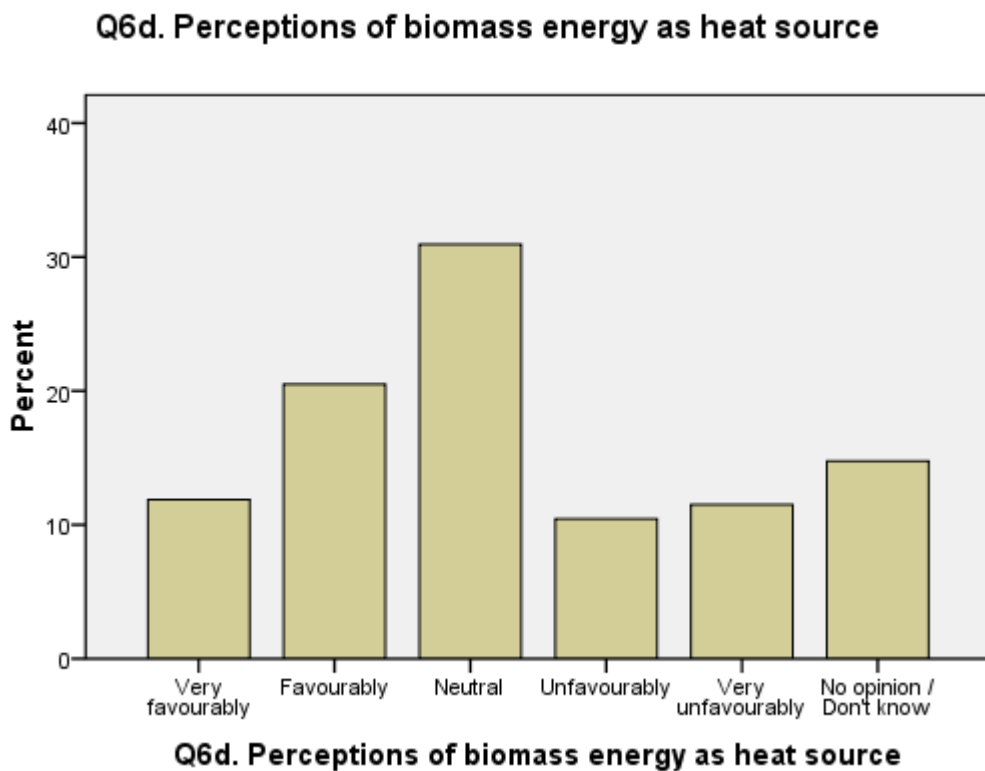


FIGURE 5.6.4: Bar chart showing participants’ responses to Question 6d

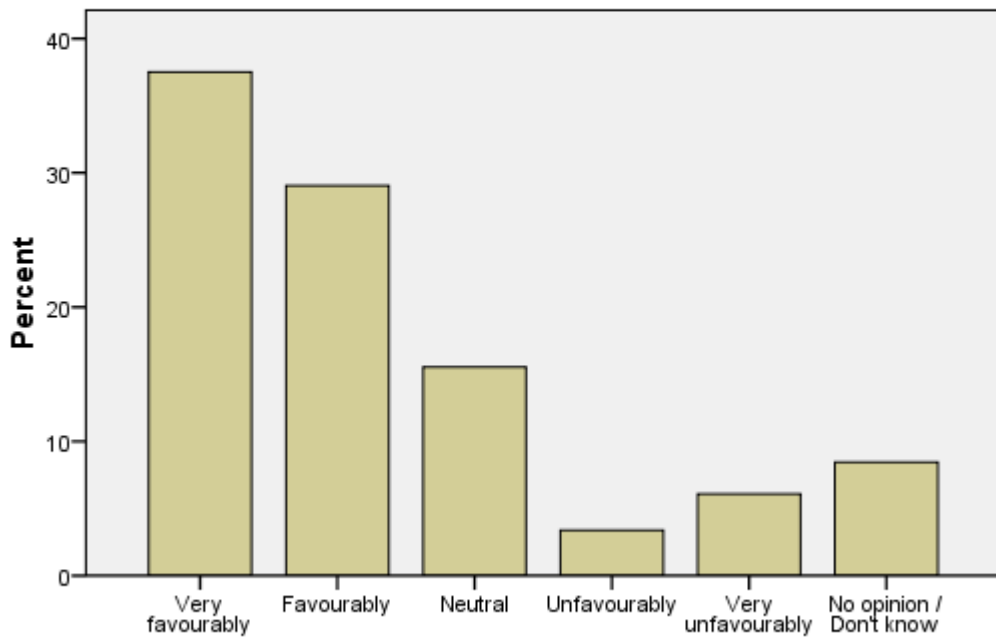
**Q6d. Perceptions of biomass energy as heat source**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	33	10.6	11.9	11.9
	Favourably	57	18.3	20.5	32.4
	Neutral	86	27.6	30.9	63.3
	Unfavourably	29	9.3	10.4	73.7
	Very unfavourably	32	10.3	11.5	85.3
	No opinion / Don't know	41	13.1	14.7	100.0
	Total	278	89.1	100.0	
Missing	System	34	10.9		
Total		312	100.0		

TABLE 5.6.4: Results table showing participants' responses to Question 6d

Figure 5.6.5 and Table 5.6.5 show that a large majority of the participants considered waste heat from industries to be a very favourable or favourable heat source; 37.5% and 29.1% respectively, totalling 66.6%. Far fewer participants rated industrial waste heat unfavourably or very unfavourably; 3.4% and 6.1% respectively, totalling only 9.5%. Therefore, nearly seven times as many participants considered waste industrial heat to be a favourable, rather than an unfavourable, heat source for district heating. A substantial proportion also indicated neutral (15.5%) and 'No opinion/Don't know' (8.4%) responses.

**Q6e. Perceptions of waste heat from industries as heat source**



**Q6e. Perceptions of waste heat from industries as heat source**

FIGURE 5.6.5: Bar chart showing participants' responses to Question 6e

**Q6e. Perceptions of waste heat from industries as heat source**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very favourably	111	35.6	37.5	37.5
	Favourably	86	27.6	29.1	66.6
	Neutral	46	14.7	15.5	82.1
	Unfavourably	10	3.2	3.4	85.5
	Very unfavourably	18	5.8	6.1	91.6
	No opinion / Don't know	25	8.0	8.4	100.0
	Total	296	94.9	100.0	
Missing	System	16	5.1		
Total		312	100.0		

TABLE 5.6.5: Results table showing participants' responses to Question 6e

The results of Question 6 indicate that a large proportion of the participants perceived waste industrial heat to be a favourable heat source for district heating. Waste industrial heat was considered to be by far the most favourable source of heat for district heating in comparison to other heat sources.

### **5.7 Question 7**

Participants were asked to indicate to what extent they agreed with the following statement:

*'I am very concerned with environmental issues.'*

The intention was to determine participants' self-rated level of environmental concern. Figure 5.7 and Table 5.7 show that a large majority of the participants considered themselves to be concerned about environmental issues as 43.1% of participants strongly agreed and 37.8% tended to agree with the statement, totalling 80.9%. Smaller numbers of participants (14.8%) neither agreed nor disagreed with the statement. However, the number of participants who tended to disagree or strongly disagreed (1.6% and 0.7% respectively) was very small, totalling a mere 2.3%. Additionally, 2% of participants stated no opinion.

**Q7. I am very concerned with environmental issues**

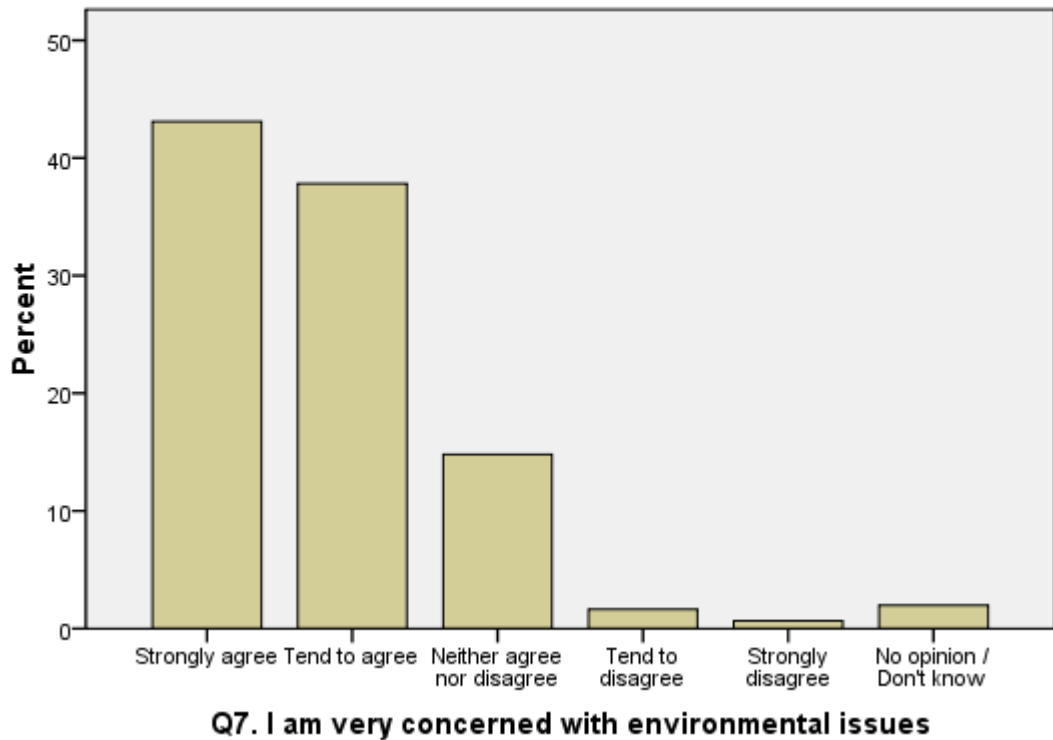


FIGURE 5.7: Bar chart showing participants' responses to Question 7

**Q7. I am very concerned with environmental issues**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	131	42.0	43.1	43.1
	Tend to agree	115	36.9	37.8	80.9
	Neither agree nor disagree	45	14.4	14.8	95.7
	Tend to disagree	5	1.6	1.6	97.4
	Strongly disagree	2	.6	.7	98.0
	No opinion / Don't know	6	1.9	2.0	100.0
	Total	304	97.4	100.0	
Missing	System	8	2.6		
Total		312	100.0		

TABLE 5.7: Results table showing participants' responses to Question 7

The results of Question 7 indicate that the self-rated levels of environmental concern among participants were very high.

### **5.8 Question 8**

Participants were asked to envisage a situation in which they were buying a new home. They were then presented with the following statements and were asked to indicate to what extent they agreed with each one (based on the assumption of an annual heating bill reduction of 10-20%):

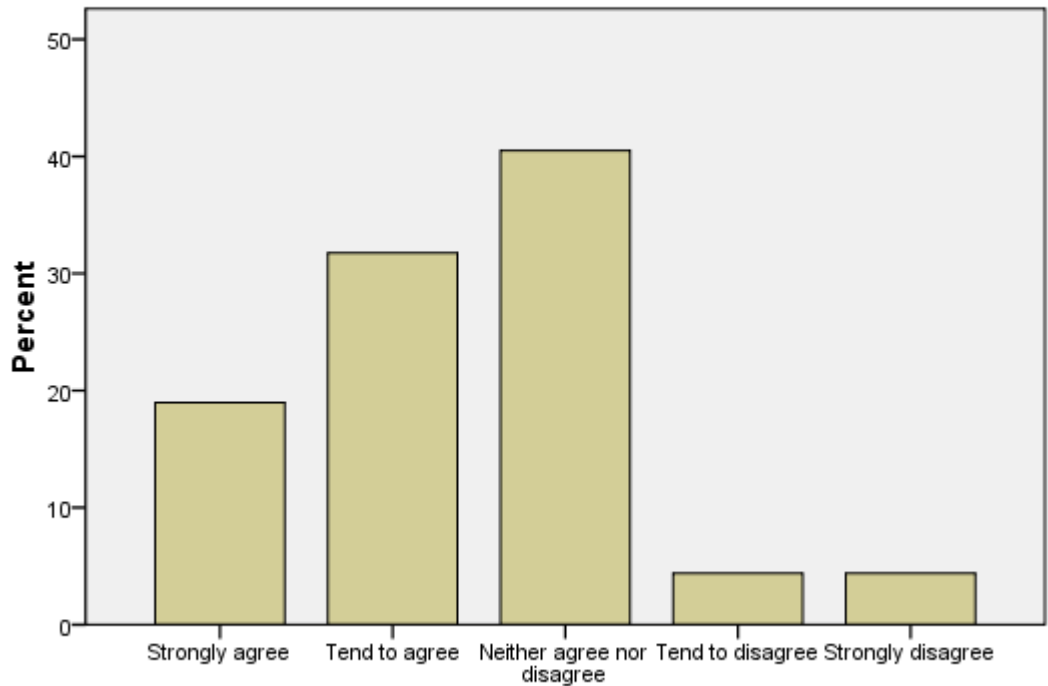
*8a) 'I would be more likely to buy a property with district heating.'*

*8b) 'I would be less likely to buy a property with district heating.'*

*8c) 'District heating would have no impact on my decision to buy a property.'*

The intention was to investigate participants' perceptions of properties with district heating. Figure 5.8.1 and Table 5.8.1 show that 50.7% of participants agreed with the statement 'I would be more likely to buy a property with district heating' (19% strongly agreed; 31.8% tended to agree), thereby indicating that they would consider district heating to be a positive asset to a property. A high proportion of participants neither agreed nor disagreed (40.5%), which indicates a high degree of indifference among participants. However, 4.4% of participants tended to disagree and 4.4% of participants strongly disagreed with the statement, which suggests that a minority of only 8.8% of participants considered district heating to be a negative asset to a property.

**Q8a. I would be more likely to buy a property with district heating**



**Q8a. I would be more likely to buy a property with district heating**

FIGURE 5.8.1: Bar chart showing participants' responses to Question 8a

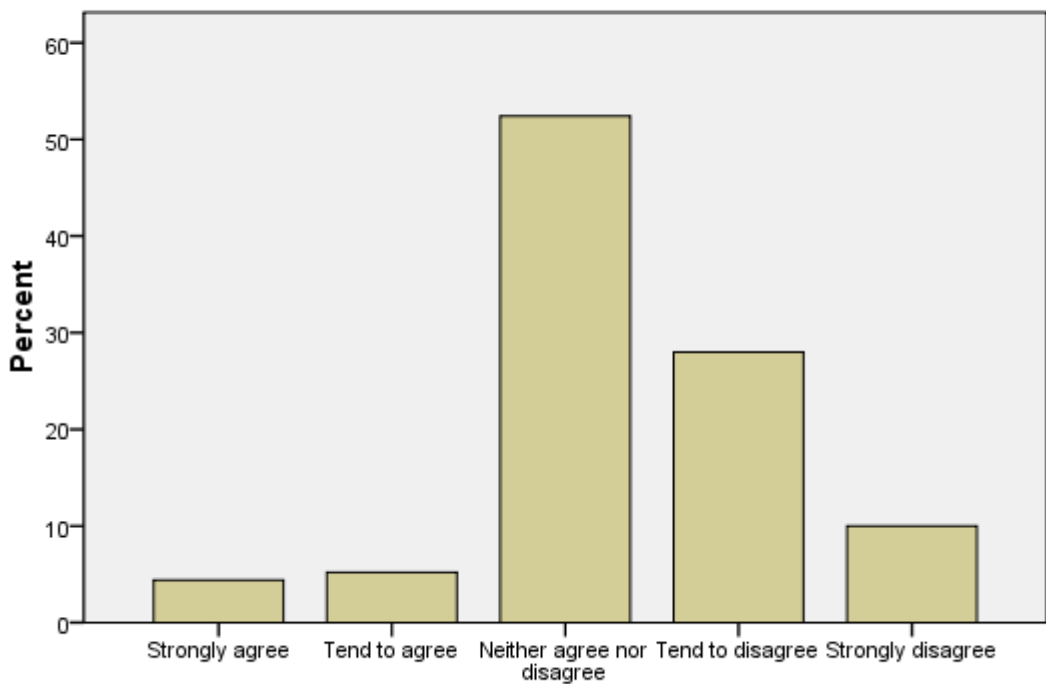
**Q8a. I would be more likely to buy a property with district heating**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	52	16.7	19.0	19.0
	Tend to agree	87	27.9	31.8	50.7
	Neither agree nor disagree	111	35.6	40.5	91.2
	Tend to disagree	12	3.8	4.4	95.6
	Strongly disagree	12	3.8	4.4	100.0
	Total	274	87.8	100.0	
Missing	System	38	12.2		
Total		312	100.0		

TABLE 5.8.1: Results table showing participants' responses to Question 8a

As Figure 5.8.2 and Table 5.8.2 show, a minority of only 4.4% of participants strongly agreed and 5.2% of participants tended to agree with the statement ‘I would be less likely to buy a property with district heating.’ Therefore, only 9.6% of participants would regard district heating as a negative asset to a property. A large number of participants (38%) disagreed with the statement (10% strongly disagreed; 28% tended to disagree) and therefore did not consider district heating to be a negative asset to a property. Over half of participants (52.4%) neither agreed nor disagreed with the statement, which indicates that they would consider district heating to be largely irrelevant to their decision to buy a new home. The high percentage of participants who indicated neutral or negative responses indicates that at the very least participants did not consider that district heating would detract from the value of a property.

**Q8b. I would be less likely to buy a property with district heating**



**Q8b. I would be less likely to buy a property with district heating**

FIGURE 5.8.2: Bar chart showing participants’ responses to Question 8b

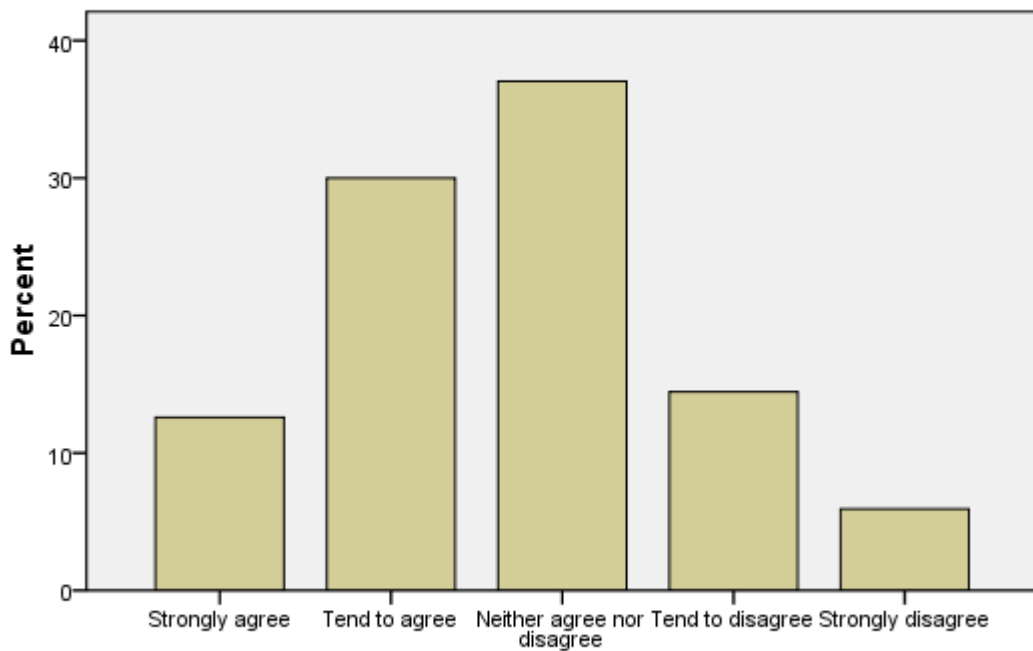
**Q8b. I would be less likely to buy a property with district heating**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	11	3.5	4.4	4.4
	Tend to agree	13	4.2	5.2	9.6
	Neither agree nor disagree	131	42.0	52.4	62.0
	Tend to disagree	70	22.4	28.0	90.0
	Strongly disagree	25	8.0	10.0	100.0
	Total	250	80.1	100.0	
Missing	System	62	19.9		
Total		312	100.0		

TABLE 5.8.2: Results table showing participants' responses to Question 8b

Figure 5.8.3 and Table 5.8.3 show that 42.6% of participants agreed (12.6% strongly agreed; 30% tended to agreed) with the statement 'District heating would have no impact on my decision to buy a property' which indicates that a fairly high percentage of participants would consider district heating to be largely irrelevant to their decision to buy a new home. A significant number neither agreed nor disagreed, (37%), which in itself indicates a high degree of indifference towards the issue. However, a significant minority disagreed with the statement (14.4% tended to disagree; 5.9% strongly disagreed) which indicates that when buying a property, district heating would be a consideration for 20.3% of participants.

**Q8c. District heating would have no impact on my decision to buy a property**



**Q8c. District heating would have no impact on my decision to buy a property**

FIGURE 5.8.3: Bar chart showing participants' responses to Question 8c

**Q8c. District heating would have no impact on my decision to buy a property**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	34	10.9	12.6	12.6
	Tend to agree	81	26.0	30.0	42.6
	Neither agree nor disagree	100	32.1	37.0	79.6
	Tend to disagree	39	12.5	14.4	94.1
	Strongly disagree	16	5.1	5.9	100.0
	Total	270	86.5	100.0	
Missing	System	42	13.5		
Total		312	100.0		

TABLE 5.8.3: Results table showing participants' responses to Question 8c

The results of Question 8 suggest that while there is certainly a high degree of indifference among participants, in relation to their perceptions of properties with district heating, a significant minority did indicate that district heating would have an influence on their decision to buy a property. In addition, significantly more participants considered district heating to be a positive, rather than a negative, asset to a property. This suggests a trend for weakly positive perceptions of properties with district heating among participants.

### **5.9 Question 9**

Participants were asked to indicate which of the following three statements best described their current position:

*9a) 'I make most or all of the decisions in my household or business regarding energy bills.'*

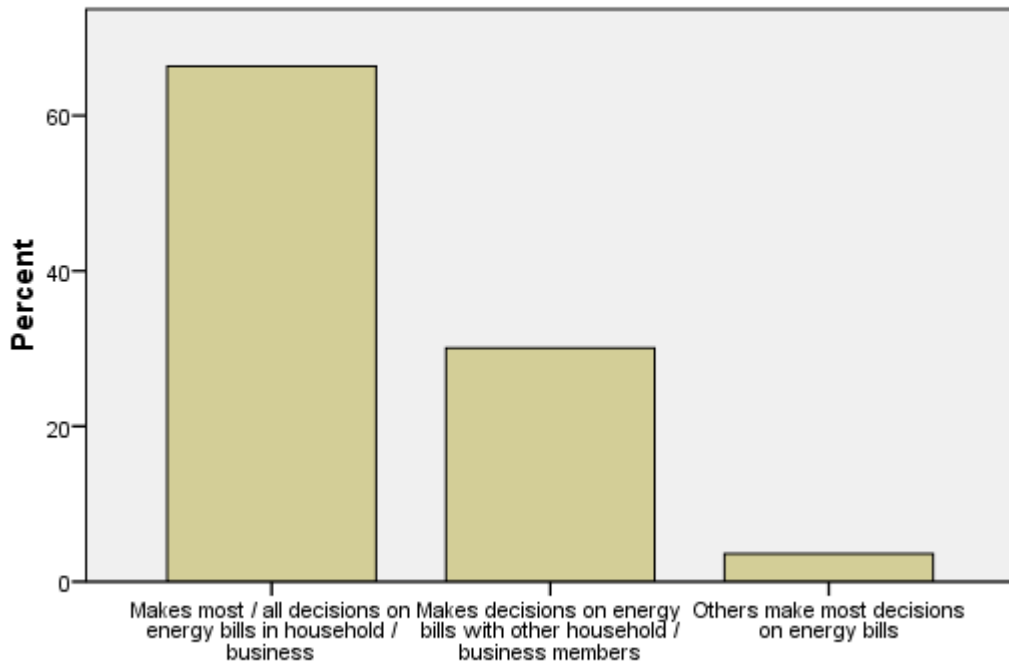
*9b) 'I make decisions regarding energy bills with other members of my household or business.'*

*9c) 'Other members of my household or business make most of the decisions regarding energy bills.'*

The intention was to determine participants' perceived degree of responsibility/autonomy with respect to making decisions on energy bills within their household or business. This question attempted to discover what percentage of respondents would be responsible for making the decision to sign up to a district heating scheme, should one be introduced. This was based on the assumption that the higher the percentage of respondents who had sole or partial responsibility for energy decisions within their home or business, the more relevant the results would be to planning purposes. As can be seen from Figure 5.9 and Table 5.9, a large majority of participants (66.3%) claimed to be solely responsible for making decisions regarding energy bills in their household or business. 30.1% of participants also claimed to make decisions with other

members of their household or business and only 3.6% reported that decisions were mostly made by other members of their household or business.

### Q9. Perceived responsibility / autonomy for energy bills



### Q9. Perceived responsibility / autonomy for energy bills

FIGURE 5.9: Bar chart showing participants' responses to Question 9

**Q9. Perceived responsibility / autonomy for energy bills**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Makes most / all decisions on energy bills in household / business	203	65.1	66.3	66.3
	Makes decisions on energy bills with other household / business members	92	29.5	30.1	96.4
	Others make most decisions on energy bills	11	3.5	3.6	100.0
	Total	306	98.1	100.0	
Missing	System	6	1.9		
Total		312	100.0		

TABLE 5.9: Results table showing participants’ responses to Question 9

The results of Question 9 indicate that the questionnaire responses are likely to be highly representative of citizens who have responsibilities for paying and making decisions on energy bills within their households/businesses, as a very large majority of the participants (96.4%) considered themselves to have sole or partial responsibility for this.

### 5.10 Question 10

Participants were asked to indicate to what extent they would be likely to sign up for district heating, based on the information they had received throughout the questionnaire. Figure 4.10 and Table 4.10 show that the most frequent response was ‘undecided’ which was chosen by 35.8% of the participants. This indicates a high degree of uncertainty about district heating among participants, even at the end of the questionnaire and is likely to reflect earlier responses which indicate that participants need more information on the topic. Responses of ‘somewhat likely,’ ‘likely,’ and ‘very likely’ were chosen by 16%, 20.5% and 12.4% of participants respectively, giving a total of 48.9%. ‘Very unlikely,’ ‘unlikely’ and ‘somewhat unlikely’ were chosen by 8.1%, 3.9% and 3.3% of participants

respectively, giving a total of 15.3%. Therefore, more than three times as many participants considered themselves likely, rather than unlikely, to sign up for district heating.

The results of Question 10 indicate that almost half of the participants considered themselves likely, to varying extents, to sign up for district heating and a further third were undecided. Although the numbers of participants that indicated unlikely responses, to varying extents, was low, a large proportion of them considered this ‘very unlikely’ indicating strong opposition among a minority.

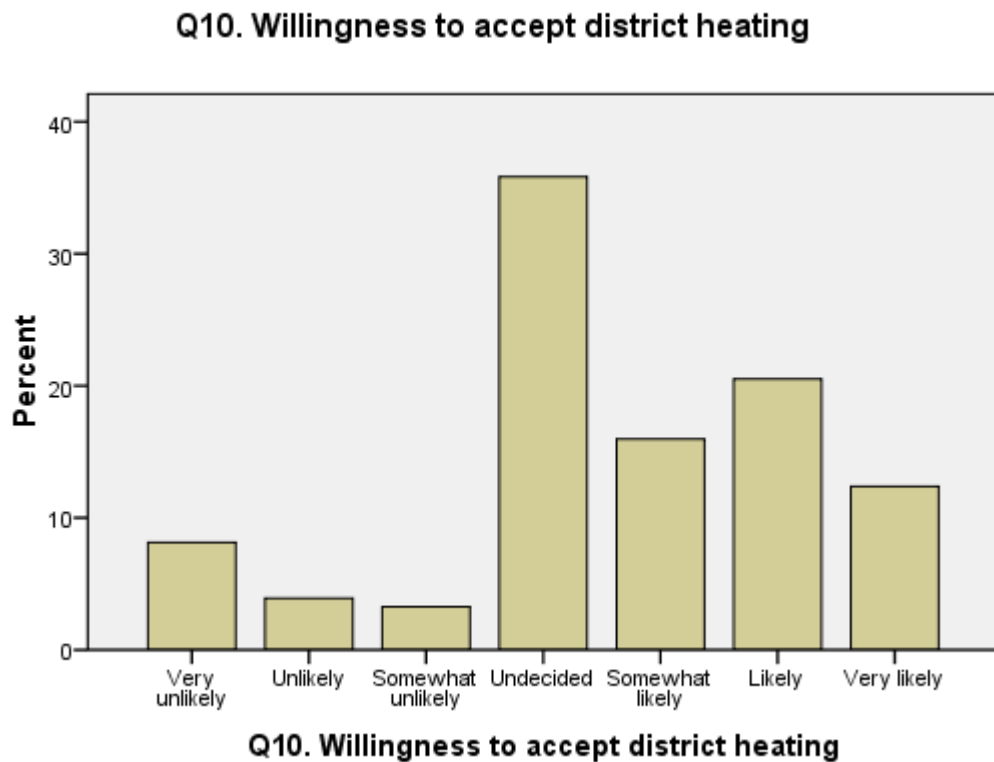


FIGURE 5.10: Bar chart showing participants' responses to Question 10

**Q10. Willingness to accept district heating**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very unlikely	25	8.0	8.1	8.1
	Unlikely	12	3.8	3.9	12.1
	Somewhat unlikely	10	3.2	3.3	15.3
	Undecided	110	35.3	35.8	51.1
	Somewhat likely	49	15.7	16.0	67.1
	Likely	63	20.2	20.5	87.6
	Very likely	38	12.2	12.4	100.0
	Total	307	98.4	100.0	
Missing	System	5	1.6		
Total		312	100.0		

TABLE 5.10: Results table showing participants' responses to Question 10

### 5.11 Question 11

Participants were asked to disclose their gender. The intention was to establish to what extent the participant sample was representative of the gender distribution of Neath Port Talbot residents. The results are discussed in section 4.2 of Chapter 4.

### 5.12 Question 12

Participants were asked to indicate whether their homes or businesses were privately owned, rented from a landlord or rented from the council in order to ascertain the household/business tenure arrangements of the sample of respondents. Figure 5.12 and Table 5.12 show that the majority of participants (66.6%) owned their home or business. 12.3% rented their home or business from a landlord and 21.1% rented their home or business from the council. The percentage of participants that owned their home or business is roughly comparable to the percentage of homeowners in the Neath Port Talbot population in the 2001 Census (71.3%), which suggests that the participants'

household/business tenure arrangements are largely representative of the Neath Port Talbot population as a whole.

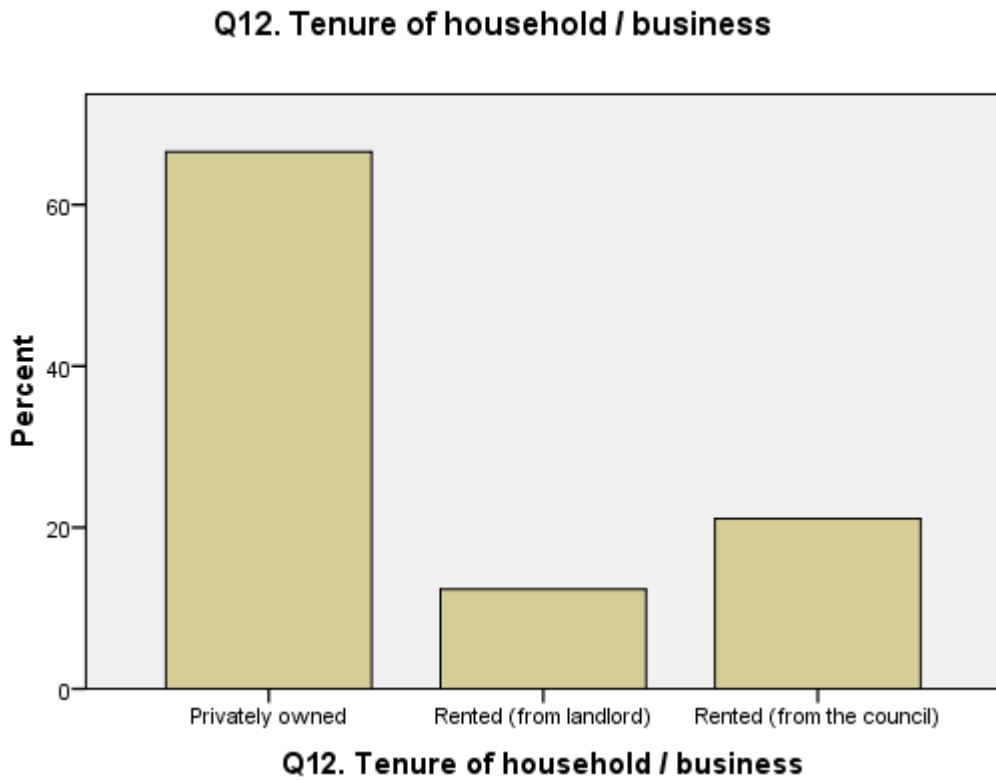


FIGURE 5.12: Bar chart showing participants' responses to Question 12

**Q12. Tenure of household / business**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Privately owned	205	65.7	66.6	66.6
	Rented (from landlord)	38	12.2	12.3	78.9
	Rented (from the council)	65	20.8	21.1	100.0
	Total	308	98.7	100.0	
Missing	System	4	1.3		
Total		312	100.0		

TABLE 5.12: Results table showing participants' responses to Question 12

### 5.13 Question 13

Participants were asked to indicate if they were replying as a householder or a business. The intention was to establish the extent to which the responses were representative of commercial, as well as residential, opinion of district heating. Figure 4.13 and Table 4.13 show that householders accounted for a very large majority of the participants (99%). Only 0.7% of participants responded as businesses and 0.3% as both businesses and householders. Therefore, the findings can be considered, almost universally, to reflect householders' opinions of district heating.

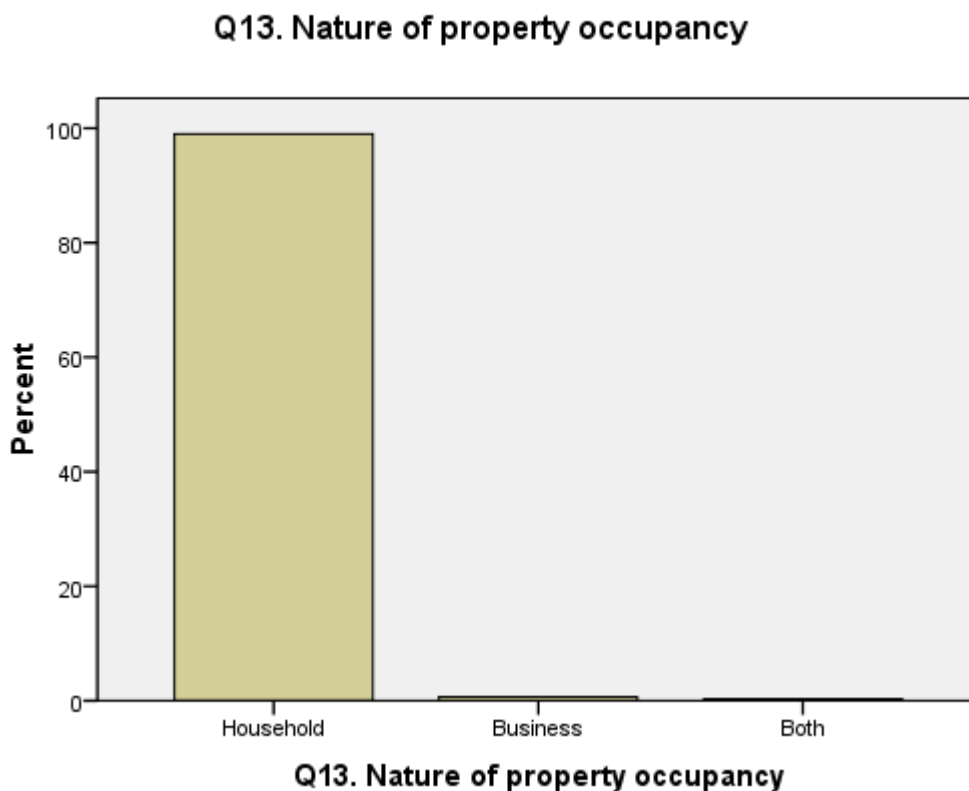


FIGURE 5.13: Bar chart showing participants' responses to Question 13

**Q13. Nature of property occupancy**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Household	302	96.8	99.0	99.0
	Business	2	.6	.7	99.7
	Both	1	.3	.3	100.0
	Total	305	97.8	100.0	
Missing	System	7	2.2		
Total		312	100.0		

TABLE 5.13: Result table showing participants' responses to Question 13

#### **5.14 Question 14**

Participants were asked to disclose their age. The intention was to establish to what extent the participant sample was representative of the age distribution of Neath Port Talbot residents. The results are discussed in section 4.2 of Chapter 4.

#### **5.15 Question 15**

Participants were asked to disclose their postcodes. The intention of this question was to establish the location of participants' residences in Neath Port Talbot. Figure 5.15 shows the location of the respondents' residences in Neath Port Talbot, which are indicated by black arrows. The map shows that a very large majority of 303 participants (97.1%) are resident in the Sandfields, Aberavon Sands and Aberavon areas of Neath Port Talbot. 4 participants (1.28%) were resident in other areas and 5 participants (1.6%) did not disclose their postcodes.

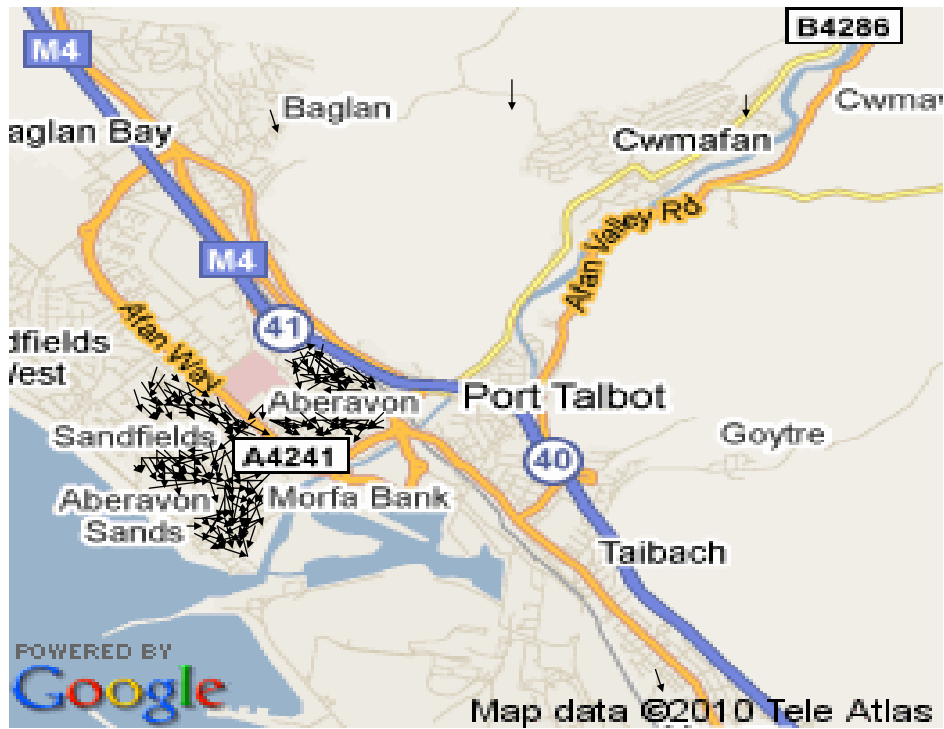


FIGURE 5.15: Map showing location of participants' residences in Neath Port Talbot

## CHAPTER 6: DISCUSSION AND SUGGESTIONS FOR FURTHER RESEARCH

### 6.1 Discussion

In compliance with its principal aim, this study has established consistently high levels of support for the use of waste process heat for district heating among Neath Port Talbot residents.

In particular, participants demonstrated a clear preference for using waste process heat as a fuel source for district heating, in comparison to other energy sources such as fossil fuels, nuclear power, waste incineration and biomass energy. This preference for low carbon heat correlates well with largely positive attitudes which have been observed among the UK public towards other low carbon energy options. Attitudes towards renewable energy technologies in particular have been shown to be very positive. Approximately two thirds of the UK public are in favour of investment in renewable energy (McGowan and Sauter, 2005) and popular, well-known renewable technologies such as wind and solar are almost universally well-liked (Upham *et al.*, 2009).

Such preferences are understandable, considering public awareness of the need to act on climate change. Self-reported awareness and knowledge of climate change has substantially increased in the UK in the past two decades and awareness of the term is now near universal (Upham *et al.*, 2009). Additionally, 88% of the UK public agree that the production and consumption of energy in the UK has an impact on climate change (Gallup Organization, 2007). Consequently, the UK public widely perceive the reduction of GHG emissions to be a central concern for future energy policy (McGowan and Sauter, 2005). In view of this, it is unsurprising that participants' perceptions of district heating were largely positive, as district heating has the potential to reduce GHG emissions as well as reduce consumer energy bills.

However, participants' perceptions of coal and gas fuel sources differed significantly in comparison to those of the UK general public. In compliance

with high levels of awareness of the need to mitigate climate change, support for the use of fossil fuels is limited in the UK as approximately only 20% of the public are in favour of using coal, oil or gas as energy sources (Eurobarometer, 2007). However, 39.4% of Neath Port Talbot residents considered coal and gas to be favourable energy sources. Therefore, in proportionate terms, nearly twice as many participants considered coal and gas to be favourable energy sources, in comparison to the UK public as a whole. This high rating may possibly reflect residents' place attachment or 'emotional bond' (Devine-Wright and Howes 2010; p1) to Neath Port Talbot, as the area is highly industrialised and fossil fuels have played a large role in the historical and economic development of the region.

Importantly, in addition to largely positive attitudes of district heating as a means to reduce GHG emissions, participants also demonstrated high levels of acceptance towards the proposal to implement a district heating scheme in their local area. This is significant as support for the uptake and diffusion of energy technologies amongst the general public does not always translate into support for a new development at the local scale (Upham *et al.*, 2009; Devine-Wright and Howes, 2010). This high acceptability of district heating is also encouraging considering that it requires 'active acceptance' as residents must be willing to install the technology in their homes, in comparison to large-scale developments such as wind farms which require more 'passive acceptance' (Sauter and Watson, 2007).

However, the study's findings imply further implications for the development proposal. In spite of positive general perceptions of district heating, participants were for the most part unwilling to commit to district heating without knowing exactly what it entailed and what was required of them as consumers. Therefore, there was a strong preference for further information on district heating among participants. Considering participants' low levels of self-reported knowledge and understanding of district heating, it is hardly surprisingly that they wished to exercise a certain degree of caution. However, this does imply that if residents were sufficiently assured of the legitimacy and benefits of district heating, and

were made aware of the consumer conditions, many more may be persuaded to accept it.

Information provision has been shown to dramatically improve homeowners' attitudes towards district heating and increase the uptake and diffusion of the technology in a Swedish context (Mahapatra and Gustavsson, 2009). Providing information to residents on the benefits of the proposed district heating scheme could significantly improve consumer uptake in Neath Port Talbot. For example, this could be achieved by distributing letters, leaflets and pamphlets to residents. Alternatively, council meetings on the proposed scheme may provide residents with an opportunity to voice their opinions, learn more about the scheme and have their questions and concerns answered.

As well as merely providing information, in order to be commercially successful, the district heating scheme should be developed with consumers' needs in mind. For example, the initial contract duration should be kept to a minimum. Ideally it should be no longer than 12 months, as the low willingness among participants to accept contracts of longer duration may impede the uptake of district heating.

Participants ascribed a high degree of importance to all aspects relating to heating and hot water (contract flexibility, cost, degree of control over the heat supply, environmental impact, reputation of the supplier and reliability). This may in part reflect sample response bias as questionnaire respondents may have been particularly interested or concerned about heating issues and therefore may have been more likely to consider aspects relating to heating and hot water as important. Similarly, the over-representation of older age groups may have contributed to this as heat may be more of an important consideration for older participants. Day and Hitchings (2009) have observed that older people report feeling colder as they get older and consider keeping themselves sufficiently warm to be an essential condition. In addition, older participants may also be more likely to spend more time at home than younger participants, in which case heating could be more of a concern.

Nonetheless, these ratings do suggest that the social norms, and habits and practices surrounding heat consumption are dependent on a multitude of factors rather than merely 'end-of-pipe' considerations of costs. However, although all the aspects were considered to be important, the extent of importance attributed to each aspect varied. Interestingly, despite high levels of self-rated environmental concern, and positive perceptions of low carbon sources of heat, participants considered the environmental impact of their heat supply to be significantly less important than every other aspect. This exemplifies the 'citizen-consumer conflict' (Clarke, 2007). By asking participants how concerned they were about environmental issues, Question 7 positioned participants in the 'citizen role,' evoking egalitarian principles and resulting in high levels of self-reported environmental concern. However, by asking participants to consider aspects relating to their own heating and hot water, Question 5 required participants to assume the 'consumer' role and evaluate how their own consumption needs could best be served. Therefore, all of the aspects which relate to participants' personal interests were rated as more important than the one aspect which relates to the interests of civil society (environmental impact).

It is therefore evident that in a liberalised energy market where individuals assume the 'consumer role' and make energy choices depending on how their own needs will best be met, a district heating scheme will have to meet or even exceed what is currently available in the marketplace if it is to be commercially successful.

## **6.2 Suggestions for further research**

As the findings of this study were highly representative of residential rather than commercial opinion of district heating, further research could investigate the types of attitudes and concerns which local businesses may have towards district heating. For example, commercial heat demand requirements may differ substantially from residential requirements. In addition, the social practices which households and businesses are structured around are likely to vary and this may be reflected in their respective perceptions of certain elements of district heating

schemes, such as technological disruption. Investigating commercial opinion on the use of waste process heat for district heating may contribute to enhancing understanding of how waste process heat can be employed to meet the requirements of commercial heat demand in Neath Port Talbot.

The study could also be replicated by distributing postal questionnaires to other areas of Neath Port Talbot. As the majority of the participants in this study were resident in the same area, replication of the study in several different areas in Neath Port Talbot may enable trends to emerge which are more representative of the population as a whole.

Furthermore, it is important to consider that this study was conducted in July 2010, when the UK economy was recovering from recession. Within this context of a harsh economic climate, the prospect of saving 10-20% on energy bills may have provided participants with more of an incentive to accept district heating than would have been observed in a period of higher economic growth. Therefore, replication of the study in a different context, during a period of higher economic growth may establish whether this influence was present.

## CHAPTER 7: CONCLUSIONS

The intention of this study was to investigate resident opinion on the use of waste process heat for district heating in the local authority area of Neath Port Talbot in Wales where waste process heat from a local integrated steelworks could potentially be used to provide local residential and commercial buildings with heating and hot water, as part of a district heating scheme.

In contrast to many other European countries such as Denmark and Finland, where the deployment of district heating is substantial, district heating has achieved only limited uptake in the UK. However, recognition of the contribution which district heating could make to reducing GHG emissions from the heating sector, which is necessary in order to achieve the UK's ambitious emissions reductions targets, has led to an increased interest in the expansion of district heating technology in the UK in recent years.

The benefits of incorporating consumers/the public in decisions about energy provision are well documented and include the creation of better conditions for a consensus to emerge, and the identification of conditions of consumer adoption of the technology. However, as a result of its sparse use in the UK, very little is known about public or consumer attitudes towards district heating. This study has attempted to address this by investigating resident opinion of district heating in a 'live' context.

The findings suggest that resident opinion on the use of waste process heat for district heating in Neath Port Talbot was largely positive. However, participants' knowledge and understanding of district heating was low, and, for the most part, participants were unwilling to commit to district heating without knowing exactly what it would involve.

While resident opinion is unlikely to represent a significant barrier to the implementation and uptake of district heating in the area, involving residents in the planning process from the outset, as well as providing them with information about the scheme and opportunities to have their questions answered, will be

essential in order to gain residents' trust in the scheme and capitalise on their predominately positive perceptions of district heating.

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## APPENDIX

### Survey for all Neath Port Talbot residents

Dear Householder,

Neath Port Talbot Borough Council are looking at ways of reducing heating bills in your area. This is a short survey from the Council, the Carbon Trust and the University of Manchester. We'd very much like to hear your views about one option. In return you will be entered into a draw to win £50 Amazon or Argos vouchers (you can choose which).

Please complete the survey **as soon as possible** and post it to us in the Freepost envelope provided, by Monday August 2nd 2010, so that you can be entered into the draw. Thank you.

1. Had you heard of 'district heating' before receiving this survey?

Yes

No

2. Some industries produce a lot of heat that goes to waste. District heating makes use of this heat by putting it into a clean hot water system and piping this around neighbourhoods. This can reduce energy bills by up to 20% and is a more environmentally friendly option than standard heating. It is common in European countries.

Each house taking part gets a heat exchanger the size of a small domestic boiler that provides heat and hot water. Any existing gas boilers or electric immersion heaters in homes would stay in place, to be reconnected if people left the scheme. The heat exchanger would be larger for businesses.

To what extent do you agree or disagree with the following? Please answer all the questions.

	Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	No opinion /Don't know
a) It sounds like a good idea in						

principle						
b) It sounds like a good idea, but I'd need to know a lot more about it						
c) I'm not sure that I quite understand what district heating involves yet						

3. There are four features to a district heating scheme that we'd like you to consider. If district heating reduces your heating bill by 10-20% per year how favourably or unfavourably would you view the following? Please tick one answer for each of options a, b, c and d.

	Very favourably	Favourably	Neutral	Unfavourably	Very unfavourably	No opinion/ Don't know
a) Temporary street disruption for pipe laying						
b) Installation of a small heat exchanger in my home, about the size of a small domestic						

boiler (larger for businesses)						
c) Being tied into a heating / hot water contract for 12 months						
d) Being tied into a heating / hot water contract for 24 months						

4. Given what you have heard about district heating schemes so far, to what extent do you agree or disagree with the following statements? Please tick one answer for each of options a, b, c, d and e.

	Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	No opinion/ Don't know
a) I'd be willing to accept district heating in return for a 10-20% cut in my heating bill						
b) I would not be willing to accept district heating						
c) I'm still unsure - I would need to know exactly what was being offered						

5. When thinking about your heating and hot water, how important are each of the following? Please tick one answer for each of the options.

	Very important	Important	Neutral	Unimportant	Very unimportant	No opinion / Don't know
Degree of control over the heat supply (e.g. ability to adjust thermostat)						
Reputation of the supplier						
Cost						
Being able to leave a contract without penalty						
Reliability						
Environmental impact						

6. There are different ways of providing the heat for district heating. How favourable or unfavourable are the following options to you? Please assume that the sources are already in place.

	Very favourably	Favourably	Neutral	Unfavourably	Very unfavourably	No opinion/ Don't know
Waste heat from industries						
Biomass energy						
Nuclear power station						
Waste incinerator						
Coal or gas						

power station						
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7. To what extent do you agree or disagree with the following statement?

	Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree	No opinion /Don't know
I am very concerned with environmental issues						

8. If you wanted to buy a new home, to what extent do you agree or disagree with each of the following statements, assuming district heating reduced your heating bill by 10-20%?

	Strongly agree	Tend to agree	Neither agree nor disagree	Tend to disagree	Strongly disagree
a) I would be more likely to buy a property with district heating					
b) I would be less likely to buy a property with district heating					
c) District heating would have no impact on my decision to buy a property					

9. Which of the following statements best describes you?

- a) I make most or all of the decisions in my household regarding energy bills
- b) I make decisions regarding energy bills with other members of my household or business
- c) Other members of my household or business make most of the decisions regarding energy bills

10. With what you now know about district heating, how likely would you be to sign up for district heating?

Very unlikely

Unlikely

Somewhat unlikely

Undecided

Somewhat likely

Likely

Very likely

11. Gender

Male

Female

12. Is your home or business rented or owned?

Privately owned

Rented (from landlord)

Rented (from the council)

13. Are you replying as a local business or householder?

Householder

Business

14. Your age?

15-24

25-34

35-44

45-54

55-64

65-74

75+

15. Please enter your postcode.

Contacting you

Thank you very much for your time and for giving us your views. To be entered for the £50 Amazon/Argos vouchers draw, please enter your email address or postal address or phone number below. We will notify the winners before the end of September 2010.

Please post the completed survey to us in the Freepost envelope provided, by August 2nd 2010. Thank you.