Pilot Resident Consultation as Part of a Combined Heat and Power System Implementation

An Interdisciplinary Project Proposal

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Abstract

This project was commissioned by Merton Council to execute preliminary steps of a resident consultation process on High Path Estate as a stage in the implementation of a combined heat and power (CHP) system. In designing, administering, and evaluating the survey and interview portions of the consultation, several site-specific issues were highlighted, however the process is intended to be replicable elsewhere. Results show it is not unreasonable to proceed with installing a CHP system; recommendations for subsequent steps are provided.

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Executive Summary

According to the International Panel on Climate Change (IPCC) as well as reputable scientists around the world, ***climate change*** caused by worldwide greenhouse gas emissions is leading to rising temperatures that threaten to drastically alter the environment. Climate change is said to be responsible for torrential flooding, colder winters, and warmer summers. With the 1990s having been the warmest decade of the last millennium, it is becoming increasingly evident that ***global warming*** – the gradual increase of the earth's temperature to a point that will have serious repercussions on daily life – is due to human activities.

The IPCC correlates the increase in concentrations of greenhouse gases with the predicted rise of the average global surface temperature by 2.5°C in the next fifty years.

To address the effects of global warming and climate change, ***sustainable development*** policies, such as the UK's target for 60 per cent less CO_2 emissions in the UK by 2050, are needed to reduce carbon dioxide (CO_2) emissions, as well as on-the-ground actions, like the Power of Well-being to empower local authorities. As can be seen in the matrix below, policies and strategies ranging from basic regulation to human aspects have been articulated at various political levels to setting targets and promoting sustainable development, the progress of society and the economy in an environmentally friendly way.

"Climate change is the most severe problem that we are facing today, more serious even than the threat of terrorism." -David King, UK government chief scientific adviser, 2004.

Policies with an Impact on Sustainable Development

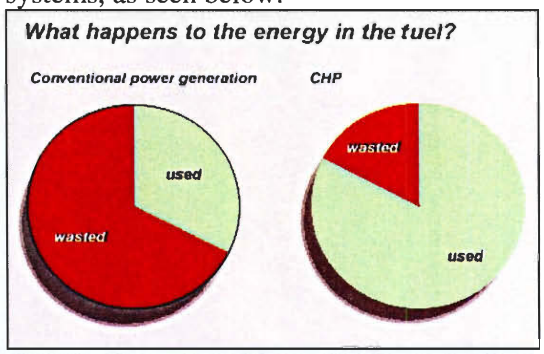
	Policy	*Vision*	*Guidance*
International		Kyoto Protocol	
National	Planning Policy Statement 22: Renewable Energy	DTI Energy White Paper Sustainable Communities Sustainable Development Strategy	Local Government Act 2000: Power of Well-being Decent Homes Standard
Regional	Spatial Development Strategy: the London Plan	Energy Strategy	
Local	Unitary Development Plan	Climate Change Strategy	

How Merton is Addressing Climate Change

In response to international, national, London regional, its own carbon dioxide reduction targets and inspired by the success of a district heat and power (DHP) scheme in nearby Woking, Merton Council is investigating the possibility of implementing its own DHP scheme. Since CO_2 emissions are a result of three sectors: transport, industry, and buildings, Merton Council acknowledges that local authorities can best achieve notable results by focusing on buildings. Although CO_2 emissions from buildings can be reduced by innovative sustainable development planning policies, such as Merton's own Unitary Development Plan, only new developments are affected. Through community awareness, a local authority can influence individual behaviours but only on a very small scale. All three strategies can be incorporated to influence CO2 emissions from the domestic and buildings sector.

What is DHP?

A ***district heat and power*** (DHP) scheme involves a network of miniature power stations dotted around the borough, generating electricity and hot water independent of the national distribution grid. These ***combined heat and power*** (CHP) or *cogeneration* units are systems that burn a fuel to generate steam, driving a turbine that generates electricity, recovering wasted energy to heat water. This method utilizes the fuel more efficiently than traditional systems, as seen below.



Commonly powered by natural gas or diesel oil, the CHP units can also use alternative fuels such as bio-fuel, and hydrogen. Typically a 30sq metre unit will provide hot water and electricity for 300 flats as well as several adjacent buildings.

However, to affect existing buildings with notable reductions, the most effective way to significantly lower CO_2 emissions is through infrastructure projects, like changing the method of a building's heating. This is ultimately the motivation behind a DHP scheme. The goals of such a borough-wide DHP scheme are:

- To save on energy costs and generate sustainable revenue for Merton Council
- To offer cheaper heat and power to Merton residents, alleviating fuel poverty and avoiding the impact of rising global fossil fuel prices
- To secure the energy supply by being independent of the national grid
- To utilise fuel more efficiently, alleviating the diminishing natural reserves of fossil fuels
- To continue the image of Merton at the forefront of innovative sustainable development.

This long-term plan is in preliminary stages; the locations for the initial combined heat and power (CHP) units are being studied. The ***High Path Estate*** is a noticeable option. Currently powered by inefficient systems, the main high-rise blocks on the estate are in need of an update. Safety inspections after a devastating fire in one of the buildings revealed that the wiring was rotten and needed replacing. This revelation, coupled with the Decent Homes Standard, has put the focus on initiating the DHP scheme with a CHP unit at High Path. In doing so, Merton Council hopes to produce a replicable model as a guide for other high-density urban areas across London.

Project Goal: Ensuring replication

This project identifies what Merton and other boroughs would need to take into account in planning for and implementing a CHP system. This project introduces several obstacles and issues that arise in the planning process of implementing a CHP system, as well as on the issues characteristic to High Path Estate. By identifying the technical, financial, and social issues surrounding a CHP installation, this document serves as one of the key interconnecting steps toward a DHP scheme.

With a focus on the resident consultation process, this example of how the process developed for High Path Estate identifies many obstacles to be considered when replicating the course of action, such as the language barrier and past bad experiences between the residents and Merton Council. These unique issues raise awareness for future similar developments.

From the survey and interview results, it was concluded that High Path residents are not happy with their heating system; it needs to be replaced. Based on this, several recommendations for subsequent stages were made, in addition to helping to detect potential issues embedded within the process. Providing informative documents such as this at each stage of the DHP process will encourage other boroughs to follow and initiate sustainable energy schemes. By concentrating on making the entire process as easy to replicate as possible, Merton Council will assist in the spread of similar low carbon developments across London.

"Heating is very much a problem." -Mr. Michael Adtei, Marsh Court resident.

Introduction

Over the last century, overdependence on fossils fuels has resulted in decreased natural reserves and in increased amounts of harmful gases into the atmosphere from the burning of these fuels. Of particular concern is the role these gases have in the deterioration of the ozone layer and the subsequent increase in the ambient temperature of the environment, commonly referred to as the greenhouse effect. The drastic effects that this warming trend is predicted to have on our daily lives is known as climate change.

In response to the environmental dangers that climate change causes, the United Nations established the Kyoto Protocol in 1997, to set greenhouse gas reduction targets that will help slow the current degradation of the planet's atmosphere. The standards set have been adopted by the European Union, requiring an overall 8 per cent decrease in greenhouse gas emissions between 2008 and 2012 in comparison to 1990 levels, with the UK responsible for 12.5 per cent reduction. In addition, the UK has set domestic carbon dioxide (CO_2) reduction goals that exceed the UK's obligation to the Kyoto Protocol, aiming to reduce carbon dioxide emissions by 20 per cent and 60 per cent in comparison to 1990 levels by 2010 and 2050 respectively.

In order to reach these ambitious goals, the need for sustainable development – the improvement of our society and economy in an environmentally friendly way – has been widely recognised. From planning regulations that promote renewable energy to policies for the improvement of social housing, a range of strategies have been published that shape current discussion of sustainable development.

To comply with such policies, the London borough of Merton wishes to contribute to satisfying emission targets. By seeking energy generation solutions with limited output of CO_2 emissions, Merton Council wishes to continue its past trend of being a leader in environmentally friendly policies. Acknowledging that infrastructure projects are the realistic method to reduce CO_2 emissions, Merton Council is proposing a long-term goal of a borough-wide district heat and power (DHP) scheme. A DHP scheme is achieved by implementing a collection of combined heat and power

(CHP) stations located throughout an urban area that provide central heating and domestic hot water, chilled water for air conditioning, and electricity. Such a solution not only lowers CO_2 levels, but also has the further advantages of providing cheaper heat and power, energy supplies independent of the national grid, and the possibility of supplying sustainable revenue for Merton Council through the sale of excess energy.

As an initial step in the DHP plan, Merton Council wishes to install CHP systems in a variety of locations. A prime candidate is a cluster of three high-rise buildings, May Court, Marsh Court, and Hudson Court that are part of the Council-owned social housing estate, High Path. Although there is a degree of uncertainty regarding the existing heating system in the buildings, it is believed to be gas-powered warm air systems, which, though functional, are hardly efficient. Also part of the motivation to focus on High Path is the faulty wirings of the buildings, discovered in the aftermath of a September 2004 fire in May Court. In response to the Decent Homes Standard of 2001 requiring social housing improvements, Merton Council is investigating the feasibility of installing a CHP unit to provide heat and power to the three buildings.

The residents of May Court, Marsh Court and Hudson Court are an integral part of this study. By the Power of Well-Being as part of the Local Government Act of 2000, Merton Council has the legal power to take actions in the best interest of the borough, promoting the sustainable development of the borough. The Act also requires the Council to actively include local residents in its decision-making. As a result, this project presents a resident consultation process, specifically tailored for High Path residents, but intended for replicable use. Through the issues raised and modifications made in regard to site-specific concerns for High Path, the process can be used as a guide for municipalities in similar situations elsewhere.

Compiling the residents' views, their energy consumption data, and technical information on CHP systems allows us to predict potential problems and solutions and to provide recommendations such as what size CHP system is appropriate and what fuel to use. These recommendations will enable Merton Council to successfully address the feasibility of a CHP system and ensure that the proper system is installed.

The problem Merton Council faces regarding the decision to constantly maintain an old, inefficient system or replace it with a cost- and fuel-efficient system is typically faced by local authorities across London. Ideally, the entire process of installing a CHP system in a social housing block is a practice that will be replicated elsewhere in the near future. This makes covering all angles important for Merton Council. Complete documentation of rationales, as well as potential problems and solutions, will aid in future replications of such developments.

Our aim is to provide a pilot example of gathering the information needed to provide guidance over implementing sustainable energy techniques. If a CHP system is established in High Path, it will give Merton Council national recognition for their energy initiatives and will provide a case study for the replication of future installations of sustainable energy systems.

Chapter 1: Energy Policies

In this section, we lay the framework necessary to understand the rationale behind Merton Council's decision to investigate implementing a district heat and power (DHP) scheme. The broader context within which our project is set begins with the problem of climate change and the environmental dangers of increased carbon dioxide (CO_2) emissions. The response to climate change is demonstrated in published policies, at various political levels, touching not only upon reducing carbon dioxide emissions but also upon involving the relevant social aspects. This background information is necessary to understand the possibility of similar energy generation schemes occurring elsewhere. In short, our project is meant to be a guide for the replication of corresponding developments.

Climate change. The current energy market is dependent on a non-renewable fossil fuel supply of coal, oil and natural gas that is quickly becoming scarce. Statistics from 2002 show that over 89 per cent of energy in the United Kingdom (UK) was generated using these fuels; electricity accounts for 74 per cent of this total energy generated (UK DTI Energy Group, 2003). Despite their widespread use, these fuels are not the ideal solution to providing the world with power. Not only are they a non-renewable resource but also their combustion produces carbon dioxide (CO_2), which contributes to such environmental degradation as pollution and the greenhouse effect.

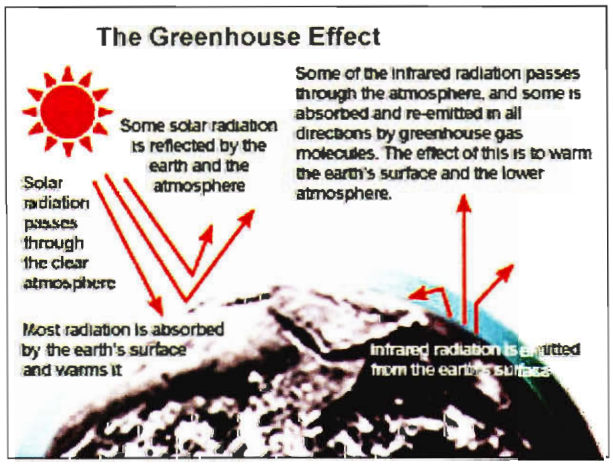


Figure 1: The Greenhouse Effect (www.epa.gov)

The greenhouse effect is caused by a build-up of trace gases that prevent the escape of the sun's radiation from the Earth's atmosphere, allowing the radiation to continually raise the surface temperature of the planet. The result is commonly referred to as global warming. The gases that contribute to this effect are known as greenhouse gases, including CO_2, methane, ozone, and nitrous oxide. However, CO_2 is by far the most abundantly produced greenhouse gas from the burning of fossil fuels.

Global warming, as a result of the greenhouse effect, in turn causes climate change. Climate change is the established knowledge that the Earth's climate is changing over time, as a result of natural variability and human activity. Evidence supports this; according to a time series compiled by the Climatic Research Unit and the UK Met. Office Hadley Centre (2004), the years 2003 and 2002 were the second warmest on record when values were rounded to two decimal places. The time series also shows that the ten warmest years globally have occurred in the 1990s and 2000s.

The Intergovernmental Panel on Climate Change (IPCC) applies such warming trends to forecast various detrimental effects in its Third Assessment Report – Climate Change 2001. In specific, the IPCC links global warming to predicted increases in the risk of damage to crops, the amount of soil erosion, the risk of drought, the instances of heat stress in wildlife, and ultimately increases in the risks to human life (IPCC, 2001).

There is indication that these predicted effects of climate change are attributable to human activities. Accordingly, a wide range of policies has been published at a variety of political levels to address this warming trend. The policies interact by level and topic, and can be seen in Table 1. Some focus on establishing the ambitious vision of reduced CO_2 levels; some outline the planning guidelines to promote future sustainable developments that are environment friendly. Others are viewed as guidance for municipalities to follow, with maintaining sustainable development as its goal.

Table 1: Policies that Impact Sustainable Development

	Policy	*Vision*	*Guidance*
International		Kyoto Protocol	
National	Planning Policy Statement 22: Renewable Energy	DTI Energy White Paper Sustainable Communities Sustainable Development Strategy	Local Government Act 2000: Power of Well being Decent Homes Standard
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Policies: International level. To combat the environmental problems that climate change has produced, the United Nations (UN) established the Kyoto Protocol in 1997, which calls for a reduction in the responsible greenhouse gases. Having taken effect 16 February 2005, the protocol legally binds endorsing industrial nations to comply with greenhouse gas reduction standards between 2008 and 2012. Ratified by the European Union (EU), this protocol commits the fifteen major European countries, the EU-15, to an 8 per cent wide greenhouse gas reduction in comparison to 1990 levels. To ensure that the EU meets its 8 per cent reduction goal, the UK is responsible for a 12.5 per cent decrease in greenhouse gas emissions (UN Framework Convention on Climate Change, 1997).

Policies: National level. The UK has set forth a number of policies and strategies encouraging action toward reaching the ambitious Kyoto targets. First, the UK Department of Trade and Industry published the *Energy White Paper: Our energy future – creating a low carbon economy* in February 2003 to act as a global leader in tackling climate change. The White Paper formally accepts the Royal Commission on Environmental Pollution recommended targets; the UK aims to have a 60 per cent reduction in CO_2 emissions by 2050 in comparison to 1990 levels, with a short-term goal of 20 per cent by 2010 (UK DTI Energy Group, 2003). The white paper also vows for installing approximately 10,000MW of renewables capacity by 2010.These domestic goals not only ensure that the UK's obligation to the Kyoto Protocol is fulfilled, but they also surpass the requirements of the protocol.

Alongside the actual carbon dioxide reduction ambition, the UK continues to promote sustainable development as a method of improving the nation. In 1999, the UK Government developed the *UK Sustainable Development Strategy: A better quality of life*, an approach for "integrating economic, environmental and social policies to ensure a better quality of life for everyone, now and for future generations" (1999). The four main objectives proposed were "maintenance of high and stable levels of economic growth and employment; effective protection of the environment; prudent use of natural resources; and social progress that meets the needs of everyone" (DEFRA, 1999).

Soon after, the UK published subsequent reports to measure its progress. In response to the 2002 Johannesburg World Summit on Sustainable Development (WSSD), *Achieving a Better Quality of Life: Review of progress towards sustainable development* (2003) compared progress against the indicators developed from the 1999 Strategy. This fourth and final annual report acknowledged the successes in many areas while simultaneously recognizing the challenge that still lies ahead. Stressing the need for "embedding sustainable development in Government decision-making; achieving a sustainable economy [and] sustainable communities; and managing the environment and resources" (DEFRA, 2003), it also identifies progress on international co-operation and development. The report also set the stage for the proposed consultation process of 2004 regarding sustainable development and the development of a new strategy for early 2005.

To encourage sustainable development decisions and developments, the Deputy Prime Minister focused on housing and planning by launching the Communities Plan, as outlined in *Sustainable Communities: Building for the future* (2003). Aiming to tackle "housing supply issues in the South East, low demand in other parts of the country, and the quality of our public spaces," the Plan sets out a "new approach to how we build and what we build" (2003). Key issues are the housing shortage, making housing decent and liveable, and protecting the countryside. This Plan also dictates the financial investment correlated with the ambitious proposed improvements regarding housing and communities. This concentrated the efforts on housing and planning, and interweaves with several other policies.

As a further step in the planning aspect, the Office of the Deputy Prime Minister (ODPM) encouraged local authorities to take initiative. Planning Policy Statement 22 (PPS22): Renewable Energy (2004a) outlines the policy framework calling for action introducing renewable generating capacity. The Companion Guide for this policy, *Planning for Renewable Energy*, however, offers practical examples and advice as to how the PPS22 is to be implemented on the ground. Together, the PPS22 and Companion Guide are for planning authorities when preparing local development documents to "encourage the appropriate development of further renewable energy schemes throughout England." It specifically promotes the London Borough of Merton's Unitary Development Plan, quoting both Policy E.11 and Policy PE.13, and encouraging authorities to follow its example.

Parallel to the planning facet of sustainable development, the UK focused on improving its housing. In 1997, there were 2,100,000 houses owned by local authorities and housing associations that did not meet the Decent Homes Standard of July 2001. This policy, introduced by the ODPM, demands an improvement of the standard of social housing in England. In specific, the Government wants to reduce the number of social housing properties by one-third which fail the Standard by 2004, and to have all social rented homes meet the Standard by 2010. Incorporating the four basic criteria of fitness for habitation, disrepair, modern facilities, and thermal comfort, the Standard outlines the conditions necessary for a home to meet the definition of 'decent' (ODPM, 2004b).

In order to unite the various policies that work toward sustainable development, the UK realised the need for emphasis on action from local authorities. A need had also arisen for legal legitimacy for local authorities to set forth such planning policies and changes to housing. The Local Government Act 2000 established the obligation of local authorities to propose community strategies for their areas, promoting and improving the economic, social and environmental well-being. Granting local authorities the Power of Well-Being, the Act provided local authorities with a means of facilitating the process of implementing the proposed community strategies. It is the legal support for local authorities to act on the basis of environmental well being. Specifically, it dictates that principal local authorities in England and Wales can "do anything they consider likely to promote or improve the economic, social or

environmental well-being of their area". In addition, it was explicitly stated that local authorities were to "actively involve and engage local people in local decisions," as well as "do anything they consider likely to promote or improve the economic, social or environmental well-being of their area" (Acts of Parliament, 2000).

Policies: Regional level. Many of the national policies have filtered down to the London regional government and the Mayor of London has proposed his own strategies for London, adding focus to national policies. In recognition of the international and national agreements to ensure a reduction of greenhouse gas emissions, the Mayor of London proposed an Energy Strategy, "Green light to clean power," in February 2004, addressing the specific aims needed to work toward the long-term vision of a sustainable energy city. The document simultaneously acknowledges the presence and importance of energy in London while stressing the need to minimize London's contribution to global climate change.

Since 1965, London's total energy consumption has increased by 16 per cent although the population decreased by 7 per cent. However, there has been a decline in the carbon content of energy used in the UK because of a shift from solid fuels and oil to natural gas and nuclear fuel. Despite this significant reduction, the Energy Strategy insists it is important to focus on continuing a reduced carbon content of energy, as well as lowering the total energy consumption. To lessen fuel poverty and climate change, the Energy Strategy focuses on London's energy-inefficient homes, which are the major source of energy consumption and carbon dioxide emissions. In particular, the value of combined heat and power (CHP) technology is recognized, insisting that London should double its 2000 CHP capacity by 2010 (GLA, 2004A).

The Energy Strategy's key guidelines "define challenging yet achievable targets" that emphasize "action on climate change...improving energy efficiency in housing and eradicating fuel poverty...improving energy efficiency in commercial and public sector buildings...increasing renewable energy...increasing combined heat and power...establishing hydrogen and fuel cells...delivering cleaner transport...[and] opposing nuclear power" (GLA, 2004a, p. 9-14).

Another of the Mayor's strategies, with legal force, emphasises the need for sustainable development in response to London's increasing population. The Mayor of London published *The London Plan: The Spatial Development Strategy (SDS) for London* (2004) to outline the strategy of "accommodating growth of population and jobs in sustainable patterns of development, based on an improved and expanded public transport network." It addresses the issue of accommodating London's growth within its boundaries, without encroaching on open spaces, ultimately making London a better city for people to live in. The Plan enumerates the potential capacity for development and identifies Opportunity Areas; in specific, it explicitly instructs local authorities to improve energy efficiency and increase the proportion of energy used generated from renewable sources. Policy 4A.7 directs local authorities to support the objectives of reducing carbon dioxide emissions by "requiring the inclusion of energy efficient and renewable energy technology and design, including…combined heat and power" (GLA, 2004b).

Policies: Local level. The borough of Merton of Outer London, which is situated along the southwest edge of Greater London, has been promoting energy efficiency amongst its 200,000 residents since the year 2000. Merton is exceptionally well suited for meeting the CO_2 reduction goals because of its noteworthy achievements. Merton has the most sophisticated and energy efficient street lighting in the UK, which are all triggered by photocell sensors.

Merton was the first Authority in the UK to pass a Unitary Development Plan (UDP) policy that requires renewable energy installations on new building developments. London borough of Merton's 2003 UDP Policy E.11: Environmental Improvements from Employment Development states:

> To achieve environmental benefits, employment developments will be expected to be of high quality and layout. All new industrial, warehousing, office and live/work units outside Conservation Areas and above a threshold of 1,000sqm will be expected to incorporate renewable energy production equipment to provide at least 10 per cent of predicted energy requirements. (p. 86)

Merton's UDP, which must be in conformity with the Mayor's London Plan, delineates objectives in regards to several key topics ranging from minerals and soils to energy, from basic needs to air, water, noise, light. As a measure of the performance of the UDP in regards to such objectives, the UDP also creates specific targets and indicators to enable "a clear link to be established between the performance of planning policy and achieving sustainable development aims within Merton" (2003).

As part of a global commitment to reduce the impact of climate change, Merton Council set forth its Climate Change Strategy (CCS). Written by a foreign consultant and amended by Merton Council officers, the document acts as "a policy framework whose purpose is to provide guidelines within which climate change initiatives would be identified, designed, implemented, monitored and reviewed in order to guarantee a secure and healthier environment for present and future generations as well as contribute to reaching the Kyoto carbon reduction targets" (Poswo, 2005). Prompted by the international, national, and regional partnerships working toward ambitious carbon dioxide emission targets, as well as the Local Government Act of 2000 encouraging local authorities to assume responsibility and take action, the Strategy outlines Merton's goals and recognizes that local actions influence global conditions. In specific, the Climate Change Strategy discusses several initiatives and measures to adapt to climate change including: waste management, energy, housing and development, transport, education and awareness, leading by example, and procurement. To aid in the transition to sustainable development, the CCS set a target for reduced fossil fuel energy use by 20 per cent from 1991 levels by 2010.

Chapter 2: Reducing Carbon Dioxide through DHP

While national targets set the goals for carbon dioxide reductions, it is local actions that have tangible results. Since carbon dioxide (CO_2) is emitted primarily from electricity production at central generation stations from inefficient systems, changes to the national large scale energy generation is an obvious choice for reducing carbon dioxide emissions. However, it is now acknowledged that reaching these targets is largely dependent on local authorities' actions. Recently, the Local Government Act 2000 stressed the importance of minimising CO_2 at a local level and promoted the global significance of local actions, motivating local authorities to take leadership in reaching carbon dioxide reduction targets.

Although local authorities can raise community awareness to change behavioural energy conservation or include innovative planning policies like Merton Council's existing Unitary Development Plan, it is important to focus on CO_2 emissions from buildings. Citing the European Commission, the European Association of Insulation Manufacturers (EURIMA) states that, in the EU, "the single largest source of [carbon dioxide] emissions is from the energy used for buildings – in particular space heating…[accounting] for some 41 per cent." The transport and industry sectors each account for 31 per cent (EURIMA, n.d.).

In recognition of the importance of local action in infrastructure projects on buildings, Merton Council has tentatively started the long process of planning for a district heat and power (DHP) scheme as a practical and realistic way to lower CO_2 emissions within the borough. Started by installing several CHP units, a DHP scheme eventually connects the CHP units, creating a network of heat and electricity, lessening the dependence on the national grid.

A DHP scheme can ultimately be successful in many areas besides its initial solution of CO_2 reductions. Economically, a DHP scheme ideally generates a sustainable form of revenue for Merton Council. It also offers cheaper heat and power to Merton residents, compared to already rising energy costs. In the last year alone, domestic users of gas and electricity have seen prices rise from between 20 per cent to 25 per

cent (A. Hewitt, public presentation, 2004). Cheaper heat and power also results in lessening the effects of fuel poverty within the borough. By providing itself with energy, the scheme would potentially lessen Merton Council's dependence on the national power grid, ensuring security of supply. Environmentally, a DHP scheme is driven by the biggest focus of reducing carbon dioxide emissions, but also helps to reduce the global effect of diminishing natural fossil fuel reserves by utilizing fuel more efficiently.

By focusing on small-scale infrastructure projects, Merton Council hopes to install combined heat and power (CHP) units dotted around the borough. Along with a possible development in South East Merton, the initial wave of the strategy is investigating the High Path Estate.

Chapter 3: Combined Heat and Power Systems

Combined heat and power (CHP) systems have proven to be a reliable method of electricity and heat generation. Many countries in Europe are producing up to 12 per cent of their heat from CHP systems (Horlock, 1997, p. xix). The technology has not been widespread throughout the UK thus far, but goals put forth in the Energy White Paper in 2003 aim to have 10 per cent of the UK's electrical power generated from such systems by 2010 (UK DTI Energy Group, 2003). In addition, the Mayor of London has expressed his support of CHP systems, wishing to double the UK's 2000 CHP capacity by 2010.

Conventional electricity generation through the use of fossil fuels operates on the principle of fuel combustion to create steam or hot gas. This energy is then harnessed to spin a turbine, which operates an electric generator. Typically, this process involves a large loss of heat in the form of exhaust gases, which are dispensed through large cooling towers and released into the environment.

CHP technology is an innovative alternative to the separate heat and power generation. Although there is more than one way to implement a CHP system, the basic concept behind each remains the same. The underlying theory is to use the heat normally wasted to create additional energy, either in the form of electricity, hot water, or steam. Variables within the implementation of CHP technology include the type of turbine, power station, and fuel, allowing for the system to be flexible in a variety of settings ("Combined Heat and Power", n.d.). The variety of sizes and efficiencies can be seen below in
Table 2.

Table 2: CHP Range Guide Chart

Standard natural gas range (internal 75dBA)																
Electric output (kWe)	33	60	95	110	122	135	150	185	206	225	305	405	500	770	1027	1150
Heat output (kW)	55	90	160	181	196	215	231	280	324	350	432	606	580	900	1325	1426
Fuel input (kW)	115	205	320	360	401	435	474	580	683	706	976	1344	1500	2365	3200	3360
Electrical efficiency (%)	29	29	30	31	30	31	32	32	30	32	31	30	33	33	32	34
Thermal efficiency (%)	49	44	50	50	49	49	49	48	47	50	44	45	39	38	32	42
Overall efficiency (%)	78	73	80	81	79	80	81	80	77	82	75	75	72	71	64	76
Length (mm)	2880	2880	2880	2880	3600	3500	3500	4000	4000	4000	3800	4266	*	*	*	*
Width (mm)	800	800	918	918	900	1450	1450	1450	1450	1450	2100	2100	*	*	*	
Height (mm)	2030	2030	2050	2050	2080	2120	2120	2120	2120	2120	2380	2300	*	*	*	*
Weight (kg)	2400	2500	3500	4000	4100	5500	5500	5700	5500	6500	8500	8500	*	*	*	*

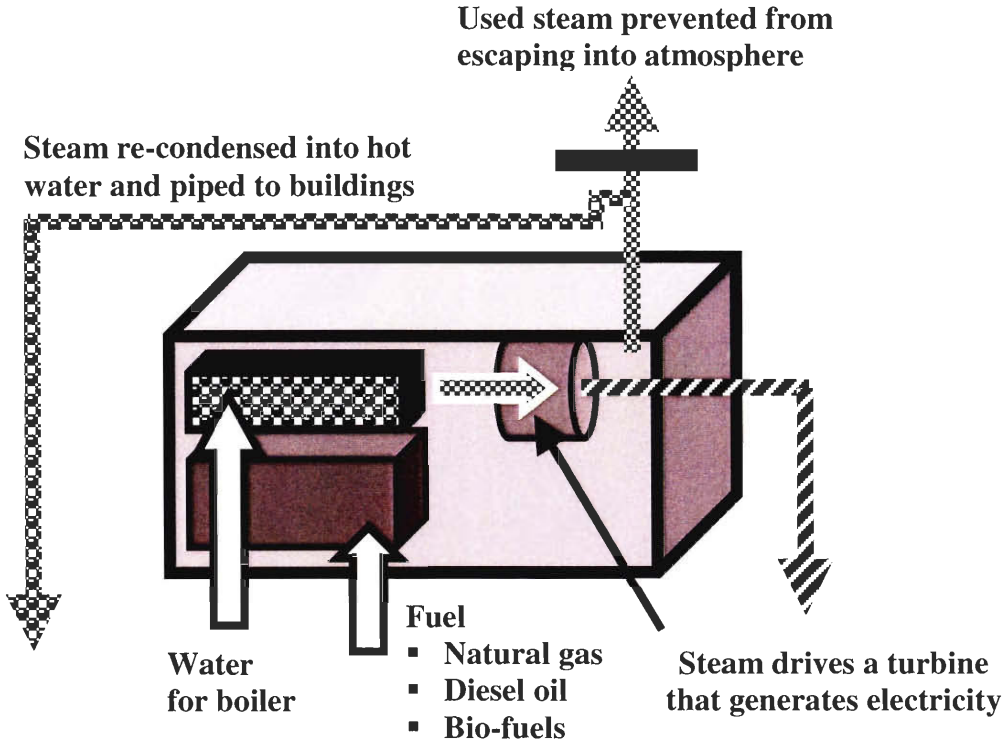


Figure 2: CHP Technology

Micro CHP technology. As an alternative option to larger CHP systems, micro CHPs are small cogeneration systems, meant to either supplement electrical and heating requirements from other sources or to act as a primary source for a small area. The smaller size allows for an ease of implementation that a larger CHP system does not, making them ideal for retrofitting. However, they produce less energy and fail to offer as large a reduction of carbon dioxide emissions. They are used in a distributed scheme, where customers would generate their own heat and electricity, while connected to the grid as backup security. Although the use of many systems allows for a large amount of demand flexibility (Gaia, 2004), the arrangement does not lend itself to incorporating other renewable energy systems, unlike a district scheme of larger CHPs (Cames, 2004). Also, because of their size and the smaller amount of electricity produced, it is less feasible to anticipate selling excess energy back to the national grid (Aircogen, personal communication, 2 February 2005).

3.1 Advantages of CHP

Efficiency. The major advantage of CHP systems is its energy efficiency ratings. By utilising waste heat, CHP systems eliminate the need for additional means of heat production, ultimately requiring less fuel to create the same result. Standard power stations have efficiency ratings of approximately 30 per cent; by utilising the waste energy that these stations do not use, CHP systems reach higher efficiencies upwards of 85 per cent, more than double the efficiency of separately generating heat and power (Johnson, 2003). These ratings directly translate into reduced fuel consumption and lower energy bills. As can be see in Figure 3, the "condenser loss" of 45.6 per cent in the condensing power plant is utilised in the CHP plant, increasing the overall useful energy to 85.9 per cent.

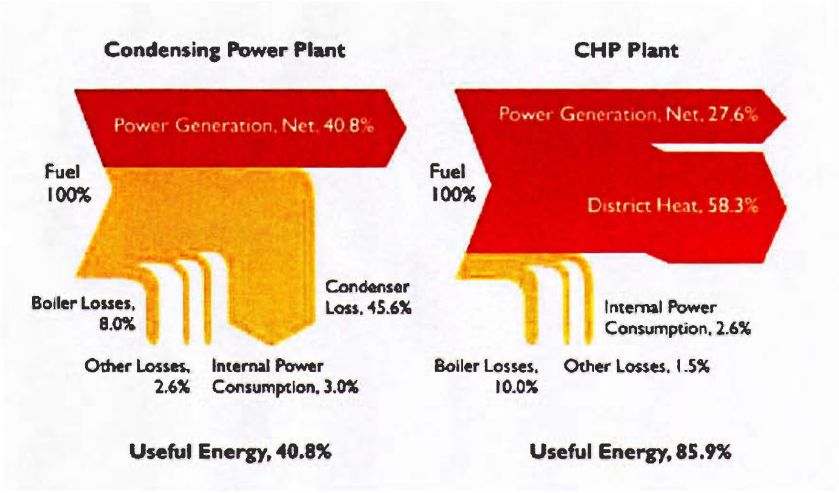


Figure 3: CHP vs. Conventional: Efficiency (www.chp-info.org)

In typical large-scale electrical generation plants, the electricity is transmitted long distances via an electrical grid to the consumers. Due to the intrinsic internal resistance of the transmission lines, a large amount of electricity is lost during this process, apparent in Figure 4. This proves that power stations are most effective when used in close proximity to where the electricity is being utilised, which is how CHP is implemented, enabling a much lower energy loss. According to Onsite Sycom Energy Corporation (1999), in California alone, the "savings from avoided transmission and distribution losses amount[ed] to over 1.5 million MWh per year, due to the location of CHP on the site where electricity is used."

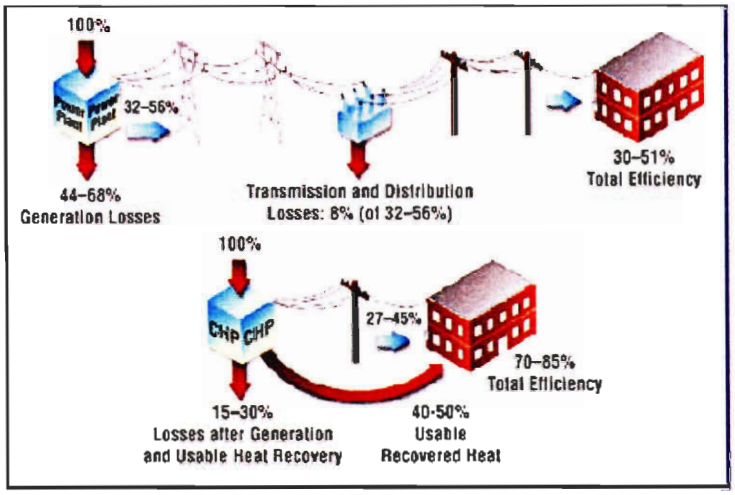


Figure 4: Transmission Efficiency (www.eere.energy.gov)

Flexibility. CHP systems are extremely flexible in their implementation. They can be utilised in both industrial and residential scenarios, providing both electricity and additional energy in the form of steam to power industrial processes or for heating in residential locations. The built in flexibility of small closed-system power stations also allows for a broad range of fuels to power the machine, further isolating the system from the global energy market and its constant price fluctuations.

Lower carbon dioxide. The last major advantage of CHP systems is their environmental friendliness. According to the UK CHP Association, CHP systems produce 30 per cent less CO_2 emissions than traditional energy generation techniques (CHPA, n.d.). This reduction in CO_2 output creates a much healthier living environment and contributes to the self-imposed 20 per cent CO_2 reduction goal that the UK is aiming to meet by 2010.

3.2 Issues of CHP Implementation

CHP systems are not without their problems, but it is the ease with which these problems can be controlled that CHP proves to be a better option than separate energy generation stations. The fact that CHP systems are close to the user will resolve the problem of transmission and distribution losses, but does create additional concerns that have to be addressed.

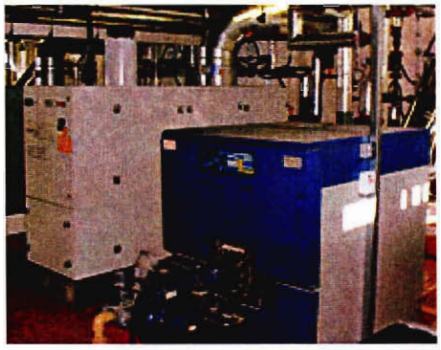


Figure 5: An Installed CHP System

Noise pollution. Noise pollution, from either a piston or turbine engine, is one obvious concern and can be addressed by distancing the system from the area it is servicing; however, this would negate the advantage of on-site electricity generation. Manufacturers already have solutions to this problem through technological advances. Currently, microturbines used in CHP systems have relatively low noise production through the use of low-friction bearings and can boast sound levels as low as 56 decibels (A) at a distance of 10 metres (33ft) (Kohler Co., 2002), which is less than the volume of a normal conversation at 3 to 5 feet (Galen Carol Audio, n.d.).

Use in rural areas. Complications can also arise regarding CHP systems servicing sparsely populated areas. This is especially true in rural UK areas due to the geographic dispersal of consumers and the low density of suburban British towns (Few & Smith, 2001). Using single CHP systems per dwelling would eliminate the issue of low consumer density, but the system then needs to be more capable of adapting itself to the needs of the consumer. Peak demand times could call for more electricity than heat or vice versa. Since CHP systems cannot produce one without the other, this would pose a problem to reaching peak efficiency.

Initial installation and infrastructure costs. One final concern regarding the use of CHP systems is the initial installation and infrastructure costs. CHP systems generally require a larger investment than conventional energy production stations. Additional costs will also arise when altering existing building infrastructures, making it receptive to a CHP system. For example, according to Ener-G Combined Power, their model Ener-G 60 would be appropriate for a single high rise building with approximately 66 flats. With 60kW electrical output and 90kW heat output, such a

system costs approximately £64,000, including installation, has an average lifetime of fifteen years, and has maintenance contracts ranging from £3,863 per year for ten years to £5,760 per year for five years (Ener-G, personal communication, 2 February 2005). In the ideal situation, these costs can be recovered rather quickly if the district heat and power scheme is developed by selling excess electricity to neighbouring developments ("Combined Heat and Power", n.d.).

3.3 CHP Case Studies

Case studies can play a critical role in finding out site-specific knowledge of a certain scheme, as opposed to a general perspective of what CHP systems are used for. A large amount of case studies explain successful CHP scheme. They provide insight not only into the company's experience, but also into the scale of the project; they also can ground aspirations with evidence for claims made about savings and implementation costs.

Newcastle, England: Retrofitting a housing block. In many of the case studies that have been done, retrofitting CHP systems tends to be the most popular choice in the residential sector. One example of this is the Stanhope Street estate in Newcastle. In this case, a housing association that rented flats and maisonettes to low income customers wanted to replace the outdated heating systems. With funding via the European Union THERMIE programme, the heating systems were replaced with a gas fired CHP unit generating 500kW of heat and 300kW of electricity, and a condensing boiler, as well as a 40 cubic metre hot water storage tank. With the new system in place, the average weekly heating bills came down to £3.35 per dwelling, the energy use on the estate was reduced by 64 per cent, and the estate's CO_2 emissions were reduced by 4,200 tonnes per year.

Aberdeen, Scotland: Generating revenue. Aberdeen City Council (ACC) decided to change the current energy efficiency of its Stockethill block. Set-up funding came in from Energy Services Programme; capitol costs were supplemented by the Community Energy Programme. ACC then set up a separate company,

Aberdeen Heat and Power Limited (AH&P), to control the business plan for the new system. An energy centre, built close to one of the multi-story blocks, holds one 210kWe gas fired reciprocating engine CHP unit and two 700kWt gas fired boilers to alleviate peak loads and to serve as back-up units. There has been a 42 per cent reduction in CO_2 emissions, which is equal to 661 tonnes per year. Currently, money earned from the sale of electricity to the customers is invested in AH&P to fund more installations of these systems.

Chapter 4: Resident Consultation Process

This project's goal was to establish a plan for Merton Council and other councils to follow beginning the implementation of a CHP system, when it begins to actively pursue installing CHP systems as part of a DHP scheme throughout its borough. Specifically, it focused on establishing how such a project would go about consulting the residents of the local borough, incorporating their thoughts and concerns into the overall design of a DHP scheme.

This section details the process of consulting residents prior to beginning a sustainable development project, in this case, the installation of a CHP system. The conception of this process is specifically tailored for High Path residents, but intended for replicable use. Through the process of creating and distributing a mail-out questionnaire as well as conducting interviews, several issues were raised and concerns were identified which prompted site-specific modifications. Despite this, this section can be used as a guide for municipalities in similar situations elsewhere.

Reasons for Choosing High Path Estate. High Path Estate is included in the 7,000 Merton Council-owned residences, which provide housing for 9 per cent of Merton's 190,000 residents (National Statistics, 2001). A social housing block that is rented as low-income housing, High Path consists of three main high-rise buildings and several low-rise buildings that cover three city blocks. The three main high-rise buildings of High Path are May Court, Marsh Court, and Hudson Court, each consisting of 66 flats dispersed throughout 11 floors.

A September 2004 fire, caused by an electrical fault, totalled £500,000 in damages to May Court, including water and smoke damage. As a result, the poor structural condition of the building was revealed; every flat's electrics needed to be verified as in working order. An estimated 48 of the 66 total units failed the test, as was discovered in an interview with Kim Henderson, former surveyor of High Path. A number of the flats' gas wirings failed as well. Because all three buildings were built nearly at the same time, it can be logically inferred that the wirings in Marsh Court and Hudson Court are also near failure and in need of renovation.

Due to municipality miscommunication, further discussed in Chapter 5, the current state of the energy system within the three buildings is known, but with a degree of uncertainty. According to Michael Fegrado, Mechanical and Electrical Officer in the Housing and Social Services Department, heat is generated in the estate using a gas-powered hot air system, with individual boilers in each flat. Although this system is not ideal, it has many advantages over the former 1960s electric hot air system.

Although the heating system has undergone a slight upgrade, the recent fire raises concern about having gas lines running throughout the building. As well as eliminate this presence of gas, installing a CHP unit may outweigh the costs of maintaining the existing system. Additionally, if the existing electrical wiring is not in working order and is in need of a complete renovation, a CHP installation may be the most cost effective long-term route. This situation encompasses a common problem local authorities often face: weighing the advantages of installing a new system against maintaining an old system. This makes High Path an ideal location for use as a test bed for the installation of a cogeneration energy system and the creation of a replicable model for involving the residents within the process.

For the successful migration of the existing system in High Path to a CHP system, the resident's acceptance is key. In order to facilitate this acceptance, the residents must be made aware of the change and be given the opportunity to voice opinions of the proposed plan. Merton Council recognises the importance of this step, and of the Power of Well-being. After the passing of the Local Government Act of 2000, local authorities were granted the Power of Well-being, empowering them to act in the best interest of its residents, but also to include the residents in decisions. For these reasons, the residents of High Path are being consulted about their energy use and their feelings towards the possible installation of a CHP system in their estate.

4.1 Identifying the Target Audience

The most effective way of reaching the entire population of the High Path Estate was by distributing a survey, followed by interviews with a select number of the High Path residents. These two approaches allowed us to gain a basic understanding of the residents' attitudes toward the current heating system as well as the possibility of installing a CHP system.

The first task in the design of our consultation was to recognize the target audience. In order to extract the most pertinent information, it was necessary to identify the residents of the estate. A major focus was ensuring that the survey kept the attention of the subject; it needed to be short and concise, but still needed to efficiently gather the data we required. To aid in this process, we enlisted the expertise of the following individuals:

- Jackie Murphy, Merton Council Housing Officer for High Path
- Anne Coombe, Merton Council Housing Officer
- Kim Henderson, Former Surveyor for High Path
- Adrian Hewitt, Merton Council Principal Environmental Officer
- Ola During, Community Development Officer

It was important to take into consideration several site-specific issues when formulating the survey. One such issue was the recent hostility of High Path residents toward Merton Council due to the feeling of abandonment after the September 2004 fire. It was the general consensus that the tenants were feeling unfriendly towards people affiliated with the Council. Parallel to this unforeseen issue was the need to gain trust by advertising that the Council commissioned the study. Another preliminary concern was the anticipated language barrier. High Path is home to almost 12 different ethnic groups; non-English speaking residents comprise 80 per cent of the estate's population (Kim Henderson, personal communication, 2005).

4.2 Introducing Ourselves and Our Purpose

To inform the residents of High Path why an energy study was being conducted and to help the community become familiar with the identities of the project members, an introductory letter accompanied the survey. This letter laid out the purpose of the energy consultation process and briefly explained the technology behind a CHP system. Also designed was a poster that was displayed in the lobbies of the three high rise buildings, reminding the residents to mail back their surveys by the requested date. All documents were written in a colloquial style, designed to be straightforward and easy to comprehend by all genders, ages, and educational levels. Arial font was also used, which is easier to read for elderly citizens.

The introductory letter's opening paragraph, shown in Figure 6, informs the participants of the survey's purpose and explains the survey's guidelines and return date. Distributed on Thursday, 27 January 2005, the survey had a suggested return date to give ample time for completion; it was determined that prolonging the return date would not greatly increase the number of returns.

> Merton Council's Environment and Regeneration Department is conducting a study about installing a new heating system and would like to include you in the consultation process by getting your feedback on a few possible heating solutions. To be included in this consultation, please fill out the enclosed survey about your energy usage and return it in the prepaid envelope postmarked by Wednesday, 2nd of February, 2005.

Figure 6: Introductory Letter First Paragraph

In Figure 7 below, it was important to introduce ourselves as students from Worcester Polytechnic Institute as opposed to members of Merton Council. This was done in an effort to make it clear that we were not employed by the Council; hopefully it would discard any prejudices the residents might have towards another Council survey.

> Four American students, Luke Marron, Keith Messina, Valery Sheridan, and Tim Walsh, from Worcester Polytechnic Institutes in Worcester, Massachusetts, are conducting this survey. They will also be conducting a few face-to-face interviews with some residents in addition to the postal surveys. If you are interested in taking part in the face-to-face interview or have any questions about the possibility of a new heating system, please fill in your details at the end of the questionnaire.

Figure 7: Introductory Letter Second Paragraph

In order to give the residents an understanding of the technology of a CHP system, the third paragraph provides a brief non-technical explanation of the system and outlined some benefits that it has over traditional energy generation techniques.

> This study is focusing on installing combined heat and power (CHP) systems that could be a cheaper way to heat your homes then what you have now. This system makes electricity like a normal power station but is the size of a small garden shed and more than twice as efficient. Normal power stations waste heat from generating electricity by getting rid of it through giant cooling towers. In CHP systems this energy is used to heat homes, controlled by a small easy to use dial.

Figure 8: Introductory Letter Third Paragraph

To visually convey how a CHP system functions compared to a conventional energy generation system, a straightforward graphic was also included.

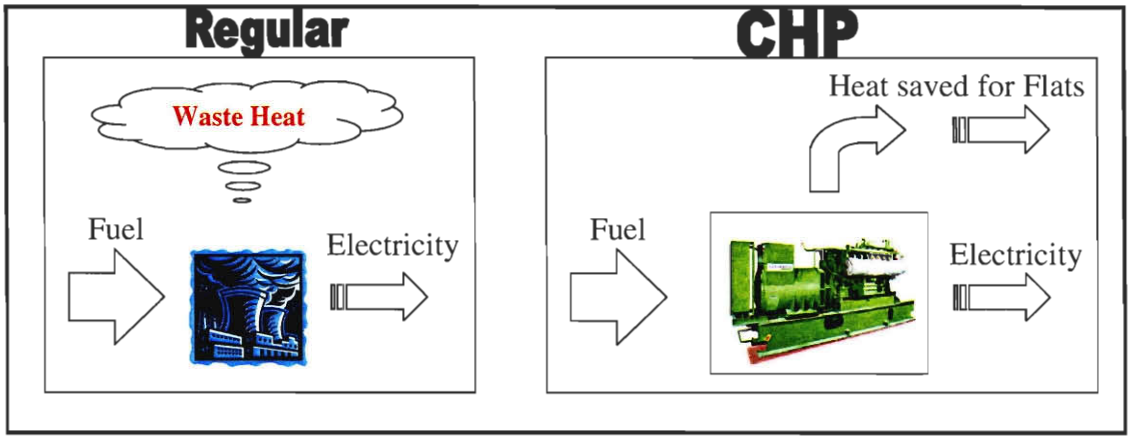


Figure 9: CHP Diagram

Since surveys typically have a return percentage of 20-25 per cent, the sentence in Figure 10 was added as a disclaimer.

> If we do not receive your completed questionnaire by the closing date, we will assume that you will agree with the majority decision.

Figure 10: Disclaimer

The final page of the mail-out is the typical translation page that Merton Council attaches onto its publications for all 12 foreign languages that are present in the borough. If they need a translation of the survey, they are informed to contact Merton Housing Services, who will then accommodate them through the translation services of the Human Resources Department.

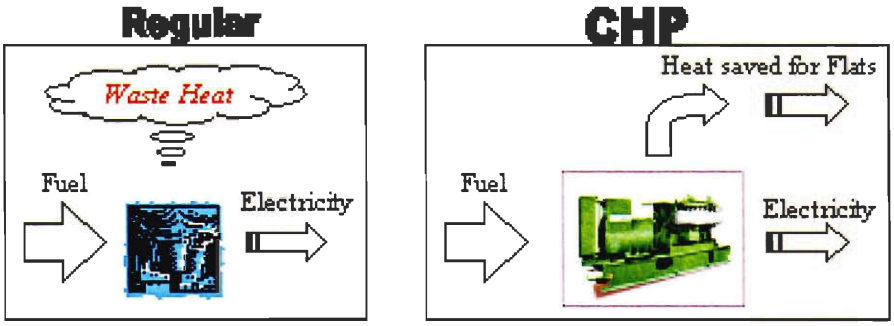
Figure 11 below shows the letter in its final format. Notice we included both the WPI logo and the Merton Council logo to demonstrate our identity.

Possibility of New Heating System

Merton Council's Environment and Regeneration Department is conducting a study about installing a new heating system and would like to include you in the consultation process by getting your feedback on a few possible heating solutions. To be included in this consultation, please fill out the enclosed survey about your energy usage and return it in the prepaid envelope postmarked by Wednesday, 2nd of February, 2005.

Four American students, Luke Marron, Keith Messina, Valery Sheridan, and Tim Walsh, from Worcester Polytechnic Institute in Worcester, Massachusetts, are conducting this survey. They will also be conducting a few face-to-face interviews with some residents in addition to the postal surveys. If you are interested in taking part in the face-to-face interview or have any questions about the possibility of a new heating system, please fill in your details at the end of the questionnaire.

This study is focusing on installing combined heat and power (CHP) systems that could be a cheaper way to heat your homes then what you have now. This system makes electricity like a normal power station but is the size of a small garden shed and more than twice as efficient. Normal power stations waste heat from generating electricity by getting rid of it through giant cooling towers. In CHP systems this energy is used to heat homes, controlled by a small easy to use dial.



If we do not receive your completed questionnaire by the closing date, we will assume that you will agree with the majority decision.

If you want more information about the consultation please contact either Jackie Murphy, Housing Officer, London Borough of Merton, on 020 8545 4578 or Adrian Hewitt, Principle Environmental Officer, London Borough of Merton, on 020 8545 3457.

Thanks for your time.

Figure 11: Introductory Letter

4.3 Creating the Survey

The creation of any survey must be specifically tailored to its target audience. Keeping in mind the fragile relationship between the Council and the tenants of High Path, we developed a survey that focused solely on energy issues and did not easily divulge into other topics. Words and sentences were properly formatted to the linguistic habits of the region.

Designed to extract the residents' interest in CHP systems, their level of dissatisfaction with the current system, as well as general energy consumption data, the survey provided useful information. This information easily gauges the residents' enthusiasm for the project and can also aid in framing a CHP system's basic technical requirements. Our survey focuses on data collection in five major areas and the relevant survey questions are located in the sidebars, with the entire mail out packet attached in Appendix B.

Demographics Data. Determining ethnicity and family size will allow us to obtain a general social background of the residents, which will be useful for identifying energy traits and attitudes among different groups. Family size is also an important factor in the energy consumption of the flat.

> How many people live in your flat between these ages?
>
> 1-8 _____
>
> 9-18 _____
>
> 19-65 _____
>
> 65+ _____
>
> Please fill in your ethnic background:
>
> Ethnic Background: _____

Energy Consumption Statistics. The number of appliances in the flat, the typical thermostat setting and general 24-hour energy use statistics are addressed here. This information addressed forming an initial establishment of technical specifications for the CHP system. The data will factor into the determined base load for the estate, an important criteria in allocating the size of the CHP unit.

Are you at home during the day or are you at work? Please tick.

☐ At home ☐ At work

Do you have your heating on while you're at work? Please tick all that apply.

☐ In the winter

☐ In the autumn/spring

☐ In the summer

Do you tend to leave a light on when you leave for security purposes?

☐ Yes ☐ No

How often do you use the following appliances?

Televisions ___ hours/minutes per day

Cooking Appliances __ hours/minutes per day

Computers ___ hours/minutes per day

Dishwasher _____ times per week

Washing Machine ___ times per week

Clothes Dryer _____ times per week

At what approximate setting do you have your heating?

Careful word choice is noticeable in these questions. Categorizing the answers according to seasons is important; energy use varies greatly at different times of the year. Determining if residents leave their light on is important to characterize their energy usage habits. The question was worded in such a way as to not seem aggressive or disapproving. Instead of directly asking if they leave the light on, we worded the question delicately and provided an excuse to ease any hesitation.

Attitudes Towards Current and Possible Future Heating Systems. The success of installing a new system depends in part on whether the residents will accept it. Therefore, for the installation of a new energy system to be successful, possibilities for the future system must be viewed as more favourable than the existing system. Determining the residents' attitudes is the single most important piece of data that the survey will collect.

Do you think the existing heating system is healthy for you?

☐ Yes ☐ No

Do you think the existing heating system is environment friendly?

☐ Yes ☐ No

Do you think the existing heating system needs to be replaced?

☐ Yes ☐ No

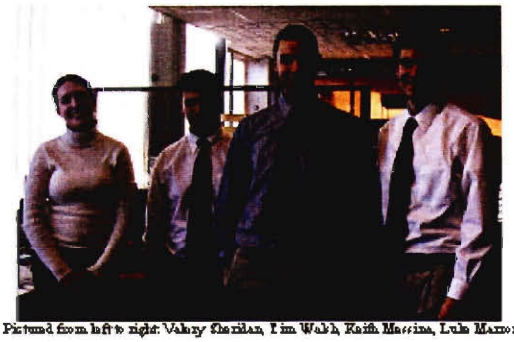
Do you think your monthly electric bill is too high?

☐ Yes ☐ No

The poster in Figure 12 was the final document that was created for the consultation process to encourage the residents to participate in the energy survey, as well as remind them to send it back on time. Additionally, to further introduce our project team to the residents, a picture of us and a short description of our role with Merton Council were included to help the tenants become familiar with us.

Have You Returned Your Energy Survey?

By returning your energy survey, you are helping the Council possibly find a better heating system for your flat. Remember to fill out your information at the end of the survey if you are interested in the face-to-face interviews with the American students pictured below.



Pictured from left to right: Valery Sheridan, Tim Walsh, Keith Massina, Luke Marron

Four American Students Visit High Path.

Students from the university Worcester Polytechnic Institute will be coming to the High Path Housing Estate to talk with residents. They will be asking questions about how you feel about the current heating system and heating issues. Before they arrive they ask you to complete a short questionnaire about electricity usage. If you would like to talk with the students, please fill in your name, phone number and flat number at the end of the questionnaire.

The students, pictured above, are engineering students studying how technology influences our daily lives. Over the course of the next month they will be working with you to consult the Council about how best to meet your electricity and heating needs.

The students hope to provide a way for residents to voice their opinions and participate in studying about installing a new heating system.

Figure 12: Reminder Poster

4.4 Distributing the Survey

The distribution of the surveys took place on Thursday, 27 January 2005. To ensure the safety of the project team and prevent confrontations with the residents of High Path, we operated in two groups of two on each floor, beginning at the top of each high-rise building and working our way down to the ground floor, sticking the packed envelopes through the door's mail drop. Mobile phones were carried for emergencies

and the project liaison, Adrian Hewitt, accompanied us as a council representative to oversee the distribution process and to ensure the safety of the team.

During the actual distribution, an encounter with one of the High Path residents occurred with project member, Keith Messina. Confronted after sliding the envelope through the mail drop, Keith was greeted by the resident as she opened her front door. After Keith was asked what was in the envelope, he briefly informed the resident. She then irritably asked if Keith was part of Merton Council; when he described his role as an American student, she smiled warmly. Their short conversation embodied the hostility and resentment toward Merton Council that was rumoured of the residents.

4.5 Survey Results

A total of 40 surveys were returned on time, producing a 20 per cent return from a distribution of 200 surveys. The survey results confirmed most of our early suspicions about the current state of the heating systems at High Path: they are out of date, unsafe, and in violation of the Decent Homes Standard. From the results, we had information to verify the type of heating system was present in High Path as gas powered boilers. This was interpreted from the residents' response when we failed to include a question enquiring about their gas or heating bill. This situation was rectified later in the interview process as the data was collected then.

Do you think the existing heating system is healthy for you?
6 – Yes 32 – No
2 – No Response

Do you think the existing heating system is environment friendly?
7 – Yes 29 – No
4 – No Response

Do you think the existing heating system needs to be replaced?
36 – Yes 4 – No

Do you work at the weekends?
9 – Yes 28 – No
3 – No Response

Where are you during the day?
21 – Home 13 – Work
5 – Both 1 – No Response

Although a total of 16 questions were asked, only five of the questions returned enough data to draw concrete conclusions regarding the general consensus of the residents. These five questions included the residents' daytime and weekend location, whether the heating system imposed any health risks,

was environmental friendly or needed replacing.

Out of the 40 returned surveys, 23 residents indicated that their current system was not healthy, demonstrating the poor condition that the system is currently in. Some residents wrote in comments, mentioning that their system produced black smoke; one mentioned having a fear that his gas boiler might explode and did not run the system when he was away from home. Twenty-two residents indicated that they believed that the system wasn't environmentally friendly.

The major conclusion that can be drawn from the survey results is that the current heating system needs to be replaced. This was one of few questions to which all thirty participants responded; 27 responses were in favour of replacing the current system and only three against. It shows overwhelming support for the installation of a new system and also implies that the residents would likely be very receptive to a system different from the one currently in place at High Path.

4.6 Interview Questions and Process

The interview process was deemed necessary to obtain a finer degree of knowledge about the needs of the estate. The results from the survey were not as informative in certain areas we were hoping for. Using questions tailored for the specific site and people, the interview was designed with the intention of gathering information about a few areas interest, including residents' opinions of the current heating and possible replacement options.

1. Do you have a gas or electric heating system?
2. Some of the residents' heating systems have problems such as producing black smoke. Does your system do anything like this?
3. What do you think are the most important reasons for replacing the heating systems?

The first question acts as a quick, easy to answer opening question that serves the purpose of confirming the presence of a gas powered heating system. Question two draws attention to known problems with the heating systems witnessed by a few members of the participants. This question

not only serves to find out if the interviewee has witnessed the same, but also raises his or her awareness that such problems are occurring elsewhere in the estate. The third question addresses the general consensus of the survey participants, that the system needs to be replaced. Answers to this question are hoped to give insight into the residents' priorities. It also gives an indication as to how the resident would react to the replacement of the heating system.

It was important that the interview results show more insight into the residents' concerns regarding the possibility of an installation of a CHP system. Question four was specifically worded so as not to have the resident provide the answer they felt we wanted to hear; its purpose was to discover the resident's honest opinion regarding a CHP system. Also important was the avoidance of sounding like a CHP installation was a promise. However, a critical piece of information for the managerial aspects of setting up a CHP system is the type of billing and payment system. Question five sought to avoid guaranteeing an installation while determining their preferred method of payment.

4. If you recall from the survey, a CHP system is one that would generate electricity and heat at the same time. This is environmentally friendly and also could possibly reduce your heating bill every month. How would you feel if the Council wanted to replace your current heating system with one of these CHP systems?

5. If Merton Council were to install one of these systems in about a year, would you like to pay for the energy by how much you use each month or by a flat rate that is added to your monthly let fee?

The general condition of the flats in High Path was also an area of concern. Installing a CHP system is an involved process; it is often worthwhile to replace windows and make other improvements at the same time. If the flat's structure wastes heat, it will be cost-effective to upgrade the efficiency of the flat, thereby saving on the consumption of additional gas.

6. Is your flat drafty? Do the windows/doors/etc. leak?

7. Do you have enough electrical outlets in your flat?

Concluding the interview are general behavioural questions. Determining how the residents utilise the heating and electricity is important to understand an approximate

level of the base load. If residents are conscious of environmental issues and energy efficient habits then the base load may be lower. The final question relates to the residents' attitude of the possible installation of a CHP system but probes deeper to determine if there has been any further discussion regarding the topic. Discussion amongst the residents would be a good sign, indicating that our survey has surfaced a topic that is important to the residents. This question also may provide information regarding the overall attitude of the estate, especially with residents who did not return the survey or did not opt for an interview.

8. Do you have any problems with your hot water? Do you know how it is heated? Are there any water leaks in your flat?

9. When you buy electrical appliances, do you tend to buy items that are the cheapest or the ones that are the most energy efficient?

10. Have you talked to any other residents in the building about the energy survey? Would you say they agree that the heating system needs to be replaced or did they have a different idea?

4.7 Interview Results

The resident interviews were completed on Monday, 14 February 2005. Of the two candidates that we could arrange face-to-face interviews with, both voiced their overall displeasure for the current heating system. The biggest problem stressed by these residents was the unhealthy dry heat that the system produces. Both of the interviewees, Mrs. Sparks, tenant at Hudson Court, and Mr. Michael Adtei, tenant at Marsh Court, voiced concerns over the effect the system has had to their own health and to that of their family's. Their overall dissatisfaction with the system, ranging from maintenance issues to the systems' overall unreliability, further reinforces the need to replace the systems in compliance with the Decent Homes Standard.

The interviews, allowing us to interact with the residents on a more individualized and personal level, brought to light the magnitude of the problems that plague the heating systems at High Path. The problems mentioned by Mr. Adtei and Mrs. Sparks were almost identical. Both cited problems with the pilot light of the gas system, as it

would extinguish itself while in operation and prove to be very difficult to relight. Mr. Adtei said his pilot light would extinguish itself every 30 minutes, which is then followed by a loud clicking sound in attempt to relight itself. This process, unless interrupted by the resident, continues for 24 hours each day. Mrs. Sparks' similar problem was not of the same magnitude as Mr. Adtei's, but her pilot light would extinguish itself approximately once per day, at which point the system would continue to blow cold air into the flat. "Heating is very much a problem" according to Mr. Michael Adtei (personal communication, 2005).

Chapter 5: Next Steps

Beginning a DHP scheme requires a detailed plan, including all the stages of installing each CHP system as well as procedures for consulting residents about the impending change to their homes. Also important are sources of funding and criteria for choosing consultant services.

Based on the outcomes of our preliminary resident consultation process, there are good reasons to think that a new heating system, preferably CHP, should be installed into the High Path Estate. The results of the consultation show the resident's dissatisfaction with the current system. More investigation is needed into the technical and financial feasibility of installing a CHP system but the subsequent phases are . In the following sections, possible refinements to the resident consultation are discussed as well as general information on the subsequent steps that will lead to the installation of a CHP system.

5.1 Refining the Consultation Process

One lesson learned from our resident consultation process is the importance of site-specific issues, many of them unforeseen at the conception of the project. Our pilot study of consulting the residents did succeed at gathering enough preliminary information to draw several conclusions of the residents' attitudes; however, it served as a pilot, subject to modifications.

Survey Redesign. Miscommunication among the people who maintain High Path and the Housing Department led to uncertainty regarding the current heating system installed in High Path. We designed the original survey based on information that the estate was heated by a 1960s electric hot air system. Shortly before the designated day to distribute the surveys, Michael Fegrado informed us that the heating systems have been updated to gas boilers. This prompted us to review the original survey to reflect this knowledge; however time constraints left some issues unnoticed, most prominently the lack of question regarding the amount of the residents' monthly gas

bill. Although a few residents realised this and wrote in the margin of the survey what their monthly gas payments were.

1. Do you have a thermostat?
☐ Yes ☐ No

If YES, at what approximate temperature do you set it too?

_____

☐ Celsius ☐ Fahrenheit

If NO, how do you control the temperature in your flat?

_____

2. At what approximate setting on your control do you use?

_____

Upon further inspection, we realised that several of our questions could be interpreted in different ways. Subject to individual residents' situations, certain answers were too general and caused some confusion. One example is the original question about the resident's typical heating system setting. Responses ranged from specific temperature settings to general comments on the system's operation. The question was revised to be more specific, allowing for a range of answers that will be easily interpreted.

3. Is English your first language?
☐ Yes ☐ No

If you answered 'No', list languages that you are able to speak beginning with your primary language:

First Language: _____

Second Language: _____

Third Language: _____

Another general modification that needed to be made was the addition of a question of which building, May Court, Marsh Court, or Hudson Court, the resident occupied. The original survey only asked for which flat number; this was insufficient information. The original language question was modified as well. The previous theory was to identify the resident's first language, to determine the need for a translator at an interview. Ignoring that much of the UK's population is multilingual, the original question did not ask the pertinent information: can the resident participate in an English-speaking interview? To find this out and to collect useful information, the question was changed to identify the resident's first three speaking languages.

Integration into City Knowledge. The final revision to the original High Path survey would be to format the results to ease future input into a manageable system that collects and displays useful information for planning similar infrastructure projects. Embarking on the creation of a DHP scheme, it is important to have a central location for detailed information regarding buildings and surrounding area. Collecting physical and technical data, as well as a layer of human geography, is important to decide possible locations for the dotted CHP systems around the borough. An innovative method for storing and presenting such comprehensive data as demographics, road usage, and maintenance statistics is known as City Knowledge (CK). The system takes data collected for any use and provides a way to view the information using Geographical Informational Systems (GIS). Collecting such data into a database allows the GIS systems to display information about an individual flat, a building, or even an entire borough. This would also provide a way to inventory a building's type of heating system with certainty, avoiding the miscommunication that surrounded the information about High Path. Such a system is expandable and can encompass any pertinent information, ranging from maintenance schedules to monthly energy usage; it is a mechanism for the constant and steady inflow and analysis of data.

5.2 Planning the Development

The implementation of a CHP system is approximately a two-year long process from conception to installation. After the preliminary scope of the possible location, the preparations become focused and specific, to ensure the accuracy of the installation. The next steps demonstrate the shift from general and conceptual to formal and business-minded.

Options Appraisal. The development stage begins after the initial conception of installing a CHP system. At the beginning of the development stage is an options appraisal of the current scheme versus alternatives. Using a technique known as whole life costing, the appraisal analyses the economic benefits over the lifetime of a scheme. The best indicator is often the scheme with the lowest whole life cost. This

method takes into account capital costs, running costs, and replacement costs, as well as revenue streams over the lifetime of the scheme discounted back to present value. The figures used, the lifetime of twenty-five years and the discount rate of three and a half per cent, are based on the Treasury Guidance (Community Energy Programme Prospectus, 2004).

An example of an options appraisal is depicted in Table 3. This was conducted for Aberdeen City Council when they were involved in the retrofitting of several multi-storey buildings. The Council decided the most attractive option was installing a CHP scheme with cladding applied; however, the capital costs of cladding were prohibitive. They chose CHP only, instead. Several factors affect the option chosen; however, with a focus on carbon dioxide emissions, estimated costs to residents, as well as a low whole life cost, a CHP system is the favourable option.

Table 3: Aberdeen City Council Options Appraisal

Option	Average NHER	% Reduction of NHER	Total capital cost £	25 Year whole life cost	Estimated running cost/ week/ flat £	% Reduction in estimated running costs	Total CO_2 emmsions (tonnes/annum)	% reduction in CO_2 emmisions
Existing heating systems	3.3	N/A	N/A	N/A	5.23	N/A	1597	N/A
Upgrading electrical unit heaters (no cladding)	3.3	0	780,000	2,680,000	5.23	0	1581	1
Upgrading electrical unit heaters (cladding applied)	4.5	25	1,570,000	3,317,745	4.47	14.5	1282	20
Centralised boiler plant (no cladding)	6.5	49	935,000	2,275,589	4.15	20.5	1007	37
Centralised boiler plant (cladding applied)	7.5	56	1,630,000	2,932,540	3.93	25	837	48
CHP scheme (no cladding)	6.0	44	1,530,000	1,896,956	3.20	39	936	42
CHP scheme (cladding applied)	6.9	52	2,250,000	2,658,854	2.75	47.5	794	50

Business Plan. Once the scheme with the lowest whole life cost is found, a business plan is developed. It contains information about possible financial packages such as leasing the system to reduce capital costs, and opportunities for residents and stakeholders. As the next focused phase, the business plan also addresses site-specific issues. The plan can also include legal implications and the strategy for setting up an operational service such as Energy Services Company (ESCo) (Community Energy Programme FAQ, 2004).

External Consultations. Because of their specialised nature, these next steps are usually conducted by external consultants. A well-chosen consultant can assist in the options appraisal, determining the least whole life cost, and creating a business plan. Different consultants may be needed for the economic and technical aspects of the process. Choosing an appropriate consultant is important; a way to judge the quality is to ask for a 'Capability Statement,' which lists similar recent projects and which employees worked on them. Another option for support is the Community Energy programme, set-up to provide guidance and funding for such developments in the public sector. The Programme can offer support for the entire process, including deciding on a consultant (Community Energy Programme FAQ, 2004). Another organisation that can help in the process is the CHP Association, which was set up to foster CHP energy schemes; the Association has access to contact details of manufacturers and other helpful companies.

Another important step is to conduct further in-depth technical consultations. During our preliminary study, general information provided a broad overview of CHP unit type feasibility to determine which systems may or may not work. However, the value of the information from preliminary technical consultations is proportionate to the precision of the known information. Providing usage patterns, demographic details, and current levying schemes of energy companies in the service area is more likely to result in a rough cost analysis from a company's technician over the phone, or through the company's website; some providers even have an interactive CHP feasibility questionnaire, such as Aircogen's (www.aircogen.com).

Funding. Because of the recent emphasis on the need for sustainable energy developments such as CHP systems, several options are available for external funding. Funding can aid in the development stage, as well as in the actual installation of the system. Grants, loans, or capital are three options. Loans are financially more feasible for public local authorities because they are offered lower interest rates as opposed to private companies based on the risk of bankruptcy. Several suppliers of grants from the Energy Savings Trust exist for renewable energy schemes, including Clear Skies, (www.clear-skies.org) and the Community Renewables Fund,

(www.countryside.gov.uk/communityrenewables) (Community Energy Programme FAQ, 2004).

5.3 Anticipate the Installation

After the business plan and a detailed feasibility study have been completed, the next step is the installation of the system. This encompasses the hiring of a company to install a CHP system, connecting the system to the electrical and heating systems of the site and the addition of controls and heat exchangers in the building.

An important issue is the contract regarding the maintenance of the system. Such contracts vary in price and in service schedule. It is important to be aware of and discuss with the manufacturer. Length of warranties and routine maintenance are factors in determining a corresponding schedule. Since individual CHP systems need to be serviced at varying intervals ranging from every 650 hours to every 5000 hours, the maintenance schedule should be finalised as appropriate for the specific system.

The actual installation of a CHP system is completed by the manufacturing company, and can take from two days to two weeks. Preparations should be made in order to minimise the disruption to residents, whether it be through taking safety measures or through minimising noise and pollution

Once the CHP unit is producing electricity and heat, the planning for the next site can begin. Each time the model is replicated, improvements and revisions can be made to the process, leading to quicker, less expensive DHP scheme development.

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Appendix A: List of Interviewees

Jackie Murphy, Housing Officer for High Path, Merton Council

Anne Coombe, Housing Officer, Merton Council

Kim Henderson, Former Surveyor for High Path, Merton Council

Ola During, Community Development Officer, Merton Council

Adrian Hewitt, Principal Environmental Officer, Merton Council

Michael King, Energy Services Consultant, Combined Heat and Power Association UK

CHP Company Interviews:

AirCogen, www.aircogen.co.uk

EC Power Engineering, www.ecpower.com

Ener-G, www.energ.co.uk

High Path Estate Residents

Mr. Michael Adtei, Marsh Court resident

Mrs. Sparks,

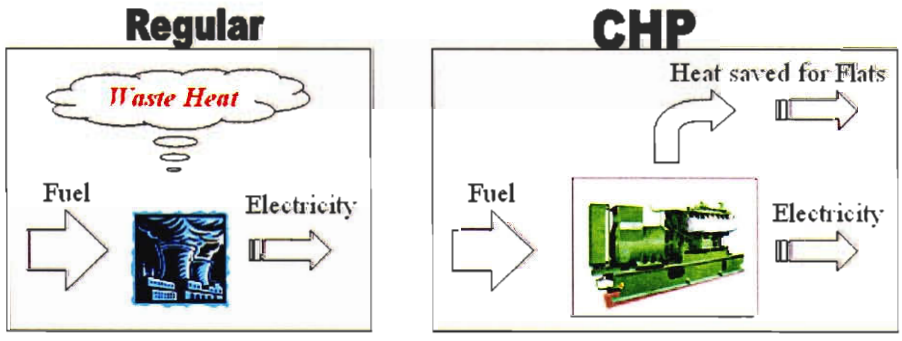
Appendix B: High Path Estate Energy Survey

Possibility of New Heating System

Merton Council's Environment and Regeneration Department is conducting a study about installing a new heating system and would like to include you in the consultation process by getting your feedback on a few possible heating solutions. To be included in this consultation, please fill out the enclosed survey about your energy usage and return it in the prepaid envelope postmarked by Wednesday, 2nd of February, 2005.

Four American students, Luke Marron, Keith Messina, Valery Sheridan, and Tim Walsh, from Worcester Polytechnic Institutes in Worcester, Massachusetts, are conducting this survey. They will also be conducting a few face-to-face interviews with some residents in addition to the postal surveys. If you are interested in taking part in the face-to-face interview or have any questions about the possibility of a new heating system, please fill in your details at the end of the questionnaire.

This study is focusing on installing combined heat and power (CHP) systems that could be a cheaper way to heat your homes then what you have now. This system makes electricity like a normal power station but is the size of a small garden shed and more than twice as efficient. Normal power stations waste heat from the generating of electricity by getting rid of it through giant cooling towers. This energy is used in CHP systems to heat homes controlled by a small easy to use dial.



If we do not receive your completed questionnaire by the closing date, we will assume that you will agree with the majority decision.

If you want more information about the consultation please contact either Jackie Murphy, Housing Officer, London Borough of Merton, on 020 8545 4578 or Adrian Hewitt, Principle Environmental Officer, London Borough of Merton, on 020 8545 3457.

Thanks for your time.

Please answer honestly. The answers from this questionnaire will be used to determine possible money saving and environmental alternatives to your existing old electrical heating system.

1. How many people live in your flat between these ages?

   1-8 _____

   9-18 _____

   19-65 _____

   65+ _____

2. Are you at home during the day or are you at work? Please tick.

   ☐ At home ☐ At work

3. Do you work at the weekends? Please tick.

   ☐ Yes ☐ No

4. Do you have your heating on while you're at work? Please tick all that apply.

   ☐ In the winter

   ☐ In the autumn/spring

   ☐ In the summer

5. Do you tend to leave a light on when you leave for security purposes?

   ☐ Yes ☐ No

6. Do you have any of the appliances listed below? Put how many.

   Television _____

   Computer _____

   Dishwasher _____

   Washing Machine _____

   Clothes Dryer _____

   Microwave _____

7. How often do you use the following appliances?

   Televisions _____ hours/minutes per day

   Cooking Appliances _____ hours/minutes per day

   Computers _____ hours/minutes per day

   Dishwasher _____ times per week

   Washing Machine _____ times per week

   Clothes Dryer _____ times per week

8. At what approximate setting do you have your heating at?

   _____

9. What is the amount of your average monthly electricity bill?

   Winter £ _____

   Autumn/Spring £ _____

   Summer £ _____

10. What is your average monthly electricity payment?

    Winter £ _____

    Autumn/Spring £ _____

    Summer £ _____

11. Do you think the existing heating system is healthy for you?

    ☐ Yes ☐ No

12. Do you think the existing heating system is environment friendly?

    ☐ Yes ☐ No

13. Do you think the existing heating system needs to be replaced?

    ☐ Yes ☐ No

14. Do you think your monthly electric bill is too high?

    ☐ Yes ☐ No

15. Would you be happy to talk to one of the American students in a little more detail about the possible replacement of the current heating system?

Name: _____

Phone: _____

Flat Number: _____

Is English your first language?

☐ Yes ☐ No

If you answered 'No', please fill in your first language below:

First Language: _____

If you would like more information in your own language, please contact us at the address shown in the bottom box.

Albanian
Nese deshironi me shume informacion ne gjuhen tuaj, ju lutemi te na kontaktoni ne adresen e dhene ne kutine me poshte.

Arabic
إذا أردت معلومات إضافية بلغتك الأصلية الرجاء الاتصال بنا
في العنوان المدون ضمن الإطار أدناه.

Bengali
যদি আপনার নিজের ভাষায় লেখা আরও তথ্য চান তাহলে দয়া করে আমাদের সঙ্গে যোগাযোগ করুন, তলার বক্ সে আমাদের ঠিকানা রয়েছে।

Chinese
如果你需要用中文印成的資料，
請按低端方格內提供的地址与我們聯系。

Farsi
اگر مایل به اطلاعات بیشتر به زبان خود هستید، لطفا با ما از طریق آدرس زیرتماس
بگیرید.

French
Pour tout renseignement complémentaire dans votre propre langue,
veuillez nous contacter à l'adresse figurant dans l'encadré du bas.

Gujarati
જો તમને તમારી પોતાની ભાષામાં વધારે માહિતી જોઈતી હોય, તો કૃપા કરીને
નીચે અંતમાં આપેલા ખાનામાં દર્શાવેલા સરનામે અમારો સંપર્ક કરો.

Punjabi
ਜੇਕਰ ਤੁਸੀਂ ਪੰਜਾਬੀ ਵਿਚ ਹੋਰ ਜਾਣਕਾਰੀ ਲੈਣੀ ਚਾਹੁੰਦੇ ਹੋ ਤਾਂ ਕ੍ਰਿਪਾ ਕਰਕੇ
ਹੇਠ ਲਿਖੇ ਖਾਨੇ ਵਿਚ ਦਿੱਤੇ ਪਤੇ 'ਤੇ ਸਾਡੇ ਨਾਲ ਸੰਪਰਕ ਕਰੋ।

Somali
Hadii aad u baahan tahay faahfaahin intaa kabadan oo ku soobsan afkaaka hooyo ama Af Somali fadlan lana soo xiira cinwaanka hoos ku qoran.

Spanish
Si usted desea más información en su propia lengua,
por favor contáctenos en la dirección al pie del formato.

Tamil
உங்கள் மொழியில் மேலதிக தகவலைப் பெற விரும்பினால், அடியிலுள்ள
பெட்டிக்குள் தரப்பட்டுள்ள விலாசத்தில் எம்முடன் தொடர்பு கொள்ளுங்கள்.

Urdu
اگر آپ اپنی زبان میں مزید معلومات حاصل کرنا چاہتے ہیں تو براہ کرم
ہم سے اس پتہ پر رابطہ قائم کریں جو کہ نیچے کے بکس میں درج ہے۔

Merton Housing Services
Chapel Orchard
Church Road
MITCHAM CR4 3BE

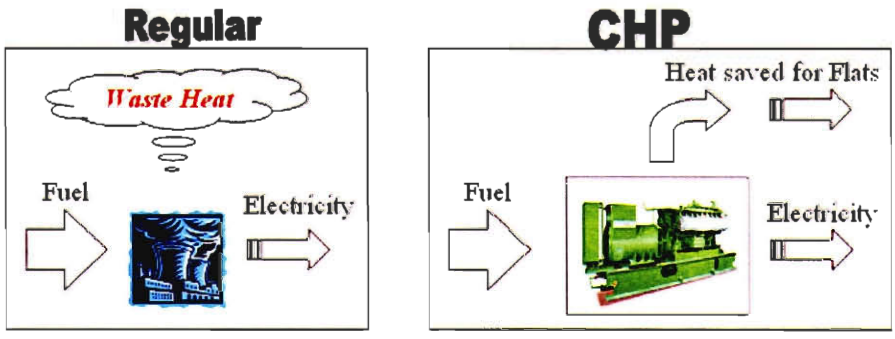
Appendix C: Redesigned High Path Energy Survey

Possibility of New Heating System

Merton Council's Environment and Regeneration Department is conducting a study about installing a new heating system and would like to include you in the consultation process by getting your feedback on a few possible heating solutions. To be included in this consultation, please fill out the enclosed survey about your energy usage and return it in the prepaid envelope postmarked by Wednesday, 2nd of February, 2005.

Four American students, Luke Marron, Keith Messina, Valery Sheridan, and Tim Walsh, from Worcester Polytechnic Institute in Worcester, Massachusetts, are conducting this survey. They will also be conducting a few face-to-face interviews with some residents in addition to the postal surveys. If you are interested in taking part in the face-to-face interview or have any questions about the possibility of a new heating system, please fill in your details at the end of the questionnaire.

This study is focusing on installing combined heat and power (CHP) systems that could be a cheaper way to heat your homes then what you have now. This system makes electricity like a normal power station but is the size of a small garden shed and more than twice as efficient. Normal power stations waste heat from generating electricity by getting rid of it through giant cooling towers. In CHP systems this energy is used to heat homes, controlled by a small easy to use dial.



If we do not receive your completed questionnaire by the closing date, we will assume that you will agree with the majority decision.

If you want more information about the consultation please contact either Jackie Murphy, Housing Officer, London Borough of Merton, on 020 8545 4578 or Adrian Hewitt, Principle Environmental Officer, London Borough of Merton, on 020 8545 3457.

Thanks for your time.

Please answer honestly. The answers from this questionnaire will be used to determine possible money saving and environmental alternatives to the current heating systems used in the borough.

1. How many people live in your flat between these ages?

   1-8 _____

   9-18 _____

   19-65 _____

   65+ _____

2. Please fill in your ethnic background:

   Ethnic Background: _____

3. Are you at home during the day or are you at work? Please tick.

   ☐ At home ☐ At work

4. Do you work at the weekends? Please tick.

   ☐ Yes ☐ No

5. Is someone home all day? Please tick.

   ☐ Yes ☐ No

6. What type of heating system do you have? Please tick.

   ☐ Electric Hot Air ☐ Gas ☐ Other

7. Do you have your heating on while you're at work? Please tick all that apply.

   ☐ In the winter

   ☐ In the autumn/spring

   ☐ In the summer

8. Do you have any of the appliances listed below? Put how many.

Television _____

Computer _____

Dishwasher _____

Washing Machine _____

Clothes Dryer _____

Microwave _____

9. How often do you use the following appliances?

Televisions _____ hours/minutes per day

Cooking Appliances _____ hours/minutes per day

Computers _____ hours/minutes per day

Dishwasher _____ times per week

Washing Machine _____ times per week

Clothes Dryer _____ times per week

10. Do you have a thermostat?

☐ Yes ☐ No

If YES, at what approximate temperature do you set it too? Please give your answer in degrees Celsius.

_____

If NO, how do you control the temperature in your flat?

_____

At what approximate setting on your control do you use?

_____

11. Do you think the existing heating system is healthy for you?

☐ Yes ☐ No

12. Do you think the existing heating system is environment friendly?

☐ Yes ☐ No

13. Do you think the existing heating system needs to be replaced?

☐ Yes ☐ No

14. Would you talk to one of the American students in a little more detail about the possible replacement of the current heating system?

☐ Yes ☐ No

If yes, please fill in the information below.

Name: _____

Phone: _____

Flat Number: _____

Building: _____

Is English your first language?

☐ Yes ☐ No

If you answered 'No', list languages that you are able to speak beginning with your primary language:

First Language: _____

Second Language: _____

Third Language: _____

If you would like more information in your own language, please contact us at the address shown in the bottom box.

Albanian: Nese deshironi me shume informacion ne gjuhen tuaj, ju lutemi te na kontaktoni ne adresen e dhene ne kutine me poshte.

Arabic: إذا أردت معلومات إضافية بلغتك الأصلية الرجاء الاتصال بنا في العنوان المدون ضمن الإطار أدناه.

Bengali: যদি আপনার নিজের ভাষায় লেখা আরও তথ্য চান তাহলে দয়া করে আমাদের সঙ্গে যোগাযোগ করুন, তলার বক্স সে আমাদের ঠিকানা রয়েছে।

Chinese: 如果你需要用中文印成的資料，
請按低端方格內提供的地址与我們聯系。

Farsi: اگر مایل به اطلاعات بیشتر به زبان خود هستید، لطفا با ما از طریق آدرس زیر تماس بگیرید.

French: Pour tout renseignement complémentaire dans votre propre langue, veuillez nous contacter à l'adresse figurant dans l'encadré du bas.

Gujarati: જો તમને તમારી પોતાની ભાષામાં વધારે માહિતી જોઈતી હોય, તો કૃપા કરીને નીચે અંતમાં આપેલા ખાનામાં દર્શાવેલા સરનામે અમારો સંપર્ક કરો.

Punjabi: ਜੇਕਰ ਤੁਸੀਂ ਪੰਜਾਬੀ ਵਿਚ ਹੋਰ ਜਾਣਕਾਰੀ ਲੈਣੀ ਚਾਹੁੰਦੇ ਹੋ ਤਾਂ ਕ੍ਰਿਪਾ ਕਰਕੇ ਹੇਠ ਲਿਖੇ ਖਾਨੇ ਵਿਚ ਦਿੱਤੇ ਪਤੇ 'ਤੇ ਸਾਡੇ ਨਾਲ ਸੰਪਰਕ ਕਰੋ।

Somali: Hadii aad u baahan tahay faahfaahin intaa kabadan oo ku soobsan afkaaka hooyo ama Af Somali fadlan lana soo xiira cinwaanka hoos ku qoran.

Spanish: Si usted desea más información en su propia lengua, por favor contáctenos en la dirección al pie del formato.

Tamil: உங்கள் மொழியில் மேலதிக தகவல்கள் வேண்டுமானால், அடியிலுள்ள பெட்டிக்குள் தரப்பட்டுள்ள விலாசத்தில் எம்முடன் தொடர்பு கொள்ளுங்கள்.

Urdu: اگر آپ اپنی زبان میں مزید معلومات حاصل کرنا چاہتے ہیں تو براہ کرم ہم سے اس پتہ پر رابطہ قائم کریں جو کہ نیچے کے بکس میں درج ہے۔

Merton Housing Services
Chapel Orchard
Church Road
MITCHAM CR4 3BE

Appendix D: High Path Estate Interview Questions

1. Do you have a gas or electric heating system?
2. Some of the residents' heating systems have problems such as producing black smoke. Does your system do anything like this?
3. What do you think are the most important reasons for replacing the heating systems?
4. If you recall from the survey, a CHP system is one that would generate electricity and heat at the same time. This is environmentally friendly and also could possibly reduce your heating bill every month. How would you feel if the Council wanted to replace your current heating system with one of these CHP systems?
5. Is your flat drafty? Do the windows/doors/etc. leak?
6. When you buy electrical appliances, do you tend to buy items that are the cheapest or the ones that are the most energy efficient?
7. If Merton Council were to install one of these systems in about a year, would you like to pay for the energy by how much you use each month or by a flat rate that is added to your monthly let fee?
8. Have you talked to any other residents in the building about the energy survey? Would you say they agree that the heating system needs to be replaced or did they have a different idea?
9. Do you have any problems with your hot water? Do you know how it is heated? Are there any water leaks in your flat?
10. Do you have enough electrical outlets in your flat?

Appendix E: WPI Reminder Poster

Have You Returned Your Energy Survey?

By returning your energy survey, you are helping the Council possibly find a better heating system for your flat. Remember to fill out your information at the end of the survey if you are interested in the face-to-face interviews with the American students pictured below.

Pictured from left to right: Valery Sheridan, Tim Walsh, Keith Messina, Luke Marron

Four American Students Visit High Path.

Students from the university Worcester Polytechnic Institute will be coming to the High Path Housing Estate to talk with residents. They will be asking questions about how you feel about the current heating system and heating issues. Before they arrive they ask you to complete a short questionnaire about electricity usage. If you would like to talk with the students, please fill in your name, phone number and flat number at the end of the questionnaire.

The students, pictured above, are engineering students studying how technology influences our daily lives. Over the course of the next month they will be working with you to consult the Council about how best to meet your electricity and heating needs.

The students hope to provide a way for residents to voice their opinions and participate in studying about installing a new heating system.

Appendix F: Survey Results

Survey Identification Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Age Group (#)														
1 to 8	0	2	0	0		1	0	0	0	0	4	1	2	1
9 to 18	0	1	1	0		0	1	0	0	0	0	3	0	0
19 to 65	1	1	1	1		2	3	0	1	0	0	2	2	1
65+	0	0	0	0		0	0	1	0	1	0	0	0	0
Ethnic Background		British	Black African	African		Iraqi and Kuwaiti	British	British	Carribbean	English	Black British	Lithuanian	White	White British
Day Activity (1 = True; 0 = False)														
Work	1	0	1	1		0	1	0	1	0	0	1	0	0
Home	0	1	0	0		1	0	1	1	1	1	0	1	1
No Response	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Work at Weekends (1 = True; 0 = False)														
Yes	0	0	1	0		0	1	0	0	0	0	0	0	0
No	1	1	0	1		1	0	1	1	1	1	1	1	1
Work Heating (1 = True; 0 = False)														
Winter	0	0	0	0		1	1	1	0	0	1	0	0	0
Autumn/Spring	0	0	0	0		1	1	0	0	0	0	0	0	0
Summer	0	0	0	0		0	0	0	0	0	0	1	0	0
Security Light (1 = True; 0 = False)														
Yes	0	0	0	0		1	1	0	0	0	0	1	0	1
No	1	1	1	1		0	0	1	1	1	1	0	1	0
Appliances (# Appliances)														
TV	1	3	1	1		1	3	2	3	2	1	1	2	2
Computer	0	1	1	0		1	1	0	0	0	0	1	0	1
Dishwasher	0	1	0	0		0	0	0	0	0	0	0	0	0
Washing Machine	0	1	1	1		1	1	1	1	1	1	1	1	1
Clothes Dryer	0	1	0	0		0	1	0	1	0	0	0	1	0
Microwave	0	1	1	1		1	1	1	1	1	1	1	1	1

Survey Identification Number	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Age Group (#)														
1 to 8	1	0	0	0	0	0	0	1	2	0	0	0	0	0
9 to 18	0	0	0	1	0	1	0	2	0	0	1	0	0	0
19 to 65	2	0	1	1	1	2	2	2	1	0	1	1	2	1
65+	0	1	0	0	1	0	0	0	0	1	1	1	0	0
Ethnic Background	British	German	Black African	White British	White English	Asian	Black African	Asian	British	White	Bangladeshi		English	
Day Activity (1 = True; 0 = False)														
Work	1	0	1	1	0	0	0	0	0	0	0	1	1	1
Home	0	1	1	1	1	1	1	1	1	1	1	0	1	0
No Response	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work at Weekends (1 = True; 0 = False)														
Yes	0	0	1	1	0	0	0	0	0		0	0	1	1
No	1	1	0	0	1	1	1	1	1		1	1	0	0
Work Heating (1 = True; 0 = False)														
Winter	0	1	1	0	0	1	0	0	0	0	0	0	0	1
Autumn/Spring	0	0	1	0	0	1	0	0	0	0	0	0	0	1
Summer	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Security Light (1 = True; 0 = False)														
Yes	0	1	0	0	1	1	0	1	0	0	0	1	1	1
No	1	0	1	1	0	0	1	0	1	1	1	0	0	0
Appliances (# Appliances)														
TV	2	1	1	4	2	2	2	2	2	1	0	1	2	1
Computer	1	0	1	1	0	1	0	1	1	0	0	0	0	0
Dishwasher	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Washing Machine	1	1	1	1	1	0	1	1	1	0	0	0	0	1
Clothes Dryer	0	0	1	1	1	0	0	0	0	0	0	0	0	0
Microwave	1	1	1	1	1	1	1	1	1	0	1	1	1	1

Survey Identification Number	29	30	31	32	33	34	35	36	37	38	39	40
Age Group (#)												
1 to 8	1	0	0	0	0	0	0	0	1	1	0	1
9 to 18	0	0	1	0	0	1	0	0	0	2	0	0
19 to 65	1	0	2	0	1	1	0	0	1	2	1	0
65+	0	1	0	2	0	0	1	1	0	0	0	0
Ethnic Background	British	English			White	Asian	English	Scottish White	White English	North africa	Black Caribbean	Black African
Day Activity (1 = True; 0 = False)												
Work	0	0	1	0	1	1	0	0	1	1	0	1
Home	1	1	0	1	0	0	1	1	1	0	1	0
No Response	0	0	0	0	0	0	0	0	0	0	0	0
Work at Weekends (1 = True; 0 = False)												
Yes	0	0	1	0	1	0	0	0	0	0	0	1
No	1	0	0	1	0	1	1	1	1	1	1	0
Work Heating (1 = True; 0 = False)												
Winter	0	0	0	1	0	1	1	0	0	0	1	0
Autumn/Spring	0	0	0	1	0	1	0	0	0	0	0	0
Summer	0	0	0	1	0	0	0	0	0	0	0	0
Security Light (1 = True; 0 = False)												
Yes	0	1	1	0	0	1	1	0	sometimes	0	1	0
No	1	0	0	1	1	0	0	1	sometimes	1	0	1
Appliances (# Appliances)												
TV	1	2	1	1	0	1	1	1	1	0	2	0
Computer	0	0	1	0	0	1	1	0	0	1	0	1
Dishwasher	0	0	0	0	0	0	0	0	0	0	0	0
Washing Machine	1	1	1	1	1	1	1	1	1	1	1	0
Clothes Dryer	0	0	1	1	1	0	0	0	0	0	0	0
Microwave	1	1	1	0	1	1	1	1	1	1	1	1

Survey Identification Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Appliances Time (Hour)														
TV	8	6	3	6	4	holiday only	6	7	8	16	8	7	8	5
Cooking Appliances	4	2	1	1	1	5	2	2	3	3	1	4	2	1
Computer	0	2	2	0	0	12.5	6	0	0	0	0	0	0	0.167
Dishwasher (Times/Week)	0	14	0	0	0	0	0	0	0	0	0	0	0	0
Washing Machine (Times/Week)	0	14	1	1	2	4	14	2	1	3	4.5	1	7	3
Clothes Dryer (Times/Week)	0	7.5	0	0	0	0	14	0	1	0	0	0	7	0
Heat Setting	I do not like it sometimes	High	Timed		80	All Day	Max	70	70	70	70		#7	70, or it does not work
Electric Bill (£)														
Winter	56	28	50	15	105		40	8	30	20	38	60	25	
Autumn/Spring		28	30	12			35	6	30		32	25	25	
Summer		24	20	10			30	6	28		28	20	25	
Electric Payment (£)														
Winter		28	30	45	50	40	40		120	20	38	20	25	20
Autumn/Spring		28	20	30			35		80		32	15	25	20
Summer		24	20	25			30		80		28	10	25	20
Heating Healthy? (1 = True; 0 = False)														
Yes	0	0	0	1	0		0	0	0	0	0	0	0	0
No	1	1	1	0	1		1	1	1	1	1	1	1	1
Heating Environmental? (1 = True; 0 = False)														
Yes	1	0	0	1	0		0	0	0	0	0	0	1	0
No	0	1	1	0	1		1	1	1	1	1	1	0	1
Heating Replaced? (1 = True; 0 = False)														
Yes	1	1	1	1	1	1	1	1	1	1	1	1	1	1
No	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Survey Identification Number	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Appliances Time (Hour)														
TV	6	2	3.5	5	6	14	8	12	7	3	0	5	10	1
Cooking Appliances	2	1.5	1	1.5	1	10	4.33	4	1.5	0.5	2	2	2	0.33
Computer	4	0	4	0	0	5	0	3	2	0	0	0	0	0
Dishwasher (Times/Week)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Washing Machine (Times/Week)	6	1	1	7	5	0	2	2	2	0	0	0	0	3
Clothes Dryer (Times/Week)	0	0	1	7	2	0	0	0	0	0	0	0	0	0
Heat Setting	65	5	22 C	80	67.50%	70 F	7	75	Full, can't turn it down	Part Time	Not Sure	28 C	No Thermostat	70
Electric Bill (£)														
Winter	31.67	40	20	30	80	60	25	60	14	12.5		40	30	
Autumn/Spring	31.67	40	15	27.5	60	30	20	60	14	12.5		35	25	
Summer	31.67	20	10	25	20	25	20	40	14	12.5		30	25	
Electric Payment (£)														
Winter			20	30	16	60	25		14	12.5		40	24	
Autumn/Spring			15	27.5	16	30	20		14	12.5		35	24	
Summer			10	25	16	25	20		14	12.5		30	24	
Heating Healthy? (1 = True; 0 = False)														
Yes	0	1		0	1	0	0	0	0	0	0	1	0	1
No	1	0		1	0	1	1	1	1	1	1	0	1	0
Heating Environmental? (1 = True; 0 = False)														
Yes	0	1	0		1	0	0	0	0	0	0	0	0	1
No	1	0	1		0	1	1	1	1	1	1	1	1	0
Heating Replaced? (1 = True; 0 = False)														
Yes	1	0	1	1	0	1	1	1	1	1	1	1	1	0
No	0	1	0	0	1	0	0	0	0	0	0	0	0	1

Survey Identification Number	29	30	31	32	33	34	35	36	37	38	39	40
Appliances Time (Hour)												
TV	8	10	2	4	0	5	5	4	4	0	5	0
Cooking Appliances	4	2	2	1	30	2	2	1	1	5	2	2
Computer	0	0	0	0	0	2	1	0	0	1.5	0	occasionally
Dishwasher (Times/Week)	0	0	0	0	0	0	0	0	0	0	0	0
Washing Machine (Times/Week)	0.75	2	1	3	4	3	4	4	11	2	2	0
Clothes Dryer (Times/Week)	0	0	1	2	4	0	0	0	0	0	0	0
Heat Setting	Has to be High	20, Gas warm air	mosente (hot air)	normal	use electric portable heating - high, claims other one is dangerous			70-80	max	lounge, bedroom, next to the bathroom	don't know	normal
Electric Bill (£)												
Winter	40	85.74	40		40	30	20	0	30	8	45	40
Autumn/Spring	40	48.46	40			20	20	0	30	8	45	30
Summer	40	15.29	40			20	20	0	30	8	45	10
Electric Payment (£)												
Winter	40	29.4	40		40	25	20	14	30	8	45	30
Autumn/Spring	40	35.03	40			20	20	14	30	8	45	15
Summer	40	18.79	40			20	20	14	30	8	45	19
Heating Healthy? (1 = True; 0 = False)												
Yes	0	0	1	0	0	0	0	0	0	0	0	0
No	1	1	0	1	1	1	1	1	1	1	1	1
Heating Environmental? (1 = True; 0 = False)												
Yes	0	0	1	0	0	0	0	0			0	0
No	1	1	0	1	1	1	1	1			1	1
Heating Replaced? (1 = True; 0 = False)												
Yes	1	1	0	1	1	1	1	1	1	1	1	1
No	0	0	1	0	0	0	0	0	0	0	0	0

Survey Identification Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bill too high? (1 = True; 0 = False)														
Yes		0	1	0	1	1	1	0	1	0	1	1	0	1
No		1	0	1	0	0	0	1	0	1	0	0	1	0
English as First Language? (1 = True; 0 = False)														
Yes		1	0	1	1	0	1	1	1	1	1	0	1	1
No		0	1	0	0	1	0	0	0	0	0	1	0	0
Language			Swahili			Arabic						Lithuanian		

Survey Identification Number	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Bill too high? (1 = True; 0 = False)														
Yes	1	0	1	0	0	1	1	1	0		0	1	1	0
No	0	1	0	1	1	0	0	0	1		1	0	0	1
English as First Language? (1 = True; 0 = False)														
Yes		0	0	1			0		1			1		1
No		1	1	0			1		0			0		0
Language		German	Somali				Ashanti/TWI							

Survey Identification Number	29	30	31	32	33	34	35	36	37	38	39	40
Bill too high? (1 = True; 0 = False)												
Yes	1	0	1	1	1	1	0	0	1	0	1	1
No	0	1	0	0	0	0	1	1	0	1	0	0
English as First Language? (1 = True; 0 = False)												
Yes	1	1	0	1	1	0	1		1	0	1	0
No	0	0	1	0	0	1	0		0	0	0	0
Language						Farsi						

Survey Results	
Daytime Location	
Home	21
Work	13
Both	5
No Response	1
Security Light	
Yes	16
No	22
Sometimes	1
No Response	1
Heating System Healthy	
Yes	6
No	32
No Response	2
Heating System Environmentally Friendly	
Yes	7
No	29
No Response	4
System Replace	
Yes	36
No	4