



# Assisting SMEs Become Energy Efficient

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## **ABSTRACT**

This project, prepared for the London Borough of Brent, investigated strategies and benefits of implementing a program to help small and medium enterprises (SMEs) understand their energy use and improve efficiency. More specifically, the project assessed the benefits of helping SMEs through energy audits. Through interviews with Council contacts, energy experts, and businesses across Brent, we laid out the reasons why the Council should pursue a pilot program.

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## EXECUTIVE SUMMARY

The London Borough of Brent has set specific goals for reducing its carbon emissions in the coming years. The Brent Climate Change Strategy clearly states that the Borough is aiming to cut emissions, and reports that it should target the commercial sector which is responsible for a third of the Borough's emissions. Nevertheless doing so is easier said than done. In Brent, most businesses are small or medium-sized enterprises (SMEs). Within Brent, there are over 12,000 SMEs and individually these SMEs only produce little amounts of carbon which makes it hard to achieve quick and large efficiency gains. After exploring all options available in Brent, we deduced that the Council could overcome this obstacle by using energy audits as the foundation for teaching SMEs how to understand and improve energy efficiency.

### Energy Auditing: Helping Businesses Overcome Barriers to Improve Energy Efficiency

There are several barriers to help SMEs reduce their energy usage. Firstly, business owners often do not understand their energy bills and the exact consumption. Energy audits deal with this barrier very effectively as they engage the business owners in the energy saving journey, teaching them how to properly monitor their energy use and getting them committed to reducing their usage. Secondly, SMEs often lack capital to invest in new technologies and building upgrades, and many do not own the building they operate in. Energy audits address these problems by offering low cost and immediate energy saving measures such as good housekeeping. These measures alone can often achieve 10% savings, and thanks to their low cost, business owners can implement them regardless of their access to capital or tenure of the premises.

### The Pilot Program: Testing the Use and Structure of the Program

To deliver energy audits to the SMEs, Energy Solutions – a non-profit expert in energy efficiency – has devised a detailed plan and is proposing a pilot program to test its potential as a full-fledged program offered by the Council. The pilot program extends over a period of 12 months and is composed of 4 different stages which are shown and listed below:

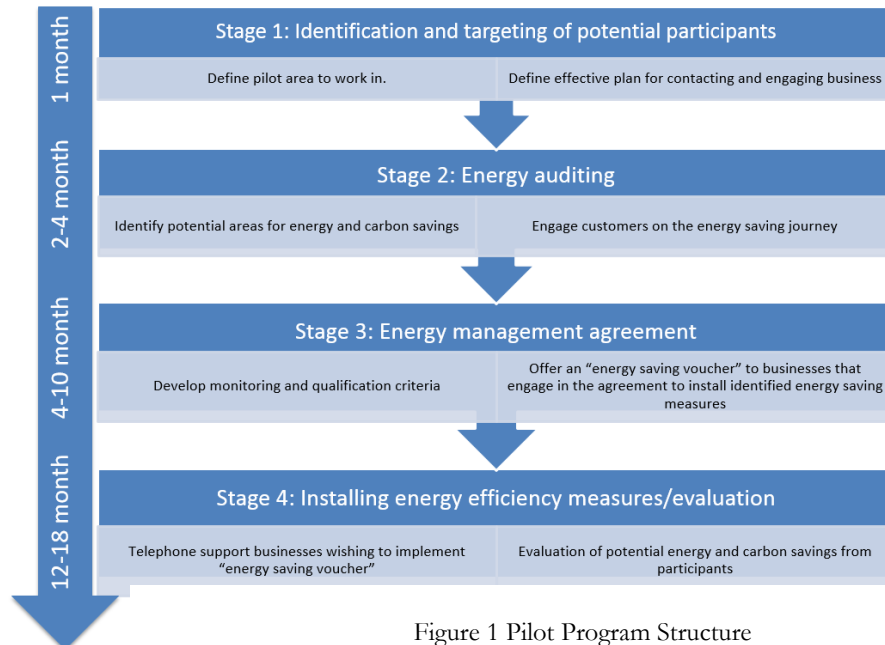


Figure 1 Pilot Program Structure

The program is designed to support SMEs in reducing energy consumption and helping increase business vitality, by having the business work towards further assistance. The business must first follow the initial behavioral changes presented by the audit to reduce their energy use, and if they do so, they then will qualify for further assistance. This incentive based approach should encourage the business owner to keep up their new habits and demonstrate their willingness to become energy efficient. Overall, this project will engage the business owner in the analysis and monitoring of their energy efficiency and make them more aware of their energy usage.

#### Why this program could work

Our findings suggested several reasons for which carrying out such a program could be successful and valuable to Brent:

### **1. SMEs present significant potential for carbon and energy savings**

Our survey of SMEs across Brent revealed that their energy usage behavior was average and easily improvable at little to no cost. Improved lighting, heating, and energy monitoring could result in immediate energy savings at very little cost, and is a reason for which the SMEs show potential to achieve significant energy savings. An additional reason is that the majority of SMEs in Brent are located in inefficient buildings. These usually have very old boilers, non-insulated pipes and inefficient lighting, all of which could be improved by the proposed program.

### **2. SMEs show interest in the program**

A survey of a small sample of SME owners carried out in various areas of the Borough showed that several SMEs were interested in reducing their energy usage. Half of those interested had already made some kind of effort to reduce their energy bills and moreover, 55% claimed that energy bills were hindering their business. This implies that there is a clear need from these SMEs to decrease their energy bills. When told about the program and asked if they would like to participate in it, all the businesses claiming to suffer from their bills answered positively. These answers suggest that there is a significant demand for such program and it would likely be well received by the SMEs in Brent.

### **3. The Program could yield several benefits for the Borough**

Apart from carbon emissions and cost savings, the program could foster good relations with the SMEs and help improve the overall building stock quality of the Borough, which could attract businesses outside Brent and keep the current businesses firmly rooted in the Borough. Finally, carrying out this program would make Brent a pioneer in helping SMEs in the UK become more energy efficient and improve their business vitality.

### **4. The Council has resources to expand the program in the future**

Energy Solutions are leading the pilot program and are committed to working with the Council should it decide to expand the program. For funding, the Council could use funds designated for sustainability, such as s106 agreements (Carbon Offset Fund), by making the case for this sustainability program. Additionally, the Council could also try to get European funding and other

external funding. Last but not least, current initiatives to increase building efficiencies could be used alongside this program to create a unified system within the Borough.

### Recommendations

From our findings, we recommend the Council to run the pilot program to gather more solid evidence on the outcomes and make a decision on whether to expand it or not. Should the Council decide to expand the program, we recommend:

1. Carefully evaluate the pilot to identify its strengths and weaknesses and areas that could be improved.
2. Look into targeting small industrial businesses, while also attempting to help the smaller town center businesses.
3. Incorporate other retrofitting initiatives to create a unified system aimed at reducing the Borough's carbon emissions.
4. Publicize the program through medias and the proposed 'One-Stop-Shop' website for business owners.
5. Designate a single point of contact for SMEs to refer to and have contact with.
6. Seek external match funding with which to sustain the program.

## TABLE OF CONTENTS

Abstract .....	2
Acknowledgements .....	2
Executive Summary .....	3
TABLE OF CONTENTS .....	6
TABLE OF FIGURES .....	7
TABLE OF TABLES .....	8
CHAPTER 1: Introduction .....	9
CHAPTER 2: Background.....	10
1.1 Demand-Side Management.....	10
1.1.1 Definition of DSM .....	10
1.1.2 Micro DSM.....	12
1.1.3 DSM Project Management and Facilitators .....	13
1.1.4 Summation of DSM.....	14
1.2 Types of SME's in Brent .....	15
1.3 Energy Efficiency Auditing.....	18
1.3.1 Understanding energy bills.....	18
1.3.2 Techniques to achieve energy efficiency.....	18
1.4 Carbon Reduction Technologies fit for SMEs in Brent.....	20
1.4.1 Solar Photovoltaic (PV) Systems .....	20
1.4.2 Solar Thermal Heating.....	21
1.4.3 Window Replacement.....	21
1.4.4 Boilers Replacement .....	21
1.4.5 Cavity and Solid Wall Insulation .....	22
1.5 Carbon Reduction Schemes in the UK .....	23
1.5.1 Green Deal .....	23
1.5.2 Energy Company Obligation .....	24
1.5.3 Feed-in Tariff .....	24
1.5.4 Renewable Heat Incentive .....	25
1.5.5 Milton Keynes Boiler Cash Back Scheme.....	26
1.6 Fund Management Logistics.....	26
1.6.1 Possible Management Styles.....	27
CHAPTER 3: METHODOLOGY .....	31
3.1 Objective 1: Interview Council contacts to gather input and resources from different areas of expertise.....	31
3.2 Objective 2: Develop a pilot program to help SMEs become more energy efficient.....	33
3.3 Objective 3: Assessed the need and interest of SMEs for reducing their energy use and participating in such pilot program.....	34
3.4 Objective 4: Analyze the benefits that would result from helping SMEs become more energy efficient and more specifically from carrying out the pilot program.....	37

CHAPTER 4: RESULTS & ANALYSIS: PROPOSAL AND RATIONALE FOR AN SME ENERGY EFFICIENCY PILOT PROGRAM.....	38
4.1 The pilot program proposed by Energy Solutions .....	39
4.2 SMEs present significant potential for carbon and energy savings .....	41
4.2.2 The majority of SMEs are located in poor quality stock that can be retrofitted to improve energy efficiency.....	44
4.3 SMEs show interest in the audit program .....	44
4.4 The program could yield several benefits for the Borough.....	47
4.4.1 Carbon emissions would be reduced in a measurable fashion.....	48
4.4.2 Potential for Economic Growth in SMEs due to financial savings.....	49
4.4.3 Council assistance to SMEs could foster good relations.....	50
4.4.4 Potential for improvement of building stock quality in Brent.....	50
4.5 The Council has resources to expand the program in the future .....	51
4.5.1 Energy Solutions can act as project deliverers for this program.....	51
4.5.2 There are several funding opportunities available to expand the program .....	52
4.5.3 Several Retro-fitting projects exist that could be incorporated into the program .....	52
Conclusion.....	54
Other Points to Consider .....	54
BIBLIOGRAPHY .....	56
Appendix .....	58
Appendix 1. In Council Interview Plan .....	58
Appendix 2. SME Survey .....	60
Survey Form: .....	60
SME Survey Instructions .....	62
Appendix 3. SME Survey Results .....	63
Appendix 4: Calculations and Assumptions for Brent SME Carbon Production .....	67

## TABLE OF FIGURES

Figure 1 Pilot Program Structure.....	3
Figure 2: Brent Demand Side Management Implementation .....	11
Figure 3: Survey results about relations between SMEs and Council(FSB's London Policy Unit, 2010) .....	17
Figure 4: distribution of energy use in different types of businesses in the UK (Eon Energy) .....	19
Figure 5: How the Feed-in Tariff works (Energy Saving Trust).....	24
Figure 6: Bottom down management .....	28
Figure 7: Top down management .....	28
Figure 8 Investment Analysis.....	29
Figure 9: Sample of streets covered while surveying.....	35
Figure 10 Pilot Program Structure.....	39
Figure 11: Results of questions concerning lighting management of SMEs.....	42
Figure 12: Results of questions regarding heating management of SMEs .....	42
Figure 13 Energy Monitoring Results.....	43

Figure 14: From left to right: a 1977 boiler, non-insulated pipes, fluorescent light tubes .....	44
Figure 15: results for which we believe SMEs would be interested in investing in their building.....	45
Figure 16: SMEs levels of effort to reduce energy bills .....	46
Figure 17: Results of questions inquiring on the SMEs' interest in reducing energy use .....	47
Figure 18: Total consumption of energy of SMEs in Brent .....	48
Figure 19: Estimated savings from 1,000 SMEs taking action in the program .....	49
Figure 20: Estimated savings from 1,000 SMEs taking action in the program .....	49

## TABLE OF TABLES

Table 1: Brent DSM Implementation .....	12
Table 2: Ethnicities in Brent.....	15
Table 3: SMEs associated with Food and Drink in Brent (iBrent).....	15
Table 4: Other types of SMEs in Brent (iBrent) .....	16
Table 5: Carbon emissions in Brent (London Borough of Brent, 2013).....	16
Table 6: breakdown of costs and savings of a 1.5 kW solar PV system(United Sustainable Energy Agency, 2012) .....	20
Table 7: costs and savings of different solar thermal heating systems(United Sustainable Energy Agency, 2012) .....	21
Table 8: savings generated by switching from an old boiler to an A-rated boiler (Energy Saving Trust, 2014).....	22
Table 9: savings from cavity wall insulation (Energy Saving Trust).....	22
Table 10: Savings from solid wall insulation (Energy Saving Trust) .....	23
Table 11: Summary of solar PV tariffs (Energy Saving Trust).....	25
Table 12: Summary of hydro, wind and microchip tariffs (Energy Saving Trust) .....	25
Table 13: Summary of tariffs for some renewable heat technologies (Energy Saving Trust) .....	25
Table 14: Summary of existing UK schemes promoting energy efficiency.....	26
Table 15: Gantt chart of objectives achieved during the 7-week term .....	31
Table 16: List of interviewed Council contacts .....	32
Table 17: General discussion topics used according the interviewee's area of expertise .....	32
Table 18: Sample of SMEs approached, categorized by streets.....	35
Table 19: Instructions for approaching a business and carry out the survey.....	37



## CHAPTER 1: INTRODUCTION

The London Borough of Brent has set specific goals for reducing its carbon emissions in the coming years. The Brent Climate Change Strategy clearly states that the Borough is aiming to cut emissions, and reports that it should target the commercial sector, which is responsible for a third of the Borough's emissions (Brent Council). But doing so is easier said than done. In Brent, there are about 12,000 small or medium-sized enterprises (SMEs). Individually, these SMEs only produce small amounts of carbon, which makes it hard to achieve quick and large efficiency gains. As stated in the Brent Climate Change Strategy, the Council needs to tailor information campaigns specifically to SMEs and involve them in the implementation of strategy, including setting milestones and targets. Therefore, a significant effort is required to successfully help the SMEs reduce their energy consumption in a way that would reflect on the Borough's overall emissions. To decide whether helping SMEs is worth the cost and effort, the Borough of Brent needs a thorough investigation of the benefits that such actions would yield.

The Electric Power Research Institute in the United States has looked to reduce energy usage within homes, businesses, and various other buildings, which has led to the coining of the term Demand Side Management (DSM)(Hull, 2010). Looking into DSM, there are various projects that work towards reducing the energy consumption of businesses of many categories. Many of these projects deal with issues such as funding, teaching businesses concepts of energy management, and finding the potential initiatives with the most successful energy saving outcomes. Commercial sector DSM has been successful in the United States, and could provide useful information to the Borough of Brent's investigation. By looking at DSM, the Borough could learn about its outcomes and analyze what could be applied to Brent.

Within the United Kingdom there has been very little research into how to effectively reduce carbon emissions of SMEs. It is thus difficult to target this group because it includes many individual businesses that also vary greatly in terms of energy use, building size, technical sophistication and other factors. Most local governments have thus shied away from trying to design a system that could help these businesses. Our research found, in fact, that there is very little data on the energy usage of different types of SMEs in the United Kingdom, which further complicates making estimates for the potential carbon savings that could be achieved in this area. Many of the projects funded by governmental bodies have only assisted public buildings and organizations, so the potential outcomes of helping SMEs in the UK remain to be explored.

The goal of this project was therefore aimed at assisting the Borough of Brent by investigating the feasibility and benefits of a pilot program to help SME's achieve energy efficiency while also producing important public benefits. The objectives followed to achieve this goal were the following: first, we interviewed Council contacts to gather input and resources from different areas of expertise. Second, we assisted Energy Solutions in developing a pilot program to help SMEs become more energy efficient. Third, we assessed the need and interest of SMEs for reducing their energy use and participating in the pilot program. Finally, we analyzed the benefits that would result from the program. This report details our background research, methods, and results.

## CHAPTER 2: BACKGROUND

Carbon emissions are one of the major problems that humankind is facing nowadays. Power plants, heating/cooling systems, transportation all contribute towards carbon emissions. Public awareness of the global warming and greenhouse effects has risen sharply and it became the focus of developed countries to reduce these emissions. In the UK, the London plan aims to reduce the carbon footprints of buildings within various Boroughs by a specific percentage over the years.

The London Borough of Brent has been actively reducing its carbon emission over the past few years. However, there has been difficulty in convincing small to medium enterprises (SMEs) become more energy efficient because of several financial and even language barriers. These SMEs are typically located in very old and inefficient buildings and suffer from high energy bills. The Council is looking into using their resources to help SMEs become greener and thus make savings. In the past, the Council has done projects that achieve greater carbon reductions and SMEs have been overlooked.

To investigate the benefits of helping SMEs, we need to understand several principles. The first one is demand-side management, which will provide the main structure needed to create schemes helping SMEs become more energy efficient. After, this section will take a look at the different types of SMEs in Brent to lay the grounds for our work. Then, the sections will research energy auditing tactics, carbon reduction technologies, and existing schemes in the UK that promote energy efficiency. This will allow us to create schemes specifically entailed to the particular needs of SMEs in Brent. Finally, we will research concepts on how to manage and implement these schemes.

### 1.1 Demand-Side Management

Demand side management is something that has come about in response to increased demands for energy supply during peak consumption hours. As implied by the name, it focuses on the demand side of the energy consumption and hopes to manage this demand in some way or form. Basically, the goal is to decrease demand from consumers during the peak hours so there is not an overload on any of the energy or fuel delivery systems. This then prevents the energy companies from having to revamp their delivery system in order to meet the demand. Balancing the energy consumption and supply has always been a complex and challenging dilemma, but with the growth and development of Demand Side Management (DSM) over the years, the two sides of supply and demand can be leveled. A deep understanding of DSM will provide the guidelines for reducing the energy consumption of SMEs in Brent.

#### 1.1.1 Definition of DSM

In the past, Demand Side Management (DSM) has focused on the storage of energy in preparation of the flux in demand. This has been a highly inefficient way of meeting the demand and is a large producer of carbon emissions. (Warren, 2014) That is why there has been a growth in the definition of DSM. It has gone beyond just trying to increase delivery capacity and storage of the energy in preparation during peak hours. Rather the focus has turned to the consumers and their levels of consumption. The idea is to not just increase the production for demand, but also do a great deal of work reducing the demand for energy. This means they are looking to increase the efficiency of the consumers, thus creating less demand for energy.

These DSM programs have been employed in various countries all over the world and have gone through quite a bit of trial and error. Because of this growth in programs, there has also been a flux in the definition of what a DSM encapsulates. Below is a figure that graphically represents the different areas a DSM program can fall under. (Warren, 2014)

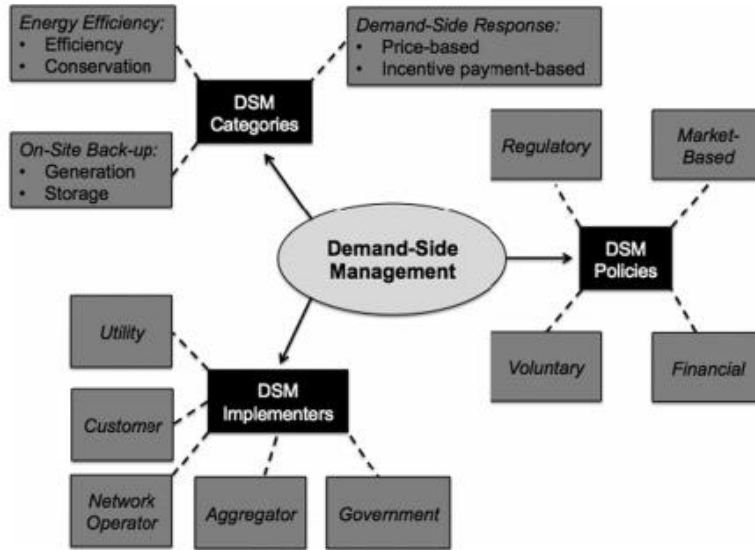


Figure 2: Brent Demand Side Management Implementation

For our project work, we are going to focus in on certain areas of this definition. Following the graphic's definition, when it comes to DSM categories we wish to look into mainly energy efficiency and demand side response. These will lead us to the programs that have dealt with the decrease of carbon emissions through refurbishment of a building's efficiency. We as a team need to understand these programs and review them to see which of them are the most successful and will fit the needs of the Borough of Brent. When it comes to DSM policies we will be focusing a bit more on voluntary due to the fact that the Council of Brent is hoping to get the SME's of Brent to voluntarily initiate these projects. This then leads us to the last bit of the definition web, DSM Implementers. In this case we will need to take a strong look at every portion of this area. Below you can see what each section entails and how they relate to the Borough.

<b>Label</b>	<b>Brent Equivalent</b>	<b>Description</b>
Utility	Contracted Companies	They would be the ones to install the energy saving companies
Customer	The SME's	They would be the ones looking to buy into the DSM projects.
Network Operator/Aggregator	Energy Solutions/Council	These would help facilitate the projects and educate the SME's on how to take part
Government	Council	The Council will give guidance and direct the fund to the approved SME's and projects

Table 1: Brent DSM Implementation

1.1.2 Micro DSM

Largely, we will be focusing on a specific type of DSM; the Micro-DSM. This type of DSM focuses on smaller projects, which in most cases are for smaller commercial enterprises and individual housing projects. The reasoning for our focus on this particular sector is because it is closely related to the types of projects we wish to undertake ourselves. In the Borough of Brent we are looking to work with these small businesses who vary greatly when it comes to not only their business type, but also building design, technological equipment, and things of similar nature. Micro DSM's allow for each case to be considered independently to find the best fitting project. The best fitting project may be the one that is currently present, and adjusted version of a current option, or a brand new option that can be presented for review. This allows for the best possible option for each SME to be implemented, which would yield the best results for all parties. (Hull, 2010)

Micro DSM came about due to the fact that domestic consumers and SME's consume up to 50% of electricity in most developed countries, thus making them very big targets for demand response. Largely, the best option is to focus on reducing their consumption levels through an increase in efficiency. The question is, how have governments and utilities gone about getting these consumers to switch to more efficient habits and technologies? In many cases it's a combination of making the knowledge of consumption and potential energy savings known to these bodies, while also giving them incentives to change with habits and better their efficiency. There are plenty of ways to go about doing so, which include (Hull, 2010);

- Presenting the consumer a breakdown of their individual end-uses of energy, its cost and environment impact, which is known as *end use monitoring and feedback* (EUMF) and is usually done through auditing.
- Using cost reflective charging, which means energy consumed during peak hours would be more expensive. This is also known as *Time of Use* (ToU) Pricing. (done by the energy companies)
- Rewarding of energy usage modification, which may include reduction in taxes, assistance in building technology upgrades, etc. This is also known as *incentive based demand response*

These are all possible options to entice the SME's to become more energy efficient and would help them save money in the long run. All should be considered and understood for our project, and we will also be looking for and thinking of other possibilities that may suit Brent's needs better.

### 1.1.3 DSM Project Management and Facilitators

Big proponents of the demand response projects are the project facilitators and management. These are the network operators and the aggregators as stated in the diagram of the DSM definition. In many situations the organizations that take on the management side of this section are known as Energy Service Companies (ESCO). These are entities that “deliver energy services, energy efficiency programs and other energy efficiency measures in a user's facility, and accepts some degree of technical and sometimes financial risk in so doing.” (Bleyl-Androschin, Schinnerl, & Energieagentur, 2008) So not only do they help in the project planning, facilitation, and completion, they also take on some of the risk of the investment in the project. This may be done through partial funding of the project or other financial incentives given to the consumer. The funding is dependent on the project meeting certain performance standards in the planning stages and/or energy efficiency improvements.

The projects brought about by these ESCO's are known as Energy Performance Contracting's or EPC's. These EPC projects “realize demand reduction measures that typically comprise building technologies like heating, ventilation, air-conditioning (HVAC), lighting, electrical applications and control systems.” (Bleyl-Androschin et al., 2008) These are the main targets of these projects because of their wide applicability. Usually all buildings considered for these projects have room for improvement within these areas, so the EPC projects usually target these areas of the building. The ones that are chosen are usually decided after the auditing of the building in question, allowing for a somewhat personalized project. The auditing should present data that will point out which areas need the boost in energy performance and efficiency. Usually a comprehensive refurbishment style of EPC projects is not considered because of the timeliness and cost of this type of project. It involves a consideration of all energy sensitive aspects, which in most cases of EPC projects are not looking to invest in. We as a team will look into projects that have done these comprehensive refurbishments and will keep an open mind to them, but our focus will be more on the EPC projects that have taken place.

Many of these EPC projects experience similar obstacles, which we as a team are looking to find solutions to these issues. A major issue is the lack of knowledge of potential projects and funding of said projects. This is something Brent is very keen on tackling and overcoming should the fund be diverted to these SME's. This education about the potential options opens up another whole set of problems such as convincing them it could save them money in the long run and crossing potential language barriers. Another common obstacle is absence of a full calculation of costs, which could hinder the convincing of SME's to partake in these projects. A lack of integration within the projects is also a big issue. This is something our team is looking to fix with the help of Energy Solutions, a non-profit organization that has worked closely with Brent in the past. We are hoping to set up a network with the Brent government and Energy Solutions that will point the SME's in the right direction. We are looking into having a system set up that can procure them any possible funding, help in selection of beneficial projects, guidance on how to carryout and/or contract the project, and anything else that may arise in the project layout.

This then brings us to how these projects are decided on and presented to the SME's. The subject of micro DSM also brings about micro demand response, which are the projects designated for the smaller businesses. In research of this term you will find a pattern in how these projects are formulated. They all seem to follow this set of objectives that will be a great guidance in our process.

The objectives common to micro demand response can be seen below as taken from Hull's text; (Hull, 2010)

- a) Define demand response and energy saving products to meet System Operator, Supplier, Government and Customer requirements;
- b) Identify, develop and define packages of demand and energy saving service products for residential and SME customers, based on EUMF, ToU pricing and demand control to meet the above requirements;
- c) Develop mechanisms to deliver demand response and energy saving service products;
- d) Evaluate how Aggregator businesses can provide demand response and energy saving service products for residential and SME customers;
- e) Develop Aggregator routes to market for residential and SME customers;
- f) Make an overall assessment of common ground and technologies to be shared with smart metering infrastructure;
- g) Estimate incremental costs of implementation of product delivery systems; and
- h) Quantify the business case for the provision of demand response and energy saving products.

#### 1.1.4 Summation of DSM

What should be gathered from this section describing the various things about demand side management is that this will be a big focus within our project and guide us to similar style project we are hoping to get information from. The Borough of Brent is looking to get examples of cases where the conversion to more efficient buildings for SME's saves them money and also decreases their carbon productions. Looking into micro demand response should yield reviews and reports on these types of projects. We want to find both the successful stories to try and build off of them, but we also need to pay a lot of attention to the failure stories. We can learn what did not work for them and apply those cases to our own and avoid similar situations. In all if we approach this in a similar fashion to DSM-type projects, then our project should have a well-structured system and work in a fashion that has been used in other professional settings.

Now that we have a better understanding of demand side management, we can turn to Brent look at its specific situation.

## 1.2 Types of SME's in Brent

To apply the demand side management tactics to SMEs in Brent, we must be familiar with the demographics of the Borough, the different kinds of SMEs and the status of their relations with the Council. Brent is one of the most densely populated Boroughs in London, with an average density of 61 persons per hectare. It is also very culturally diverse: the table below represents the percentage of population by ethnic groups residing in Brent area(London Councils, 2011).

<b>Ethnicity</b>	<b>Population (2011)</b>	<b>Percentage (2011)</b>
White British	76,893	29.2%
Indian	48,624	18.5%
Caribbean	27,574	10.5%
White other	24,072	9.1%
African	20,640	7.8%
White Irish	18,313	7.0%
Other Asian	12,628	4.8%
Pakistani	10,626	4.0%
Chinese	2,812	1.1%
Bangladeshi	1,184	0.5%
Other ethnic group	6,173	2.3%

Table 2: Ethnicities in Brent

Since the majority of Brent's population is non-white, foreign entrepreneurs operate most of the SMEs. Hence there is a wide range of SMEs that reflects the cultural diversity of Brent. The most widespread types of SMEs in Brent are restaurants, pubs and retail stores.

<b>SMEs associated with Food and Drink in Brent</b>	<b>Number of SMEs</b>
Take away food shops	74
Public houses, Bars and Inns	60
Cafes, Snack Bars and Tea Rooms	38
Restaurants – Other	27
Restaurants – Indian	19
Caterers	19
Restaurants – Chinese	5
Restaurants – Mediterranean	4
Restaurants – English	3
Restaurants – Thai	3
Restaurants – Caribbean	2

Table 3: SMEs associated with Food and Drink in Brent (iBrent)

This table shows the diversity of the restaurant and food business in Brent, with 19 restaurants specializing in Indian cuisine (and that's only what is accounted for). Bars and inns are also a very widespread type of business in Brent. Other types of SMEs in Brent are shown the table below.

SME Type	Number
Estate agents	54
Newsagents	52
Dry Cleaners	34
Supermarkets	32
Car body repairs	27
Furniture – Retail	24
Florist	16
Carpets and Rugs – Retail	15
Car dealers	14
<b>Total</b>	<b>268</b>

Table 4: Other types of SMEs in Brent (iBrent)

Brent was recently affected by recession, which resulted in the bankruptcy of many SMEs and hindered the economic development of the area. Furthermore, Brent has the 3<sup>rd</sup> lowest average annual income rate in London. In July 2010, the unemployment rate was 5.29%, which is above the London rate (4.37%) and the Great Britain rate (4.09%)(Brent Council). Another problem that Brent is facing is the inefficiency of its buildings. The table below shows the Borough’s carbon emission per year since 2009.

Carbon Emissions Source (tonnes of CO <sub>2</sub> )	2012	2011	2010	2009
Electricity generation	20,063	18,908	20,892	21,339
Electricity transmission & distribution	1,585	1,616	1,682	1,690
Natural gas and gas oil	12,685	10,594	12,709	13,971
<b>Total Gross Emissions</b>	<b>34,333</b>	<b>31,117</b>	<b>35,283</b>	<b>37,000</b>

Table 5: Carbon emissions in Brent (London Borough of Brent, 2013)

From the data presented above, it is calculated that CO<sub>2</sub> emission were reduced by 7.2% between 2009/2010 and 2012/2013, but if broken down by the year the results are different. CO<sub>2</sub> emission in Brent was reduced by 4.6% between 2009/2010 and 2010/2011, and by 11.8% between 2010/2011 and 2011/2012. However between 2011/2012 and 2012/2013 emissions increased by 10.3%(London Borough of Brent, 2013). The increase is explained by the fact that that year’s winter was very cold and more electricity and gas was spent on the heating. The additional need for electricity and gas can also be explained by the fact that buildings in Brent are not very energy efficient.

The Standard Assessment Procedure (SAP) – government recommended system for home energy efficiency rating - determines the energy efficiency of buildings. The minimum score on SAP is 0 and the highest score is 120, higher score means that a dwelling is more energy efficient. The SAP score is based on annual energy cost for space and water heating. In 2001 7.4% of buildings in Brent got a SAP score of less than 30 and 11.4% got rating of 70 and higher (Fordham Research, 2004). Furthermore 31.6% of buildings failed to pass the standard for ‘Decent home’ set out by



government in 2000, of which 80.8% of the buildings failed due to inadequate heating. As with home, the energy efficiency of buildings is a very important factor for SMEs, since it may save substantial amounts of money to the business owner and reduce carbon emissions(Fordham Research, 2004). In response to the recession and high carbon emission rates, Brent Council has been trying to revive the economy by helping existing SMEs and trying to attract new business to the area.

70% of all the new jobs are created by SMEs and self-employment. In Brent there are 170 businesses that employ more than 50 people, and 9700 businesses that employ less than 10 people. These SMEs are the driving force and a key to prosperity, and they are willing to expand and create new jobs. To help these SMEs function properly and maintain their business (consequently making Brent more attractive to businesses residing in other areas), the Council has tried to enable more communications with them (The federation of small businesses). Several surveys were conducted to assess the needs of SMEs, and what they were struggling with.

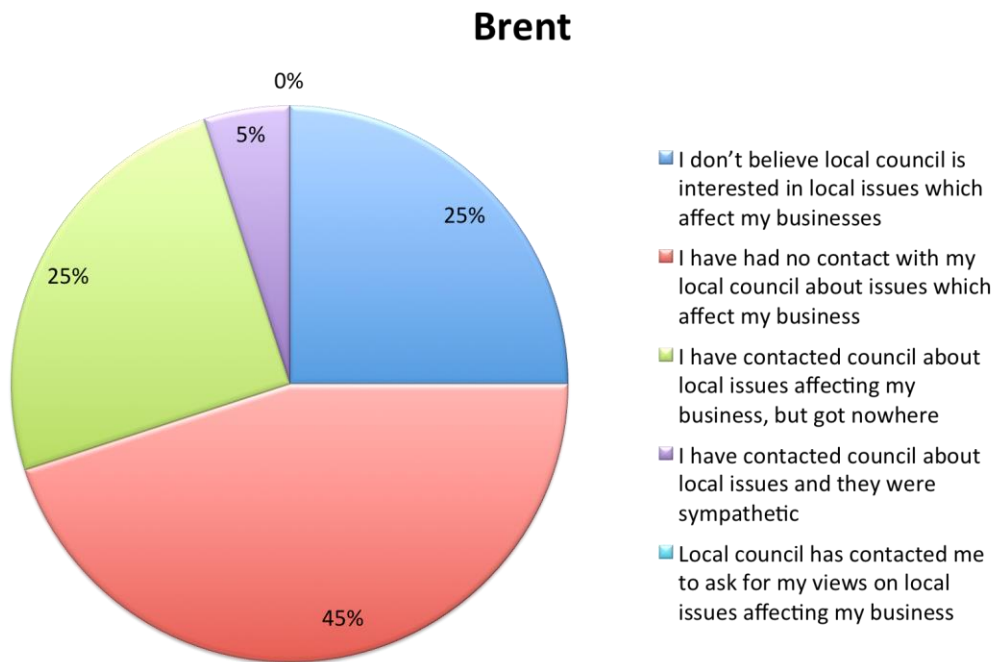


Figure 3: Survey results about relations between SMEs and Council(FSB's London Policy Unit, 2010)

This graph suggests that 25% of SMEs don't believe that the Council is interested in local issues that affect them. What is even more alarming is that 45% have not even contacted local authorities for help and advice. Thus to help SMEs it is important to contact them, inform them on ongoing funds and schemes that may benefit them and consequently involve them to work alongside the local authorities.

In addition to attempts by the Council to help existing SMEs in Brent, local authorities have been actively developing new trading centers and floor space to attract new businesses. From the most recent surveys it's been concluded that there are significant new floor space requirements, particularly for comparison goods (non-food related). Taking into consideration already existing businesses, it is calculated that an additional 27000m<sup>2</sup> gross of comparison floor space and 5200m<sup>2</sup>

gross of convenience floor space will be demanded. It is also projected that by 2016 comparison floor space will increase to 90000m<sup>2</sup>(London Borough of Brent, 2010).

With a clear picture of the current situation in Brent and its different kinds of SMEs, we can turn to investigating how to help them. The SMEs currently have little knowledge on how to become more energy efficient, and the first step in helping them achieve this is to provide them advice and guidance. The next section of this chapter will look at energy efficiency auditing and how it can be used to guide these SMEs in the process of reducing their energy use.

### **1.3 Energy Efficiency Auditing**

Becoming more energy efficient sometimes requires a lot of money. Installing photovoltaic systems, renewable heat technologies and other sources of renewable power are effective but also costly means of reducing carbon emissions. Hence businesses may not always have the resources to acquire these technologies. Fortunately there are several ways of becoming energy efficient that do not present such financial barriers. Examples are reviewing energy bills, analyzing relevant government policies to save money, and applying simple techniques to reduce energy consumption. However, SMEs in Brent are often not aware of these opportunities. Therefore they need someone to provide them with expert guidance. Energy auditing is key to helping SMEs in Brent become energy efficient. Researching ways of providing energy audits will allow us to include an auditing process for SMEs in Brent as part of the schemes that we will create.

#### 1.3.1 Understanding energy bills

It is important to understand contents of energy bills, because it may result in considerable savings of money. Every business energy bill includes a unit rate and a standing charge. The unit rate is the cost of one kWh of electricity, and the standing charge is the rate one pays each day and is independent of the amount of energy used, to cover for the cost of transporting electricity. The standing charge varies by the area, depending on the proximity to the supplier. For consumers that use more than the average amount of energy, the unit rate will take the bigger part of the bill. For others, it will be the standing charge. Depending on their consumption, businesses can determine which charge they should prioritize to lower. Depending on the outcome, businesses may want to change suppliers to get a lower standing charge(uSwitch for Business, 2014 ).

Looking at government policies may also result in money savings. The Climate Change Levy (CCL) is a government levy that requires consumers to pay for every unit of non-renewable energy consumed. The unit rate is 0.509p per kWh of electricity and 0.177p per kWh of gas. The regulations state that consumers that use less than 33kWh of electricity or 145kWh of gas daily don't have to pay the additional rate(uSwitch for Business, 2014 ). Consumers who monitor the energy use will have higher chance of avoiding the additional fees required by CCL. Value added tax (VAT) is another government regulation that increases consumers' energy bills. Large companies usually pay 20% VAT, but consumers who fall under 33kWh daily rate pay only 5%. Thus it is important to monitor energy use and contact the supplier if energy bills don't represent the energy consumed(uSwitch for Business, 2014 ).

#### 1.3.2 Techniques to achieve energy efficiency

Lighting, heating, air conditioning, and office appliances consume most of the energy used by businesses. The distribution of energy use for different kinds of businesses is shown below:

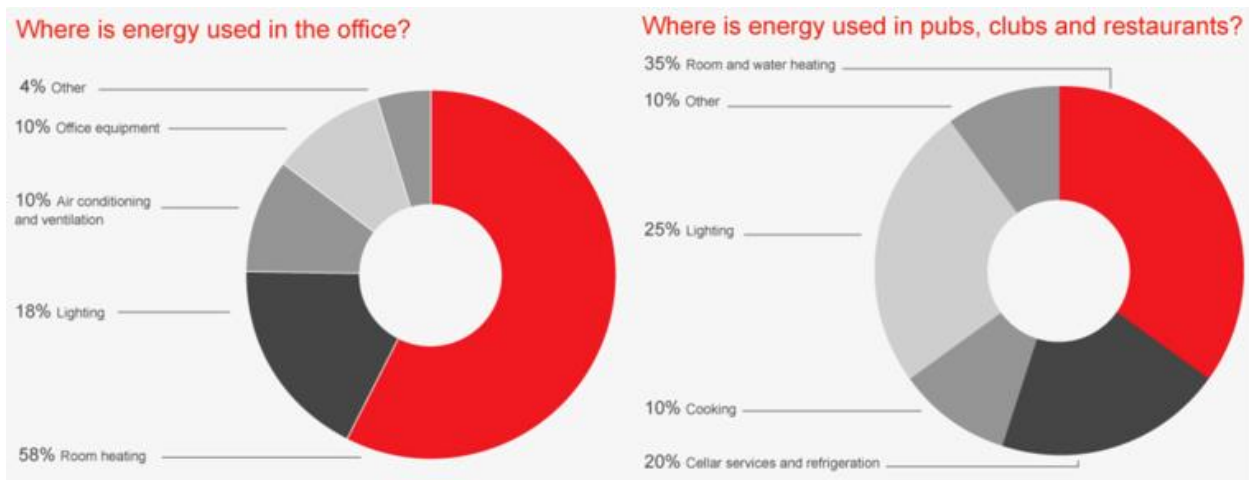


Figure 4: distribution of energy use in different types of businesses in the UK (Eon Energy)

To achieve energy efficiency, power savings can be made in each of these categories. Lighting constitutes a big portion of energy use in businesses. Several options exist to reduce this (Carbon trust):

- Turning off the lights when not needed, encouraging employees to turn off the lights in unoccupied areas or areas with natural sunlight. Just by following this instruction, consumers can save as much as 15% off lighting costs.
- People tend to forget to turn off the light; installing sensor controls will solve this problem.
- Changing lamps to more energy efficient ones like LEDs and T5 fluorescent tubes will substantially reduce energy use.

Heating and air conditioning accounts for 40 - 60% of energy use on average. Using heating and air conditioning as efficiently as possible results in lower energy bills, thus utilizing the following guidelines will be financially beneficial (Carbon trust):

- Adjusting the thermostats. Reducing the heat even by 1 degree Celsius results in 8% reduction of fuel consumption.
- If the consumer has one or more boilers, switch one of the boilers off during summer periods to reduce costs for water heating.
- Encourage employees to turn down the heating/cooling, and turn off the heating/cooling an hour before the business day ends.
- Don't overheat water; temperature of 60 degrees Celsius is optimal. (trust)

Nowadays computers and office appliances account for 10% of the total energy. One option to reduce this is to buy new but that is expensive. Another way is to turn off the computer screen every time an employee leaves his desk, and shut down the computer at the end of the day. A single monitor left on for 24 hours will cost a business about 50 pounds per year, and by switching it off

one can save about 15 pounds per year. There also exists software that can assist in saving energy, one of such being Adblock plus. Adblock plus is a software that blocks advertisements and pop-ups, which can reduce an application's total energy demands by about 23%(Eon Energy, 2014). Power management software is solely designed to reduce energy usage of computers. The software monitors each individual's power usage in the network and based on this information, it allocates the required amount of power. In this way power management software can result in reduced power consumption(Eon Energy, 2014).

Although these simple and cheap techniques can reduce surprising amounts of energy use, things can be pushed much further by installing more expensive technologies such as modern boilers and wall insulation. The auditing process for SMEs should include an analysis to determine which technologies would best help each business. To achieve this, we must research the technologies that are fit for SMEs in Brent.

## 1.4 Carbon Reduction Technologies fit for SMEs in Brent

There exist several technologies that can provide substantial benefits to SMEs in Brent. To create schemes that will help the SMEs, we must research these technologies and determine which ones fit our goals best. This section will look into solar panels, solar thermal heating, window replacement, boiler replacement, and cavity and solid wall insulation.

### 1.4.1 Solar Photovoltaic (PV) Systems

The interest in Solar Photovoltaic (PV) systems is increasing steadily, and the technology has become much more cost effective. The energy efficiency of a solar panel is about 20%, which is not enough to replace conservative energy generation technologies like fossil fuel and coal, but is enough to start its implementation. The benefits of solar PV systems are reduced energy bills, reduced carbon emissions, and low maintenance costs. On average solar panels can save up to 180 pounds per year and reduce carbon emissions by a tonnes of CO<sub>2</sub> per year. In addition to these benefits, solar panel users in the UK can receive up to £570 from the Feed-in Traffic (FIT) scheme(Service magic, 2012). This will be further discussed later.

Solar PV systems range from sizes of 1 to 10 kWp and from 10 to 100 kWp and even more. For small-businesses, only size of 1 to 10 kWp should be considered because of the limited roof space. The climate of the area and the activity of the sun is also an important factor to consider. In the UK it is estimated that a solar PV system of 1 kW installed at appropriate location on the rooftop will generate 700-850 kWh/year. The Micro generation Certification Scheme (MSC) suggests that a solar PV system of 1.5kW will cost between £5000 and £7500. Considering the energy and carbon reduction savings, it is sensible for small business to start deploying these systems.

System size (kW)	Cost	Cost per kW	Annual energy generated per kW	CO <sub>2</sub> savings per kW per year (kg)	CO <sub>2</sub> saved over a 25 year lifetimes (tonnes) per kW	Cost per tonne of CO <sub>2</sub> saved over lifetime per kW
1.5	£8,000	£5,333	800	429.6	10.7	£498

Table 6: breakdown of costs and savings of a 1.5 kW solar PV system(United Sustainable Energy Agency, 2012)

### 1.4.2 Solar Thermal Heating

Solar thermal heating uses sun energy to heat water. This is done with solar collectors located on the roof that absorb radiation from sun and convert it into heat. There are two different types of solar collectors: flat plate collectors and evacuated tubes. Flat plate collectors are cheaper compared to evacuated tubes and are more commonly used, but they require bigger space and are less efficient. Evacuated tubes are smaller and about 10-15% more efficient.

Using Solar thermal heating will significantly reduce carbon emissions due to heating and electricity usage. These systems are easy to install and have a lifetime of 25 years, with recommended maintenance every 3-4 years. The savings made by solar thermal heating varies depending on the location where it is installed, its size, types of solar collectors and their number. The Energy Saving Trust (EST) estimated that solar thermal heating could save 250 kg of carbon emission if switched from gas heating and 580 kg CO<sub>2</sub> if switched from electric heating. Several government funding's are oriented towards popularizing renewable heating technologies. The Renewable Heat Incentive (RHI) can grant about £300 to anyone who installs solar thermal heating systems(Service magic).

Prices for installing solar thermal heating system vary depending on the size of the system and the type of the collector. On average a system of 4m<sup>2</sup> costs £4000. Savings made from solar thermal heating systems depend on the type of heating fuel it displaces. The table below summarizes the carbon emission reductions and money savings over different types of heating fuel displaced.

System size	Cost	Annual kWh	Fuel displaced	Fuel CO <sub>2</sub> Content	CO <sub>2</sub> savings per kW per year (kg)	CO <sub>2</sub> saved over a lifetime (tonnes)	Cost per tonne of CO <sub>2</sub> saved over lifetime
4m <sup>2</sup>	£4,000	1500	Gas	0.218	327	6.54	£612
4m <sup>2</sup>	£4,000	1500	Oil	0.299	448.5	8.97	£446
4m <sup>2</sup>	£4,000	1500	LPG	0.246	369	7.38	£542
4m <sup>2</sup>	£4,000	1500	Electricity	0.537	805.5	16.11	£248

Table 7: costs and savings of different solar thermal heating systems(United Sustainable Energy Agency, 2012)

### 1.4.3 Window Replacement

Heating requires a substantial amount of energy, and thus heat losses must be minimized. Properties lose 26% of the heat through windows. Poor quality windows should be replaced with new ones. New windows provide better insulation and thus lower heat loss. Old windows are single-glazed and therefore are not very good at maintaining heat. New windows have B-rated double-glazing that substantially improves insulation. The cost for a double glazed window of 980mm x 1340mm is around £450. These windows can save up to £170/year and reduce carbon footprint by 680kg/year. They last for more than 20 years and need no additional money for maintenance(Service magic).

### 1.4.4 Boilers Replacement

Boilers take up 55% of energy bills, thus old ones should be replaced with more efficient ones. The main difference between an old boiler and a modern one is that new boilers are condensing. With old boilers some of the hot gases escape. Condensing boilers are more efficient. With larger exchangers, the gases escaping are much cooler and less in quantity. There are two types of modern boilers: regular and combi boiler. The main difference between the two is that regular boilers have a separate cylinder to store hot water, which results in more heat loss during the

transfer into another container. Combi boiler doesn't use a separate water cylinder so less heat is lost during transfer, but generate hot water less efficiently than regular boilers. Indeed, Combi boilers are more compact and small in size, and thus generate less hot water. They are best suited for domestic use, inside apartments. For larger spaces regular boilers are more suited. Regular boilers are compatible with renewable heat technologies such as solar thermal heating. Therefore SMEs should pick their type of boiler depending on their floor space and need for heating. No matter what type is chosen, installing a modern boiler is essential. The table below shows the annual savings made by switching to newer A-rate boilers.

Old boiler rating	Annual saving	CO <sub>2</sub> saving per year
G (<70%)	£310	1,200kg
F (70 – 74%)	£205	810 kg
E (74 – 78%)	£155	610 kg
D (78 – 82%)	£105	430 kg

Table 8: savings generated by switching from an old boiler to an A-rated boiler (Energy Saving Trust, 2014)

#### 1.4.5 Cavity and Solid Wall Insulation

Wall insulation holds a very important part in maintaining the heat inside the building. About a third of the heat inside the building is lost due to the poor wall insulation. Maintaining the heat in the building reduces the energy consumption required for generating it and hence reduces carbon emissions. There are two types of walls: solid and cavity. Cavity walls have an empty space between the outer and inner parts of the wall, while solid walls have none. Insulation techniques depend on the type of wall, thus the cost for insulation varies by apartments.

To insulate cavity walls the space between the two layers is filled with insulates, usually mineral wool, beads of granules or foamed insulates. The cost of cavity wall insulation is around £450 – £500 depending on the size of the apartment or office. The savings can be calculated by analyzing specific apartment utility costs before and after insulation. The table below presents the data for a gas-heated house with three bedrooms.

Measure	Annual saving	Installation cost	Payback time	CO <sub>2</sub> saving per year
Cavity wall insulation	Up to £140	£450 to £500	Under 4 years	Around 560kg

Table 9: savings from cavity wall insulation (Energy Saving Trust)

While cavity wall insulation is beneficial and cost-effective over a 4-year period, solid wall insulation is substantially more efficient. The reason for this is that solid walls are much less efficient than cavity walls. Because solid wall has no cavity in between two layers, heat flows through it faster. The way to solve this problem is to insulate the wall from either one of its sides. Insulating can be either external or internal; both approaches have advantages and disadvantages. With internal insulation, insulating material is attached in the inside of the building, so that heat will have to go through the insulant first and only then reach the solid wall. This approach requires additional space in the inside of the building, which is an important factor to consider. The second approach is external insulation where insulation is attached to the outer side of the wall. The problem with this approach is that it may need permission to conduct the work. Nevertheless both approaches result in good insulation and reduction of heat loss. The table below represents the savings and carbon reduction from solid wall insulation.

Type of solid wall insulation	Saving per year	Total cost including installation	CO <sub>2</sub> saved per year
Internal	Around £460	£5,500 to £8,500	1.8 tonnes
External	Around £490	£9,400 to £13,000	1.9 tonnes

Table 10: Savings from solid wall insulation (Energy Saving Trust)

As the data suggests, internal and external insulation result in nearly the same amount of savings and carbon reductions. However external insulation is more costly.

## 1.5 Carbon Reduction Schemes in the UK

Now that we have researched technologies that could help the SMEs, we shall look at current schemes being used in the UK to promote carbon efficiency. Doing so will provide the background necessary to create our own schemes for Brent in the future. The schemes in question are the Green Deal, the Energy Company Obligation, Feed-in Tariffs, and the Renewable Heat Incentive. Local authorities have also developed their own schemes; such as the Milton Keynes Boiler Cash back Scheme.

### 1.5.1 Green Deal

The Green Deal is an innovative carbon reduction funding scheme implemented in 2013, aimed at achieving the UK's goal of reducing carbon emissions by 80% by 2050 compared to 1990. According to the Government, the Green Deal will lead to savings of approximately 5.6 tonnes of CO<sub>2</sub>.

The scheme works as a loan to domestic or commercial buildings for installing cost-effective equipment that improves energy efficiency, such as efficient boilers and wall insulation. The main benefit of this mechanism is that the loans payments are charged on the user's regular energy bill, and the surcharge must be equal or less than the amount of savings that the user makes thanks to the new installment. This means that no matter what, the user will make savings from the first day the improvement is made. Moreover, although the loan must be repaid in full, it is tied to the building and not the owner. Hence if a building changes owner, the surcharge is billed on the new owner's bill since he is now the person benefitting from the savings (Energy Saving Trust).

In order to apply for a Green Deal, the first step is to have a Green Deal Advisor carry out an assessment in the applicant's home or business. This assessment will use software to identify the options available to improve energy efficiency or micro generation, and determine which of these will be the most cost effective. The advisor must next outline how payments work and must deliver to the applicant an advice report containing all the options from the results of the assessment. Once the assessment is finalized, applicants may choose to refuse or accept any of the available options. Should they choose to continue with the Green Deal, they must approach a Green Deal Provider who will arrange and fund the installation. A Green Deal Plan is signed which is the contract between both parties. Finally, the Green Deal Provider will arrange for a Green Deal Installer who meets all the required standards to install the improvements. The last thing remaining to do is paying the surcharge every month through the electricity bill until the cost of the improvement along with an agreed interest is repaid in full, which will complete the Green Deal (Energy Saving Trust).

Although the government is fully confident in the Green Deal, some have criticized the scheme and doubted if it will really achieve the promised goals. One critique is that although the

scheme deals very effectively with the financial barriers to the users by removing all upfront costs, it does not deal with other barriers that keep people away from become more energy efficient. Such barriers include the discomfort and disruption caused by the construction necessary to install the improvements, the general lack of interest from people to become more energy efficient, and more. Additionally, charging through the user's electric bill is a new and untested mechanism and nobody knows for sure whether it will work or not. Finally, loans schemes are generally used for big and expensive technologies, whereas the Green Deal uses them for low-cost technologies, and the market shows that not many people are interested in such loans (Rosenow & Eyre).

### 1.5.2 Energy Company Obligation

Since the Green Deal focuses on cost-efficient carbon reduction projects, the Energy Company Obligation (ECO) was created by the government to fund more expensive projects. The ECO obliges the big six energy suppliers of the UK to make certain communities more energy efficient. These obligations fall under 3 different categories. The first is the affordable warmth obligation, which requires the energy suppliers to provide heating and insulation improvements to houses suffering from poor incomes. The second is the Carbon Saving Obligation, which requires the suppliers to fund the expensive insulation of solid walls or cavity walls that are harder to treat than normal. Finally, the Carbon Saving Communities Obligation is aimed at providing insulation to the poorest of the UK's areas (bottom 15%). This last obligation is expected to raise about 1.3 billion pounds every year (Energy Saving Trust).

### 1.5.3 Feed-in Tariff

The Feed-in Tariff is a scheme in the UK that allows people that generate electricity on their own to gain money from their electricity suppliers. Examples of technologies that qualify for the scheme are solar panels, wind turbines, anaerobic digesters and hydroelectricity.

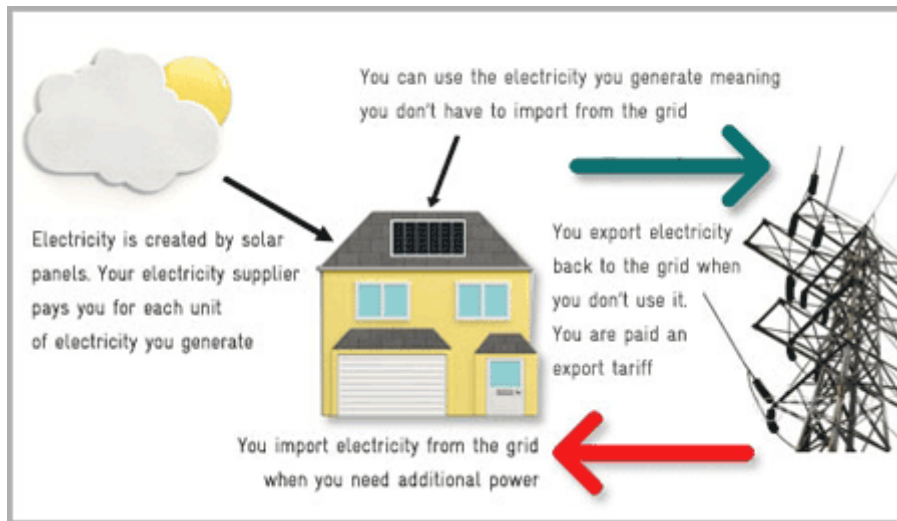


Figure 5: How the Feed-in Tariff works (Energy Saving Trust)



Under this scheme, electricity suppliers have to pay people a set rate for every kWh of electricity that they generate. This is called the generation tariff. Additionally, suppliers also pay the export tariff, which is a further 4.64 pounds for each kWh of generated electricity that is exported into the electricity grid. This means that people that generate electricity can sell any amount that they don't consume. This is estimated to be about 50% of the total generated electricity. Under the UK law, all big suppliers are forced to pay this tariff, and small suppliers tend to follow along. The period of the tariff can be up to 20 years depending on the technology being used (Energy Saving Trust). Below are some rates for the generation tariffs of different qualifying technologies.

Total installed capacity (kW)	Generation Tariff (pounds per kWh)
<4kW (new build and retrofit)	14.90
>4-10kW	13.50
>10-50kW	12.57
Stand-alone	6.61

Table 11: Summary of solar PV tariffs (Energy Saving Trust)

Technology	Total Installed Capacity (kW)	Generation Tariff (pounds per kWh)
Hydro	<15	22.23
	>15 to <100	20.76
Wind	<1.5	22.23
	>1.5 to <15	22.23
	>15 to <100	22.23
Micro-CHP	<2	13.24

Table 12: Summary of hydro, wind and microchip tariffs (Energy Saving Trust)

#### 1.5.4 Renewable Heat Incentive

Like the Feed-in Tariffs, the Renewable Heat Incentive is a financial incentive for people to install renewable heat technologies in order to save energy. This scheme is aimed at achieving the UK's goal of having 12% of all heating come from renewable sources. The incentive currently only applies for non-domestic installations but domestic installations are planned to be implemented in spring 2014.

According to the Office of Gas and Electricity Markets – the manager of the scheme – non-domestic installations can include any renewable heat unit supplying large-scale industrial heating to small communities such as small businesses, hospitals and schools. The tariff will last for the lifetime of the technology or for 20 years, whichever happens first (Office of Gas and Electricity Markets).

When the scheme will be expanded to domestic sectors, any person using renewable heat will be eligible for a grant. Tariffs for some qualifying technologies are shown below.

	Air source heat pump	Biomass	Ground source heat pump	Solar Thermal
Tariff (pounds per kWh)	7.3	12.2	18.8	19.2

Table 13: Summary of tariffs for some renewable heat technologies (Energy Saving Trust)

### 1.5.5 Milton Keynes Boiler Cash Back Scheme

Although much more simplified, carbon reducing schemes at the local level work in the same way as the big government schemes previously described. The Milton Keynes carbon offset fund has undertaken several of such schemes. One of its most successful is the Milton Keynes Boiler Cash Back Scheme. It works as a financial incentive for anyone looking to replace an old boiler with a new and efficient one. The grant gives 150 pounds to any homeowner who replaces a D-rated (or below) boiler with a new A-rated boiler. The only requirements are that the boilers must be installed by a certified expert. In order to benefit from this scheme, people must simply fill out a form and have it signed by the installer who must certify that the boiler that was removed was rated D or below and that the new one is A-rated. After this is done the applicant must send the application form to the organization that manages the fund, who will then approve the payment of 150 pounds (National Energy Foundation).

<b>Scheme</b>	<b>Type of incentive</b>	<b>Type of technology</b>
Green Deal	Financial support	Cost effective technologies such as insulation, boilers, windows...
ECO	Financial support	Expensive technologies such as solid wall insulation
Feed-in Tariffs	Financial reward (Cash Back)	Generating technologies such as solar panels and wind turbines
Renewable Heat Incentive	Financial reward (Cash Back)	Renewable heat technologies such as solar heat
Milton Keynes	Financial reward (Cash Back)	Modern and efficient boilers

Table 14: Summary of existing UK schemes promoting energy efficiency

In summary, some schemes such as the Green Deal and the Energy Companion Obligation help people become more energy efficient by providing financial support to install energy efficient technologies. On the other hand, schemes like the Feed-in Tariffs, Renewable Heat Incentive, and the Milton Keynes Boiler Cash Back scheme provide financial rewards to people installing these technologies. In all cases, the scheme acts as a financial incentive to become more energy efficient. This concludes the research required to develop carbon education schemes to help SMEs in Brent. However, we still need to look at how to implement these mechanisms.

## **1.6 Fund Management Logistics**

Determining how to implement the schemes will require a good understanding of how the funds available should be managed. In its study for a carbon offset fund for Southampton, the United Sustainable Energy Agency (USEA) explains that whoever is in charge of managing the fund must be able to track referrals and installation, provide excellent customer service, build long-lasting relationships with installers, produce reports and evaluate projects applying for funding. Furthermore, that management structure is also in charge of making sure that what is spent from the fund is always equivalent to the amount of CO<sub>2</sub> that is saved, and should review the price per tonne of Co<sub>2</sub> on a regular basis.

The USEA identifies several options for managing a local offset fund. One of these options is having an internal management mechanism in which the Council itself is in charge of all the responsibilities detailed above. For such a mechanism to be successful, the Council needs to have all necessary internal resources to accomplish its tasks.

If that is not the case, then the management of the fund can also be outsourced to an external organization, such as a charity or non-profit organization. The Milton Keynes carbon offset fund is managed this way. Indeed, the Council outsourced the management of the fund to the National Energy Foundation (NEF), a local charity funded in 1988 that helps other organizations achieve greater energy efficiency. On behalf of the Milton Keynes Council, the NEF administers the fund, initiates ideas and programs to reduce carbon emissions, markets and manages all agreed programs, ensuring that everything complies with the terms and conditions imposed by the fund, manages the finances of all these programs, and reports to the Council on a regular basis (National Energy Foundation).

The Southampton study reports that it can be costly to outsource the management of a fund to an external organization, typically averaging around 10 to 15 percent of the fund's income. However, it is mentioned that outsourcing management for a small local fund will be cheaper because the scheme of the fund is simpler and the amount of money transferred is smaller.

#### 1.6.1 Possible Management Styles

There are two major ways to manage Council funds for this type of project; the bottom down management System and the top down management system (Kollmuss, Knovel Sustainable, amp, & Development, 2010). The bottom down management system is more of a community driven system that allows for a broader range of projects to come about. The bottom down system works by having the businesses whom are looking for funding for these projects, come and present the projects they are hoping to get funded. The proposals are then held to a set of regulations and standards that make sure the proposals achieve what the goals of the Borough. Then, the projects that get through that portion are then proposed to a set of professionals who can then choose which projects will get the final approval and decide how much funding they will receive. This process allows for a wider range of projects to be done because new ideas can be proposed. But, a big problem with this is the ideas need to be brought up by the businesses and then they can begin the funding project. This project can be visually explained below.

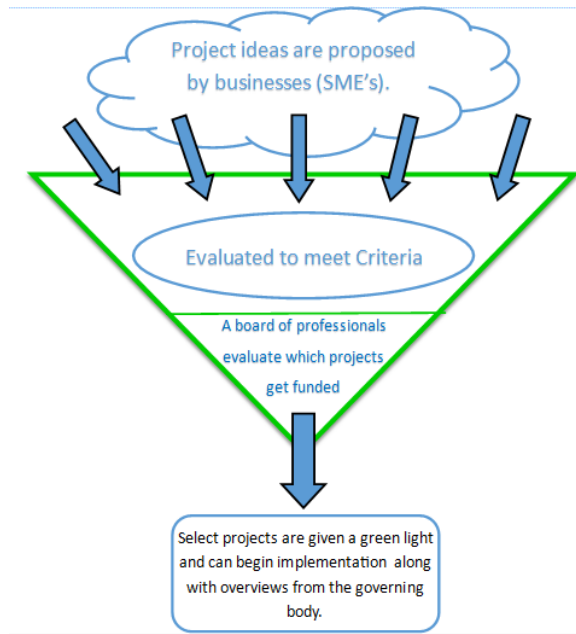


Figure 6: Bottom down management

The next type of management system is the top down management system. In this type of management, the set of professionals who would analyze the submitted projects in the previous management system would instead analyze potential projects that could fit in all types of SME's within the area, and they would also help along with the reduction goals of the Borough. The projects are then presented to the SME's who can then apply for them and get the funding for the chosen projects. This type of system is a bit more restrictive when it comes to the creativity and range of projects being implemented, but it requires less action from the SME's. Instead the projects can then be brought to the SME's by organizations such as Energy Solutions and help educate them about the projects and get them to sign up. A depiction of the process can be seen below.

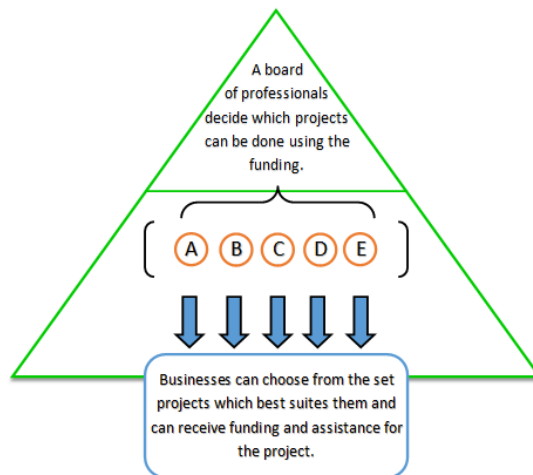


Figure 7: Top down management

At first glance the best fitting management system for the Brent situation would most likely be the top down system due to the little involvement of proposals from the SME's. This would allow for a more streamlined and organized way to administer the funds to the businesses, and the businesses would not have to do any sort of research about what they could implement. Instead we can present them and contact them about their eligibility for certain project funding's and a quick estimate of the savings and reductions it would bring to their business. But this does limit the scope of the projects if they are just limited to the set choices, so there could be set an option to propose any ideas that are not on the list of approved options. This would allow the businesses that were really looking to get any ideas of their own some of the funding to implement it if it will help the Borough's plan. So the best option may be to create a slight hybrid between the two plans, but with a heavier emphasis on the top down management system. This would fall under an energy auditing system, which will be looked into in later sections.

Now the next big portion of this management system is to analyze various projects and options for reduction of carbon production and energy usage. The projects should not only reduce the amount of carbon a business produces, but it also be some sort of money saving tool for the business. The projects that will be funded should be treated as investments. They are investments into development and economic rejuvenation of the Borough. Brent wants to keep its carbon footprint down not to just adhere to the London Plan, but to also keep it in the running with the other Boroughs of London, which should also keep it economically strong. So this fund should truly be seen and managed like an investment. There are ways to go about analyzing these investments to judge whether or not they are viable options and one of the best ways to do so is in the process depicted below:(Government, 2009)

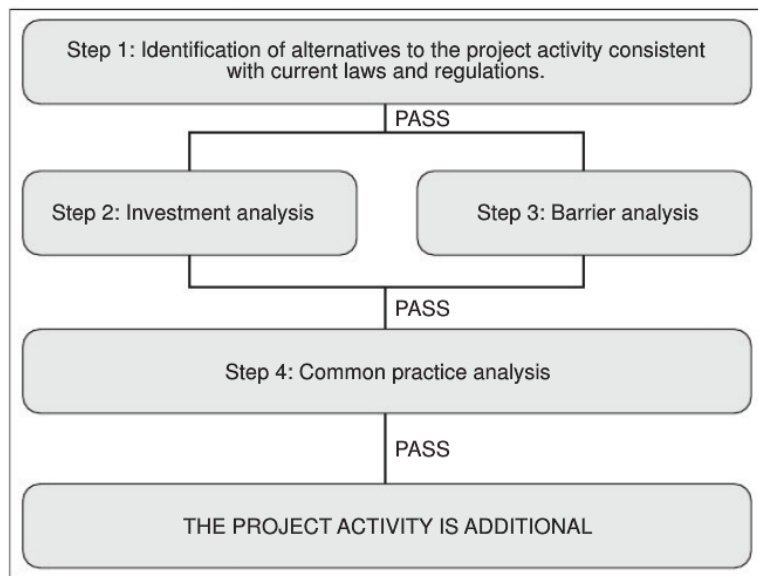


Figure 8 Investment Analysis

First, this process begins with the identification of possible projects that will help with the reduction of carbon emissions in such a way it meets the standards of the London Plan and the Borough of Brent. Step two, the investment is analyzed. This means the project's effectiveness in carbon reductions and viability within the region, its generation of savings for the SME's, and its availability for outside funding. Step three runs alongside the second because there is a bit of

overlap. This third step is about possible problems or barriers that may arise from the proposed projects. This may include lack of eligibility for outside funding, the ability to adapt it to the region, and anything else that may hinder the economic or technical aspects of the project. Finally, step four calls for us to find out the common practice of the project. This means we must see how it is usually instituted and installed so that we may find the correct way to get these options into the SME's. This way the process can be made as streamlined as possible and the SME's know how to go about getting these projects completed. Then all that is left is to propose these projects to the SME's who can then apply for and begin the installation of these projects and help move along Brent's goals.

To sum it all up, the funds can be managed by the Council itself or by an expert organization depending on the needs. There are 2 ways to generate and implement schemes. One is having the SME's propose project ideas which are then evaluated and approved or denied. The alternative is creating schemes and proposing them to SME's. In all cases, the schemes must be treated as an investment aimed at improving the Borough.

This chapter investigated demand side management to provide the basic mechanism that will be used to help SMEs. Then it turned to Brent itself and more specifically to the different kinds of SMEs that are present in the Borough. Doing so gave us a better picture of our target, and will allow us to devise the best ways to help them. Next, the section took a look at the technologies with the potential to help SMEs become more energy efficient, and examples of existing schemes that use these technologies. This will be a great asset when it comes to creating our own schemes specifically designed to help SMEs in Brent. Finally, the chapter ended by looking into managing the funds to provide insight as to how to implement the schemes that we will create. This concludes the research chapter of this paper. Following is the methodology chapter, which entails the methods that will be followed to achieve our objectives and mission.

## CHAPTER 3: METHODOLOGY

The goal of this project was to assist the Borough of Brent with the investigation of the feasibility and benefits of using Council resources to help small and medium enterprises (SME's) achieve energy efficiency and make savings. Our team fulfilled this goal through the following objectives:

1. Interviewed Council contacts to gather input and resources from different areas of expertise
2. Developed a pilot program with Energy Solutions to help SMEs become more energy efficient
3. Assessed the need and interest of SMEs for reducing their energy use and participating in such pilot program
4. Analyzed the benefits that would result from helping SMEs become more energy efficient and more specifically from carrying out the pilot program

Our first objective was to understand the Council's expectations of the project and gather all the resources available to us. We did this through interview with Council employees from different departments. Once we had the Council's input, we were able to work with Energy Solutions – a non-profit organization – to develop a pilot program that would allow the Council to provide financial help to SMEs seeking to improve their energy efficiency. After that, we investigated whether the business owners of Brent were interested in such program or not, and we analyzed the potential of the SMEs to achieve significant carbon savings. We achieved this by surveying several businesses and observing their housekeeping and how it affected their energy use. Finally, we analyzed the benefits to the Borough that would come from helping SMEs become more energy efficient. Not only did we consider direct benefits such as carbon savings, but also secondary effects such as economic stimulation and growth.

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Interviews with Council						
	Develop Pilot Program					
		Survey SMEs				
				Analyse Benefits		
						Finish Report

Table 15: Gantt chart of objectives achieved during the 7-week term

### 3.1 Objective 1: Interview Council contacts to gather input and resources from different areas of expertise

When we first contacted our sponsor at the Brent Council, she wanted us to go around and interview various people within the Council. She later provided us with contacts within the Council along with their respective roles and job titles. These mainly concentrated around the Planning and Development, Financial, And Environmental Sustainment Departments. The point of interviewing the people within these departments was to gather input from different areas of expertise and as many resources as possible to help us in our efforts. We wanted to find out key information from these interviewees; their experience would be useful in learning how to make a viable project proposal to the Council. We quickly populated a list of all contacts and scheduled interviews with them within the first 2 weeks of our project.

Name	Title	Role/Experience
Ken Hullock	Head of planning and regeneration	Responsible for all planning projects of the Borough
Claire Jones	Principal Planner	Responsible for planning policies. Knows all the town centers and all the employment areas. Ken Hullock is her line manager.
Emily Ashton	Environmental Projects and Policy	Responsible for carbon reduction projects in Brent's Civic Centre.
Dave Carroll	Head of New Initiatives	Expert on finance and regeneration projects. Knows everything about Brent.
David Glover	Planning Officer	Experienced with planning projects
Beth Kay	Regeneration Officer	Has worked on a project that involved surveying SME's.
Angus Saunders	Principal Project Officer	Responsible for s106 agreements funding
Sinead Prunty	Business Engagement Officer	Responsible for relations between Council and SMEs
Anis Robinson	Energy Manager	Responsible for retrofitting programs such as the Salix fund and the RE:FIT program. Can provide insight into quick, affordable energy efficiency wins
Jonathan Kay	Development Manager	Experienced with fundraising and match funding
Paul May	Senior Finance Analyst	Expert on financing projects

Table 16: List of interviewed Council contacts

We set out to devise a set of key information points we wished to extract from these interviews to give us the broadest, most vivid idea of how a project like this could be carried out. With these points in mind, we created a general interview plan for the interviews. The general interview plan was made to be easily edited and adjusted for the different positions we were planning to interview.

Topic	Key Points
Introductions- Their Job and the Project	<ul style="list-style-type: none"> <li>Understand the interviewee's role in the Council</li> <li>Explain the project in full to them</li> <li>Explain the analysis document we are planning on writing for the Council</li> </ul>
Assess SME interest in Project	<ul style="list-style-type: none"> <li>Discuss what should be in our survey</li> <li>Key questions, results that should be yielded</li> <li>Best way to approach SMEs</li> </ul>
Discuss energy and carbon reduction technology	<ul style="list-style-type: none"> <li>Costs and types of tech that Brent is willing to invest in</li> <li>Amount of savings the Council looking for, financially and carbon-wise</li> </ul>
Project/Program Structure	<ul style="list-style-type: none"> <li>Way for program to be funded</li> <li>Selection of SMEs for the program</li> <li>Distribution of knowledge to SMEs</li> <li>General structure of this program and any past similar programs</li> </ul>

Table 17: General discussion topics used according the interviewee's area of expertise

The general point of the discussion was to fully introduce the project and how we envisioned it unfolding. It began with us introducing ourselves to the Council members in order to get our faces and names known. We then asked for the interviewee to give us an overall explanation



on what their role is within the Council. This was so we could fully understand what they would be most knowledgeable on for certain portions of our project.

From there we explained our project to them in depth so they could then understand where they could help us most. We shared our goals and got their general opinion on the project. We explained that our ultimate deliverable would be a document analyzing the benefits of the project. We intended for this to bring up a discussion on what the Council's expectations of the project were, and if they could point us to any information they may have to help this analysis.

From there we moved on to explaining our objectives. We broke this up into a few key topics the first being: Assessing the interest from SMEs for Council assistance to become energy efficient. We wished to speak with them about how we were planning to survey the businesses within Brent to figure out their interest in the project and hence measure the project's chances of success. We wished to know the interviewee's input on what to ask in the survey, and how to approach SMEs. We then moved on to identifying and analyzing carbon reduction technologies that would best benefit Brent SMEs. This portion was used for those who deal with these types of technologies such as the environmental development departments. We then discussed our plan to draft possible ways of implementing these technologies and strategies. We knew there were several options for creating such schemes, and we wanted to gather their input on what mechanisms they thought would fit our project best.

Finally we closed the conversation by thanking them for their time, giving them our contact information, and making it known that we will contact them in the future should we need any information from them. After the interview, we took minutes on the entire discussion for the analysis portion of this project. We made notes of any documents or contacts they said they would provide us, and followed up with thank you emails reminding them to send us the resources.

### **3.2 Objective 2: Develop a pilot program to help SMEs become more energy efficient**

After all the interviews were carried out we proceeded to develop a very basic structure for a pilot program that would test out the possible application of the project. To do this, we first used our background research to identify the technologies that were being used in other parts of the UK for similar retrofitting projects. Using this, we chose what we considered could be applied to SMEs in Brent. This resulted in a list of potential technologies and strategies that could be used for creating the pilot program. To trim down this list further down we used the information extracted from our interviews. As such, we used the feedback from the finance department to identify what kind of funds could be available for such project and understand what they could and could not be used for. Next, we had to analyze different kinds of mechanisms, or schemes, which could be used to implement the technologies. For instance, one option was to create a program that gives away grants to applicants, and another was to create a loan system with a revolving fund. Again, we used knowledge gained from interviews to choose what would work best in Brent.

Once that was done, and after a discussion with our sponsor and our advisors, we drafted an idea for a pilot program that could realistically be carried out in the Borough. Although the idea was good, it needed to be turned into a concrete proposal. To achieve this, we turned to Energy

Solutions, a non-profit organization working for the Council and focused on improving the energy efficiency of the Borough. We foresaw Energy Solutions acting as the project deliverers of the pilot program. However this would only be possible if we convinced them that the project was worth pursuing. In a 2 hour meeting, we shared our objectives and expectations, as well as how we envisioned the pilot program. We discussed their past projects and their experience with reducing energy consumption of buildings, and how we saw those services being used in the pilot program. They gave us their feedback and we discussed the possible ways that we could work together. In the end they liked the project and agreed to create the formal proposal for the pilot program.

### **3.3 Objective 3: Assessed the need and interest of SMEs for reducing their energy use and participating in such pilot program**

The next objective was to assess the interest and need from the SMEs in Brent in our project. We needed to determine if there was an appetite for such project by figuring out if the business owners were interested in reducing their energy bills and if so, if they were interested in receiving financial assistance from the Council. Moreover, to understand the potential of the project, we had to determine if the business' building and behavior presented an opportunity for significant carbon reductions.

Talking with our sponsor and advisors, we decided that a short survey of business owners would be the best way of approaching this objective. Being small businesses, the owners would surely be busy and unable to accord us more than 5-10 minutes of their time. A short survey would allow us to quickly retrieve relevant data that would allow us to come up with clear statistics and a general feel of the SMEs interest in the project. To create such survey, we had to accomplish two tasks. The first one was to identify the information that we wanted the survey to yield, and the second one was to learn how to actually create the survey. For the first task, we used our own knowledge from our research as well as the feedback gained from the interviews. More specifically, energy solutions had told us what information was needed to evaluate the pilot program's potential. After we had a clear picture on the information we needed to gather from the SMEs, we focused on creating the survey. To do this, we turned to our interview with Beth Kay, a Council employee who had experience with surveying SMEs. Using her feedback on aspects such as the formatting and the wording of questions, we created our own survey entailed to the information we wanted to retrieve for our project.

The survey that we created initially consisted of 3 parts. The first part was a visual survey to be filled in by us. It consisted of all the information that could be collected by simple observation and required no discussion with the business. That is information such as the name and address of the business, and also the kind of business and the type of building. The next two parts of the survey went more in depth into the subject an interview of the business owner or manager. The first of these parts consisted of questions about the tenure of the premise as well as the history of the business. These were meant to provide clearance on certain barriers that might affect our project. The other part was the core of our survey, and consisted of more detailed questions regarding the energy use of the business and of the owner's interest in reducing his energy consumption and participating in our project.

After testing this survey for a day, we realized that in most businesses the manager was not present. This resulted in a low number of responses and a poor use of our time. To overcome this obstacle, we added a fourth part to our survey. This was a checklist regarding behavioral aspects of the business. It was a series of short yes or no questions that could be answered by any employee of the business, not just the manager. Examples of such are if the business turns off the lights at night

and if they keep windows or doors open. These would allow us to gather at least some data from every business that we approached; making our time spent interviewing much more valuable. Furthermore, the information would be useful in determining the potential of the business for significant carbon savings by simple behavioral changes, whereas the previous parts focused more on the owner’s interest in the project.

Along with the survey, we created a consent form to get permission from the SMEs to use their answers in our research. The consent form explains the focus of our study and clearly states how their answers are going to be used as part of our study and that their identities will never be disclosed.

Forty Ave	
Hameed & Co	Attorney
Grey & Co	Real Estate
Al Nakheel Supermarket	Supermarket
Lahori Masala	Restaurant
Soaps & Suds	Dry Cleaner
SGN Glass	Safety Glass
Bridge Rd	
Wok N Roe	Restaurant
R T Whitehurst	Dentist
Haart	Real Estate
The Crock of Gold	Tavern
Lamartine Design	Hair Dresser
Dapper Dry Cleaners	Dry Cleaner
Wembley Park Dr	
Chicken World	Restaurant
Foster Games	Real Estate
Hunter Estate Agents	Real Estate
The Wembley Tavern	Tavern
Green Cars	Courier Service
Biosculpture	Beauty Supply
Empire Way	
Mama Calabar	Restaurant
Life Insurance Corporation Of India	Car Insurance
Early Bird Sandwich Bar	Restaurant
Clean Waste Solutions	Garbage Collection
Big John Bldg	Builder
Global Metcorp	Exporter
Alperton	
Acha	Restaurant
Alperton Halal Meat	Restaurant
Biblos	Restaurant
G Cut	Hair Dresser
Abbey Hair	Hair Dresser
B&K Car Repairs	Car Repair



Table 18: Sample of SMEs approached, categorized by streets

Figure 9: Sample of streets covered while surveying

Once the survey and consent form were created, we needed to identify and map out the businesses that we wanted to approach. To do so, we looked at the various town centers of the Borough and other clusters of businesses. Using the Council’s list of businesses, we picked those businesses that seemed to match the profile we were looking for according to the feedback from some of our interviewees. These included businesses such as restaurants, dry cleaners, car repair shops and others. We also picked the businesses that showed up on the Internet, as we reasoned that those having websites would be more willing to talk with us if it could help their business. Once all the businesses were identified, we mapped them out and separated them into different areas as to effectively plan out the surveys.

Before we could go out and carry out the survey, we had to determine a clear strategy on how to approach the businesses. We needed to figure out how to introduce ourselves to the business owner and how to present the project as to maximize the number of owners that would agree to take the survey. All this was figured out by using the input provided by Beth Kay, energy solutions, and some other interviewees. We created a set of instructions to go along with our survey, explaining all the steps needed to be taken, from the moment we enter the business to the moment we leave. The instructions explained exactly what to say when making the first contact and throughout the entire survey. By following these instructions, we were guaranteed to approach all SMEs in the exact manner, increasing our chances of success.

## **1 Approaching the business**

### 1.1 Identify an employee and approach him

Present ourselves as follows: "Hello, we are students working on a project to help businesses reduce their energy bills. Would you or another person be willing to give us 2 minutes of your time to answer a short survey for our research?"

### 1.2

If the person says they are just an employee and that manager is not present, explain that some of our question can be answered by any employee and that we would greatly appreciate their input as well.

### 1.3

If the person says they are busy at the moment, ask if we could come back at a better time

### 1.4

### 1.5 If the person agrees to taking the survey, move on to the next part

## **2 Carrying out the survey**

### 2.1 Carry out part 2 of the survey first (checklist)

### 2.2 If the manager is being interviewed, move on to part 3 and 4

In Part 4, before asking them if they are interested in the audit explain to the interviewee the project: the Council is looking to pay for an expert to go to businesses and analyze their energy use to inform you of what you can do to reduce your energy bills at little to no cost. This audit would be entirely funded by the Council and could lead to a 10% decrease of your energy bills. Would you be interested in such offer?

### 2.3

### 2.4 Finish part 4 and complete part 1

Give out contact information and thank interviewee for our time.

### 2.5

Give him thank you card

Table 19: Instructions for approaching a business and carry out the survey

After having the questions, the list of sampled SMEs and the approach strategy all figured out, we were able to go out and carry out our survey. The first day, we all went and approached the businesses together. We stayed out all day, taking a short break around lunchtime where most businesses were too busy to be approached. This first day was meant to be a test day, allowing us to adjust and tweak our survey and consent form, as well as the way we approached the businesses, in order to maximize the number of responses from the SMEs. The following days, only two of us went out to survey while the third person stayed in the office working on the report and other matters.

Once all surveys were carried out, we imported all of our raw data into a spreadsheet. This allowed us to interpret our data by generating plots and graphs and calculating statistics. For the open ended questions of the survey, we put all the different answers into pre-defined categories, which enabled us to calculate statistics for those as well.

### **3.4 Objective 4: Analyze the benefits that would result from helping SMEs become more energy efficient and more specifically from carrying out the pilot program**

To help the Council make a decision about helping SMEs become more energy efficient, we needed to show the benefits to the Borough that would result from doing so. Therefore, our last objective was to analyze every possible outcome of the project to clearly identify its benefits.

To achieve this, first we relied on our Council interviews to understand what kinds of benefits could result from generally helping SMEs reduce their energy use. Using this information, we set up a list of possible benefits that we would need to analyze one by one to determine the extent to which they would be yielded by our project. The analysis process of each possible benefit differed depending on the nature of the benefit. In all cases, we gathered the evidence and resources available to us and analyzed them to determine if the benefit would truly be achieved by the project. This required critical thinking from our part, breaking up the information available to us and forming arguments showing the benefits.

To understand the benefits of the pilot program specifically, we decided to carry out a test audit with energy solutions. To choose what SME to audit, we looked at those that we had surveyed and considered factors such as level of interest, energy consumption, type of business, and potential to improve energy behavior. Once the business was chosen, we scheduled the audit with all parties.

## **CHAPTER 4: RESULTS & ANALYSIS: PROPOSAL AND RATIONALE FOR AN SME ENERGY EFFICIENCY PILOT PROGRAM**

The Council of Brent is aiming to cut the Borough's carbon emissions. One of its specific objectives is to reduce energy consumption from SMEs and enable them to implement energy efficiency measures by accessing financing from the Council. Therefore the Council of Brent is currently looking to develop a program to financially assist the SMEs in becoming more energy efficient. From our interviews with several contacts, we found out the Council has the a few expectations. First, the Council expects the program to yield clear and measurable carbon savings to assess its success. Next, the program should be cost effective to justify the use of Council funding. And lastly, the program should deliver enough benefits to the Borough as to justify an investment into the private sector.

Our proposal is to allow Brent to use Council funding to help SMEs become more energy efficient by providing them free energy audits. There are several barriers when it comes to helping SMEs reduce their energy usage, and energy audits help overcome many of these. The first one is that most business owners do not understand their energy use. There seems to be a general lack of awareness and care about the issue of energy waste and efficiency, and this makes it hard to get the SMEs to become active in reducing their energy consumption. Therefore it is key to change this mentality in order to move forward. Energy audits deal with this barrier very effectively as they engage the business owner in the energy saving journey, teaching them how to properly monitor their energy use and getting them excited about reducing their usage. Another big barrier for SMEs is that they are less flexible and less able to invest in energy saving technologies, given their lower incomes and the fact that most are leaseholders and do not own the building they operate in. Energy audits can solve this problem by offering low cost and immediate energy saving measures. These typically concern energy management improvements, such as using less heating and switching lights off when not needed. These measures alone can easily achieve 10% savings, and thanks to their low cost, business owners can implement them regardless of their capital or tenure of the premise.

For such program to take place, Energy Solutions has developed a pilot program to test the program's potential. Our investigation analyzed the feasibility of the pilot and the potential benefits that it would yield, to both the SMEs and the Council. Our findings led us to the conclusion that the proposal meets all the Council's expectations and that carrying it out would present several benefits to the Borough as a whole. Therefore we believe that the pilot program is an opportunity that should definitely be pursued by the Council to properly assess the implementation of a full-scale project in the future. Below are the findings, which led us to this conclusion:

1. SMEs present significant potential for carbon and energy savings
2. SME show interest in the audit program
3. The program could yield several benefits for the Borough
4. The Council has resources to expand the program in the future

Before diving into the details of these findings, the following section discusses the proposed pilot program in more detail.

## 4.1 The pilot program proposed by Energy Solutions

The proposed pilot program is composed of 4 stages spreading over a length of 12 months. The first stage is identifying and targeting the potential participants, and the second stage involves the actual energy auditing of the SMEs. The third stage is a training period in which the business commits to following the behavioral measures given by the audit, to achieve the estimated savings. Finally, the fourth stage is the installing of energy efficiency measures for those participants that successfully completed the training.

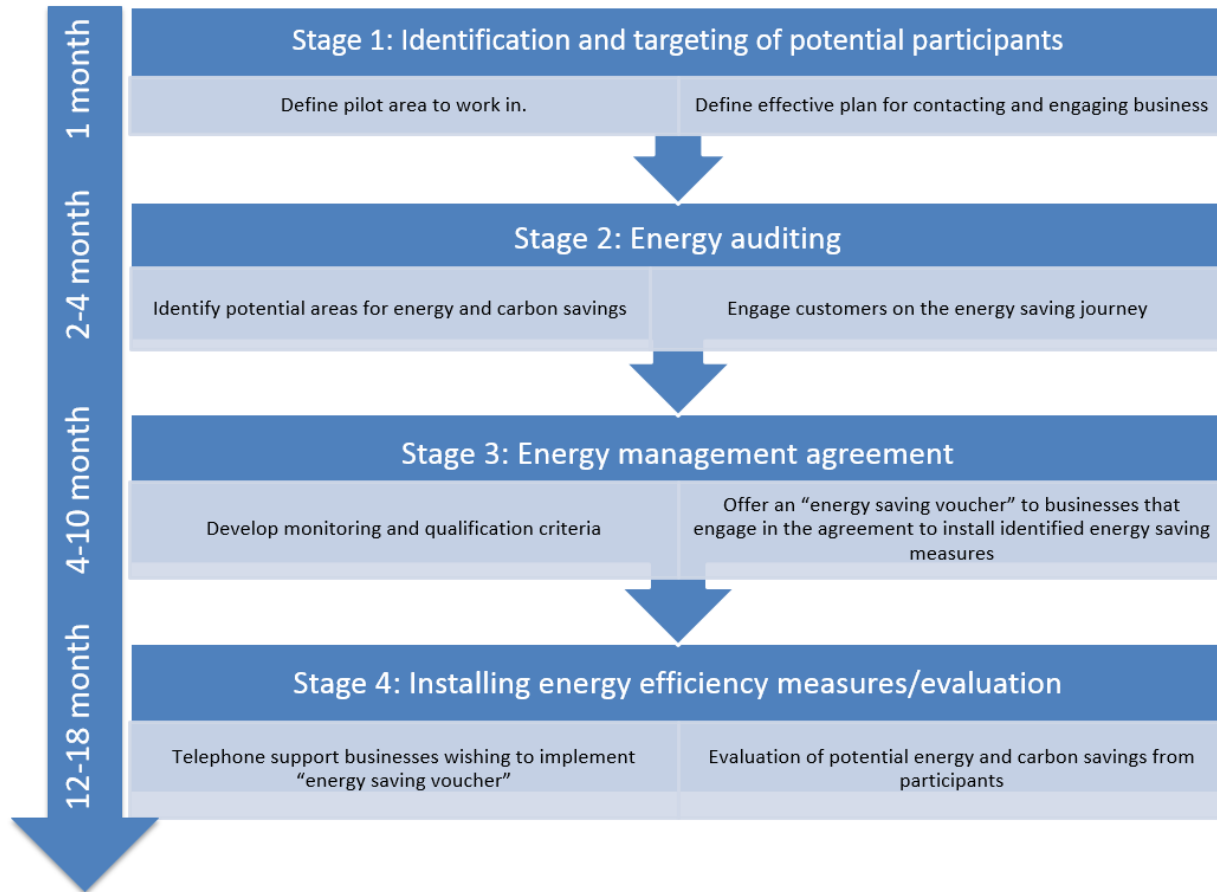


Figure 10 Pilot Program Structure

### 4.1.1 Stage 1: Identification and targeting of potential participants (time frame – month 1)

To ensure the program achieves strong results, the participating businesses must be chosen carefully. Not only must the participating businesses be interested in decreasing their energy use, but they must also present enough potential to achieve significant energy savings. The first stage of the project is aimed at identifying those businesses and having them participate in the program.

To do this, the first step will be to define the pilot area to work in. This will be based on 3 factors. One of these will be a desktop analysis of business types and potential for energy savings to identify which ones to target. Additionally, this desktop analysis will be supported by the findings of the energy questionnaire survey that we conducted earlier. Finally, an analysis of geographically “distinct” areas within Brent where synergies exist with other Council initiatives will yield areas more keen to participate in a program with the Council.

The second step is a marketing plan that defines the most effective way for contacting and engaging the business. Examples of such plans to consider are questionnaire follow ups, direct marketing via leaflets, cold calling, advertising through local papers, and an area based “door knocking” approach.

This stage will result in a list of 20 qualifying businesses willing to partake in the pilot, with all the audits scheduled and ready to be carried out in stage 2 of the program.

#### 4.1.2 Stage 2: Energy auditing (time frame – month 2 to 4)

Stage 2 will involve performing an energy audit of the SMEs. A comprehensive energy audit is the essential first step in helping a business reduce its energy consumption. Audits typically provide 3 main outcomes. First, a benchmark of current energy consumption yields exactly how much energy the business consumes and from what sources. Second, the audit identifies potential areas for energy and carbon savings. This could be bad behavior such as leaving lights or other electrical equipment left on unnecessarily. Finally, audits serve as a tool to engage the client on the energy saving journey, allowing them to get actively involved in monitoring their energy use and making efforts at decreasing it.

The audits of this pilot will be conducted by a professional and experienced auditor to ensure it is robust and the participant is confident in the results. Moreover, the audit report will be sufficiently detailed to provide accurate results and identification of potential energy and cost savings but simple enough to be clearly communicable to the client. The audits shall identify immediate no cost energy management actions with potential savings, as well as suitable retrofit energy efficiency measures with an indication of install costs, savings, and return of investment (ROI) periods.

This stage of the pilot will result in 20 businesses being audited and delivered an energy report. The report shall have an assessment and breakdown of all management and retrofit measures. On top of that, the stage will identify the businesses suitable for stage 3, i.e. where savings and practicalities allow further support.

#### 4.1.3 Stage 3: Energy Management Agreement

The next stage is a period in which the participating SME agrees to go through training and follow the management instructions given to them. Good energy management should always be the first measure undertaken, as it requires no capital cost. Almost all businesses will be able to implement some immediate no cost actions to reduce consumption. Energy Solutions’ experience indicates that on average savings of approximately 10% can be achieved this way.

This stage will draw up an “energy management” agreement with the participant that clearly identifies the actions required to implement and realize energy savings. Such actions include but are not limited to:

- Appointing an “energy champion” responsible for implementation of actions
- On site training session



- Implementing energy management as standard policy in line with other quality management practices
- Practical actions, e.g. setting heating, lighting, and ventilation controls in accordance with occupancy regimes to eliminate waste of energy

Depending on the energy intensiveness of the business, actual financial savings from energy management can be relatively small. For many businesses the perceived effort in implementing and sustaining good energy management may not seem worth it. Therefore, incentivizing the SME to engage in these actions is important. The pilot proposes to offer a “voucher scheme” whereby the businesses that engage in the energy management agreement and fulfill its requirements will qualify for a partial grant to install identified energy saving measures.

This stage will result in 20 businesses signing up for the energy management agreement, and the implementation of the voucher scheme. Additionally, both parties will agree the monitoring and qualification criteria on. There will also be Wi-Fi energy monitoring systems installed depending on the costs. Finally, the participants successfully completing the energy management agreement will be given the voucher.

#### 4.2.4 Stage 4: Installing energy efficiency measures and evaluation of pilot program

This stage will offer telephone support for the businesses that completed the previous stage and are looking to implement measures beyond behavioral. Energy Solutions shall be responsible of managing the payments on receipt of evidence of installation. Finally, this stage will evaluate the potential energy and carbon savings from participants of the pilot program. With this understanding of the pilot program, we then can move on to the findings for potential carbon and energy savings within SMEs.

As stated before, our findings indicate that the Council should pursue the pilot program. The following sections explain these findings and our reasoning in further detail.

## **4.2 SMEs present significant potential for carbon and energy savings**

The survey that was conducted showed that the pilot program has the potential to achieve significant carbon and energy savings. The findings that led us to this conclusion are the following:

- SMEs energy usage behavior is average and easily improvable at little to no cost.
- The majority of SMEs are located in poor quality stock that can be retrofitted to improve energy efficiency.

### 4.2.1 SMEs energy usage behavior is average and easily improvable at little to no cost

Our first finding from this category was that some SMEs in Brent have an average energy use behavior that can be easily improved with little effort. This was found by asking them behavioral questions about their use of lighting and heating, as well as their monitoring of energy use.

Question	
A	Is there Lighting switched on unnecessarily?
B	Is lighting left on at night?
C	Are PC's or monitors switched on unnecessarily?
D	Are there other electrical equipment left switched on?
E	Are windows dirty?
F	Could daylight be used more effectively?

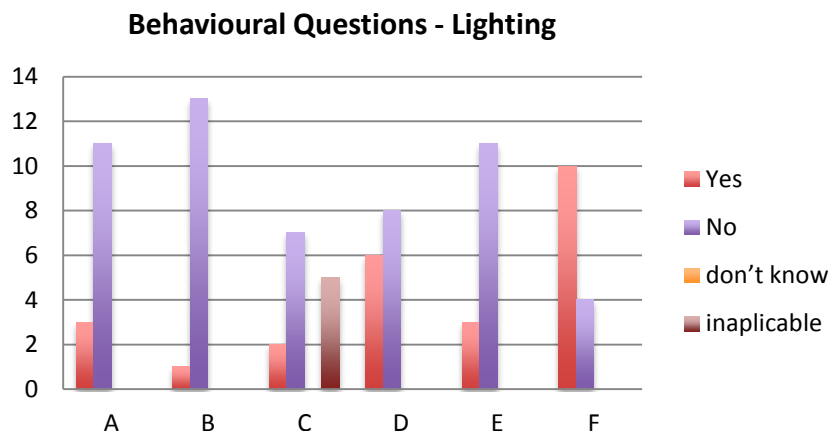


Figure 11: Results of questions concerning lighting management of SMEs

For lighting, we found that the majority of SMEs have a decent behavior. Indeed, most of them try to avoid electricity waste as they reported they only use lights and monitors when necessary (see questions A, B, and C). However, some aspects did present opportunity for improvement. First, many of the SMEs have electrical equipment running 24 hours per day (Question D). Some of these equipment included printers, which if turned off would provide significant reduction of energy use. Other equipment such as fridges and freezers are less convenient to simply turn off, but there are still plenty of options available to decrease their consumption. Furthermore, although most SMEs kept their windows clean (Question E), of the small sample we surveyed a 70% of them did not use daylight effectively. These businesses obstructed their windows with posters and products, which led to a significant blockage of sunlight. Clearing the windows would directly decrease the need for electrical lighting and presents yet another opportunity for Brent SMEs to become more energy efficient. In summary, although the electricity management of SMEs in Brent is not terrible, there are several areas that can be easily improved and that would yield noticeable energy reductions.

Question	
G	Is thermostat settings unsatisfactory
H	Is heating left on at night?
I	Are external doors/Windows left open?
J	Are radiators/Heaters obstructed?
K	Is kitchen Equipment running unnecessarily?

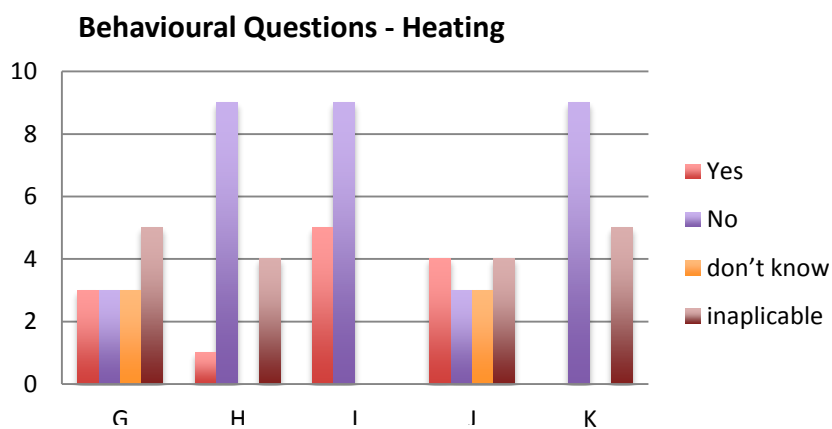


Figure 12: Results of questions regarding heating management of SMEs

As for heating, our findings show a significant potential for carbon savings. Looking at question G, half of the SMEs that used either heating or air conditioning had the thermostat set at an unsatisfactory temperature (either above 20C during winter or below 24C in summer). According to Energy Solutions, decreasing the temperature of the thermostat by just 1 degree results in a 5% decrease of heat cost. Given the fact that half of the interviewed businesses were not at the satisfactory temperature – and some by much more than just 1 degree – the opportunity for savings here is quite significant. Moreover, of the sample we interviewed more than half of the SMEs that used heating had their radiators obstructed or hidden in inefficient places (Question J), making place for even more savings to be achieved. Last but not least, some of the SMEs kept external doors or windows open at all times (Question I), which leads to an important heat loss that can be easily corrected. These findings show that when it comes to heating, the housekeeping of SMEs in Brent could be below average. By correcting some of their behaviors, these businesses can achieve immediate savings at no financial costs.

Last but not least, the survey showed that the owner’s awareness of energy use is lacking, and also shows opportunity for improvement.

### SMEs energy use monitoring level

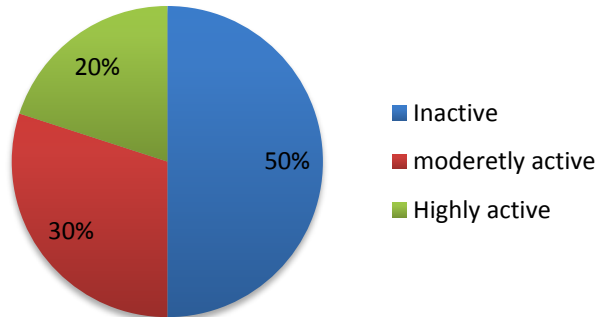


Figure 13 Energy Monitoring Results

As seen from the above figure half of the businesses we interviewed do not even monitor their energy usage. According to our discussion with them, this half does not pay attention to how much energy they consume or to how their energy bills fluctuate. This means that most of them probably don’t understand their bills, which is key to making savings. Teaching these businesses how to understand and monitor their energy bills can provide positive results, as they can identify and analyze the trends of their energy use, and hence minimize their consumption and prevent unforeseen bill spikes. Additionally, getting them to monitor their usage could also incite them to take further steps to become more energy efficient. The behavioral changes discussed previously

showed good promise for improvement towards carbon savings, but with better energy monitoring, the businesses could reduce usage even more.

#### 4.2.2 The majority of SMEs are located in poor quality stock that can be retrofitted to improve energy efficiency.

SMEs present significant potential for carbon and energy savings due to the fact that the majority of SMEs are located in inefficient buildings. Previous studies led by the Council suggested that the Borough suffers from an overall poor quality stock. We confirmed this when we interviewed several businesses and inspected their facilities.



Figure 14: From left to right: a 1977 boiler, non-insulated pipes, fluorescent light tubes

Throughout different business buildings we found several areas which needed improvement and posed a potential for carbon and energy savings. First, many SMEs are using outdated equipment that is highly inefficient. One of such businesses was using a boiler from 1977, which according to the experience auditor from Energy Solutions, is roughly only 60% efficient compared to the 90% efficient modern boilers. Another area of concern identified was non-insulated pipes. This causes considerable heat losses, especially if the pipes are located on the outside of the building, which was the case in several SMEs. Insulating the pipes is a low cost effort but could result in significant energy savings. Finally, we also observed a potential for efficiency improvement through the lighting of the buildings. Many SMEs are using incandescent bulbs and fluorescent tubes, which are not very efficient ones. Changing them to LED lights could result in a quick reduction of energy consumption.

Because of the SME's general poor management of energy as well as the poor state of their building, the pilot program has the potential to achieve significant carbon and energy savings. Beyond this potential for good results, we believe the program should be pursued because the SMEs show interest in participating in it.

### **4.3 SMEs show interest in the audit program**

The core part of our survey was aimed at evaluating the business owner's interest in reducing their energy use and receiving assistance from the Council to achieve this. Naturally, this part of the

survey required the presence of the owner or manager. Out of the 16 businesses that accepted taking the survey, 10 of them completed this portion. From their answers, we concluded that there is a good appetite from the SMEs to participating in the proposed pilot program. Below are the findings that led to this conclusion.

- Most SMEs we spoke with are willing to invest in their building even though they are leaseholders
- Half of the SMEs we spoke with are interested in becoming more energy efficient

#### 4.3.1 Most SMEs are willing to invest in their building even though they are leaseholders

The first questions were meant to investigate the interest of the SMEs to invest in the building. A concern for the pilot program was that the majority of SMEs might have been leaseholders and therefore not willing to invest in the building. If that were the case, then business owners would not be incentivized by the vouchers to install energy saving measures on the building, and the pilot program would not achieve its objectives. The survey results proved this concern wrong.

Out of the 10 SMEs interviewed, 7 of them were on leaseholds and 3 of them were on subleases. This, along with data collected by the Council from previous projects, confirms that the vast majority of business owners are not the actual owners of the building. However, the survey showed that the leaseholders' contracts tend to be quite long, the bigger one being for 100 years. This means that even though they do not own the building, some SMEs might still be inclined to make some moderate investments into the building to improve their business. For the portion of owners being on a sublease, they might still be interested in investing their effort into methods with little to no financial costs.

The next question asked how long the business had been running at that location. The results showed that 60 percent have been operating for over 15 years, with the oldest one having been there for 37 years. Furthermore, none of the businesses have been there for less than 4 years.

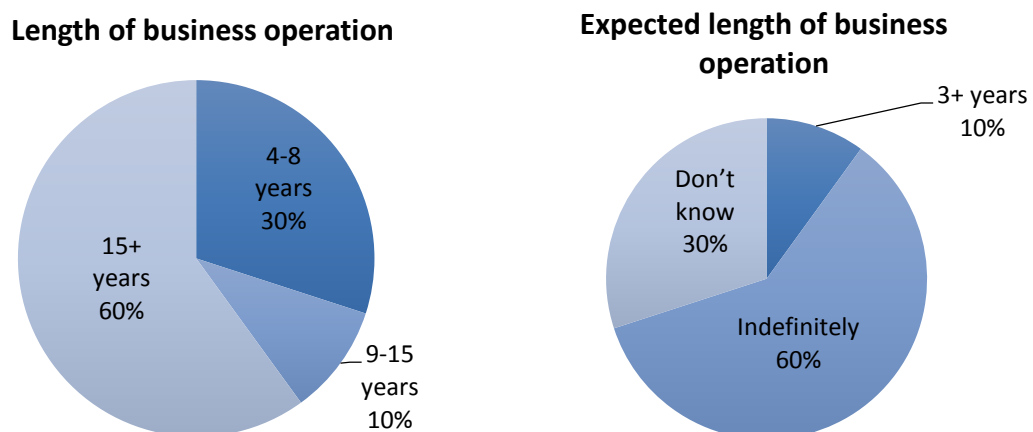


Figure 15: results for which we believe SMEs would be interested in investing in their building

This presents further support for the idea that the SMEs in Brent might be interested in investing into the building. Indeed, the majority are well installed and have already put years of effort into the building. This means that they are dedicated to their business, and are more likely to be willing to invest in it to improve it. Furthermore, when asked how long they foresaw to stay in the building, 60 percent of them answered indefinitely, 30 percent say they didn't know, and 10 percent said at least 3 years. Again, this shows a clear potential for interest to invest in the building.

4.3.2 Half of the SMEs are interested in becoming more energy efficient

The next set of questions concerned the SME's interest to invest specifically in decreasing their energy usage. When asked what kinds of efforts they had made any efforts towards reducing the cost of their energy bills, the answers were quite different. Half reported that they had never made any kinds of efforts. Twenty percent reported doing some efforts, such as verifying their energy bills and turning lights and heating off at night. The remainder made some more significant efforts such as installing LED lights, analyzing the trends of their energy bills, and investing into monitoring systems.

**SMEs level of effort to reduce energy bills**

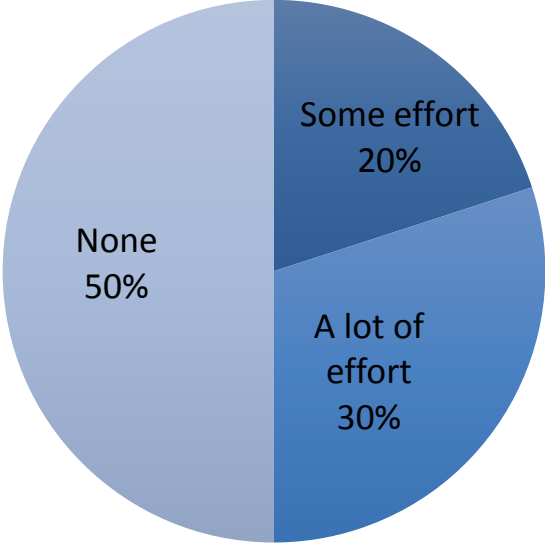


Figure 16: SMEs levels of effort to reduce energy bills

The fact that half of the businesses reported making no effort to reduce their bills can be seen as an indication of poor interest from these businesses to reduce their energy consumption. However, we observe that these businesses all had low energy bills. Indeed, none of these businesses spent over 500 GBP per month on their energy bills. In contrast, the other half of businesses that had made some kind of efforts spent on average around 1,000 GBP per month, with one of them spending up to 3,000 GBP each month. This means that the businesses with higher energy bills are definitely interested in improving their energy efficiency. From our sample, examples of such

businesses are dry cleaners, large restaurants, liquor stores, and theatres. These make for good candidates that could qualify for the pilot program, because they show both interest and motivation to become more energy efficient. The less interested businesses, which should be avoided include real estates, pubs and bars, and markets.

The next set of questions were meant to assess the SME’s interest in reducing the cost of their energy bills and participating in the pilot program. When asked if the bills hindered their business, 6 out of 11 answered yes. When asked if they were interested in finding out simple and cheap ways to reduce the cost of their bills, all the businesses that claimed being affected by their bills answered yes as well. They were then asked if they were interested in a free audit and in the pilot program, and once again they all answered positively.

Question	
A	Do you believe the cost of your energy use is hindering your business?
B	Interested in finding out simple, free and cheap ways to reduce your energy bills?
C	Interested in a free energy audit from the Council that could lead to a 10% decrease in your bills?
D	Would you be interested in participating in a pilot program?

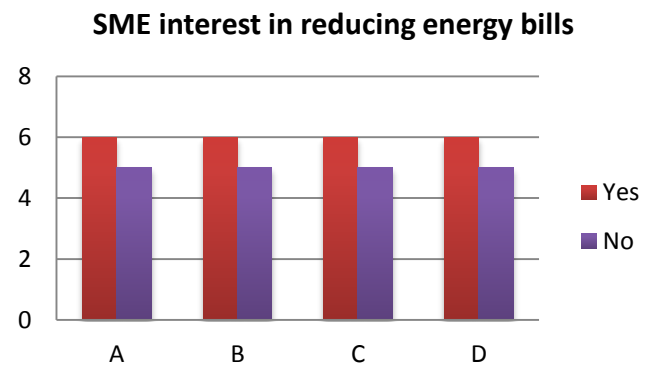


Figure 17: Results of questions inquiring on the SMEs’ interest in reducing energy use

These answers provided real evidence that there is a strong interest to participate in the pilot program. The fact that over half of the businesses reported being hindered by their energy bills means that this is a real struggle for them and they all agreed they needed help. One of the owners even said that his bills were killing his business. Through the pilot program, the businesses would be able to receive help and guidance to successfully to reduce their energy consumption problem and improve their business.

These findings prove that there is a target demographic that is interested in reducing their energy use. The next section looks at the several benefits for the Borough that the program can yield, and is the next reason for which we believe it should be carried out by the Council.

#### 4.4 The program could yield several benefits for the Borough

Part of the project’s goal was to investigate the benefits of helping SMEs reduce their energy consumption. There are a lot of different aspects to consider when making the case for this program. Points to consider are the economic, social, and environmental impacts that this could have on the Borough. All of these considerations point to the support of carrying out this pilot program and eventually establishing this program as an offering of the Council. There is the potential for economic growth, a better environment for businesses to grow within Brent, and a

chance to reduce the carbon footprint of the Borough. Our findings in this project support these claims. The key findings from our project are:

- Carbon emissions would be reduced in a measurable fashion.
- Potential for economic growth in SMEs due to financial savings.
- Council assistance to SMEs could harbor good relations.
- Potential for improvement of building stock quality in Brent.

#### 4.4.1 Carbon emissions would be reduced in a measurable fashion

There is a regrettable lack of information in regarding the amount of energy consumed and carbon emissions produced by SMEs within the UK and Brent. So, we made some assumptions and calculations based upon those assumptions to come up with the following findings. The full data, equations and sources can be found in Appendix 4.



Figure 18: Total consumption of energy of SMEs in Brent

As can be seen, SME's account for roughly a quarter usage of energy within Brent. Largely, the potential for carbon reduction in the SME sector has not been explored in the UK, but with it being a significant portion, this sector should not be over looked. This project is aiming to reduce energy usage through simple and cheap techniques that would at least result in a 10% reduction in energy usage. We then took this into account to make the following assumptions to analyze the potential situation.



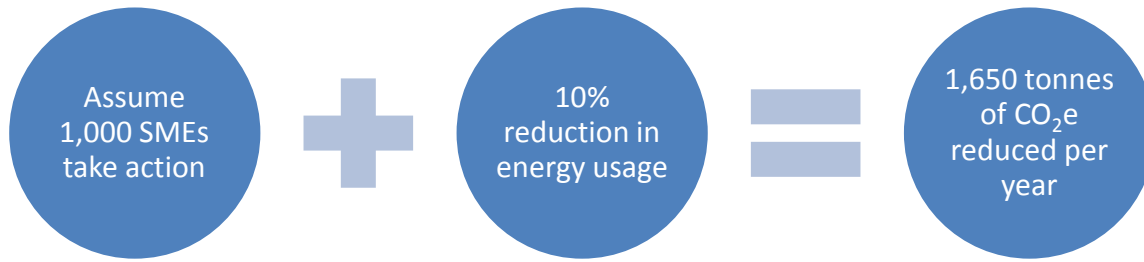


Figure 19: Estimated savings from 1,000 SMEs taking action in the program

This may not seem like a large amount of carbon reduction initially, but again these are assumptions based on averages. So, if the program targets larger energy users, then the averages will increase, and the amount of carbon reduced could be increased. Furthermore, many SME's have a potential of achieving savings much greater than just 10%, further increasing the potential savings that the program can achieve. This is an untapped source of emissions reduction, and Brent could be on the forefront of this idea. The pilot program would test this idea on a small scale, but the end goal is to make this available to as many SMEs as possible to reduce as much carbon emissions as possible. The possibility of reducing emissions could go beyond these assumptions, but to find out the pilot program needs to be carried out and tested. Brent has the potential to be a trend setter for other Councils, and bring about a new potential standard of SME assistance and carbon emissions reduction.

#### 4.4.2 Potential for Economic Growth in SMEs due to financial savings

As can be seen in the carbon savings section, there is quite a bit of energy being used by the SMEs within Brent. From these numbers we have found a conversion to account for the total amount of money these SMEs are paying for energy, within Brent. ("Advanced metering for SMEs: Carbon and cost savings," 2007) With our assumptions stated above we found that the SMEs within Brent spend roughly £24.8 million on electricity and gas alone. This is quite a bit of capital that could be kept within the business through simple efficiency increases within the business. If we take into account that there are 12,610 SMEs within Brent we can get a rough average of what each SME spends on their energy bill. Now consider the potential of getting just 1,000 of these businesses to take action and reduce their energy usage by just 10%, this would lead to a total of £197,000 that could be saved by the businesses.

Now the question is why would the Council want to help the businesses essentially increase their income through these energy savings? In short, this not only benefits the businesses, but it also has a big potential for benefitting Brent as whole. In a study commissioned by the Council, it was



Figure 20: Estimated savings from 1,000 SMEs taking action in the program

stated that, “that for every £1 SMEs take in turnover they will spend 49p in the local economy...where a larger business will spend only 31p.” (Evans, Miles, & Rowelle, 2013) This is a clear and measurable benefit to the Borough. If this assumed 1,000 SMEs save the 10% on their energy bill, then there is a potential for roughly £96,500 being spent back in the Borough. This is one of the potential economic benefits that could result from this assistance to SMEs. Another is the money saved by these businesses could allow them to expand. This expansion may lead to more jobs in the Borough and money that these businesses could invest into their buildings. In all, more money in the Borough’s economy would be an economic stimulus that has the potential to revitalize the area and bring about a rejuvenation of the town centers within Brent. Below is a diagram depicting our assumptions and potential economic benefits.

Even though we have presented these numbers, it should be made clear that they are very rough estimates. The pilot program could yield much better results and give a more concrete idea as to what the actual outcomes could be, since there is no current research published on the subject matter. The carbon and financial savings could very well increase because these estimations are based off of averages of all SMEs, so if the businesses with larger bills and energy use are the final targets, the average bill cost would go up by quite a bit. But, once again, the pilot program would give a better insight into this subject matter.

#### 4.4.3 Council assistance to SMEs could foster good relations

As was mentioned in the Council expectations, there is no point of contact within the Council for SMEs. There is no one person or information point that is meant specifically for SMEs within Brent. The Council was told in the report they commissioned (Evans et al., 2013) that they are not showing any sort of support for businesses within the Borough. This is detrimental to the Borough’s economic climate. If the environment in the Borough is of no help to the SMEs, then they have no solid reason to root themselves in the Borough, and may look to move to more nurturing areas. This also may drive away businesses from settling within the Borough, causing another stunt in the Borough’s potential growth. This project has the potential to mend this crack in relations.

The project would be seen as a helping hand offered by the Council to the businesses. With the Council showing support to the businesses, they are creating a beneficial environment for current SMEs that could help them grow and open up communication between both parties. With this point of communication open, the Council could learn more about what they can do for the SMEs within the Borough and better serve the businesses than they have in the past. Largely the Council is seen as ‘not open for business’ (Evans et al., 2013) and by fixing this relation between the Council and business, the Borough will benefit as a whole. Good business and Council relations could lead to more businesses coming into the Borough, businesses staying rooted in the Borough, and a further improvement of economic and town center climate.

#### 4.4.4 Potential for improvement of building stock quality in Brent

The other possible benefit to helping the SMEs is the possible improvement of building stock quality. Once again, the report that the Council commissioned states that the quality of building stock is bad and hindering the growth and image of the Borough. (Evans et al., 2013) Should the stock be improved, this could bring about an improvement of the Borough’s image and climate. This could then also being another enticing factor that may bring new businesses into the Borough or convince current businesses to stay rooted. The report also states that the Borough is

lacking in its image and needs improvement, which this program could help fix. The only real way to tell is to continue with the pilot program and see if anything comes about on the smaller scale.

Running the program would yield several benefits for the Borough beyond just carbon savings. The next section looks at the final reason for which we recommend pursuing the program.

#### **4.5 The Council has resources to expand the program in the future**

The Council has all the resources necessary to expand the program in the future and create a full scale program, should the pilot program generate convincing results to do so. These resources include the commitment of Energy Solutions to working with the Council, funding opportunities from s106 agreement and European funding, and other existing projects that the incorporate alongside the program.

##### 4.5.1 Energy Solutions can act as project deliverers for this program

Energy Solutions is a non-profit organization created by the Council that works with residential buildings and businesses to improve their energy efficiency. Energy Solution employs experts who conduct energy audit and work with them to identify and improve the issues with the building.

There are two different kinds of audits: the building audit and the behavioral audit. The Building audit measures the efficiency of the building but neglects to take into consideration the usage of the building. Building audit purely relies on the factors such as the state of the building and the efficiency of the technologies installed within the building, and ignores the building's housekeeping.

To complement building audits there is a second type of audit which is the behavioral audit. This measures the energy consumed by the way the building is used, i.e. by the energy management of the occupant. This type of audits analyses habits such as use of lighting, the temperature of the heating and more. The audit identifies the behaviors that can be improved to reduce energy consumption and makes recommendations on which ones to take, along with calculated estimates of resulting savings. This audit helps reduce the energy consumption by taking behavioral measures with little to no cost.

Energy Solutions offers an audit which encompasses both the building and behavioral audit. This audit is carried on with the use of software EPODA. It measures every energy consuming factor (both structural and behavioral) of the building through methods such as analysis of energy bills, metering, and heat loss calculations. Then it identifies the most effective ways to reduce the energy use of the business and creates an elaborate plan listing the measures needed to be taken. The software outputs:

- The current energy use of the building
- The list of the costs needed to implement the measures
- The list of the projected energy and financial savings
- The list of the payback periods in years

Energy Solutions is committed to working with Council on the pilot program by acting as the project deliverers. Not only would they provide the audits, but they would also be responsible

for all communication with the SMEs which includes: marketing, monitoring of results, customer support for the client, management of the voucher scheme, and evaluation of the pilot program. If the pilot program should be successful and the Council would want to create a full scale program, the Council could rely on the experience of Energy Solutions not only to improve the program, but also to keep acting as project deliverers.

#### 4.5.2 There are several funding opportunities available to expand the program

To carry out the project funds are needed to pay for the audits. For the pilot program proposed by Energy Solutions, the Council's Planning and Development Department has set aside a portion of funds for the project. However, for the long term development of the project the Council will have to find another source of funding. One funding resource available comes from the S106 agreements.

The Town and Country Planning Act 1990 is an Act issued by the British Parliament that is meant to consolidate certain legislations concerning town and country planning. Section 106 of this act enables local authorities to impose certain conditions or "planning obligations" on any prospective developer looking to make use of land ("Town and Country Planning Act 1990 Section 106,"). These planning obligations are usually negotiated between the 2 parties and allow the developer to make up for its impact on the community by making contributions towards new structures and services. According to the most recent version of the act, such contributions can be made through periodical payments from the developer to the authority.

S106 agreement allows the Brent Council to impose financial charge on big developers. These developers in Brent must pay fines when they do not meet the regulations of the Borough. Currently these payments accumulate to about 18 to 19 million GBP. This money is invested to improve the Borough in several fields such as education, transportation, parks, sports, training, sustainability and more.

The portion of the s106 funding which can be used to fund the project would come from the sustainability portion of the fund. The funding would come from the developers who fail to meet the Council's carbon regulations and must pay fine equivalent to the amount of carbon that they emitted over the limit. To use s106 funding for our project, a clear case should be made showing that diverting the money from the sustainability portion of the funds will lead to definite carbon emission reductions. Another requirement is that s106 agreements cannot be used to fund infrastructure, as it is exclusive to another regulation called the Community Infrastructure Levy (CIL). Therefore, to use s106 funding it must be proved that the project is does not involve any infrastructure work.

The s106 funding is strictly meant for grants, as the money received from developers is meant to be spent on reducing carbon emissions elsewhere to make up for the developers' own emissions. To present a convincing case for diverting the funds to the project, the exact amount of carbon emissions saved along with the cost of doing it should be calculated.

#### 4.5.3 Several Retro-fitting projects exist that could be incorporated into the program

There are several existing retro-fitting projects available for the Brent Council, one of such projects is called RE:FIT. The project is in its final developing stages and employs experts to choose buildings best fit for the project and conduct necessary work. The scheme uses an Energy Service

Company (ESCo) to implement energy efficiency measures to help organizations achieve energy efficiency. The objectives of RE:FIT are to accelerate the reduction of energy use, energy bills and carbon emissions. The RE:FIT program uses a wide range of methods to reduce carbon emissions, these methods include: insulation and fabric improvements, replacement or upgrading of mechanical and electrical equipment and installation of modern efficient technologies. Our project and RE:FIT scheme have the same goals, in the future they can be a part of a larger program or can be used alongside each other.

Salix is another scheme that can be a support to our project in future. Salix is a publicly funded company dedicated to providing the public sector with loans for energy efficiency projects. Salix enables public sector organizations across England, Scotland, Wales and Northern Ireland to use their resources for the effort to become more energy efficient. Salix provides 100% interest-free capital for the public sector to reduce their energy consumption by providing the opportunity to use a wide variety of energy efficient measures. Salix could be considered as a funding mechanism and support for the future development of our project alternate to s106 agreements. Now, with all these findings stated, we can move on to our conclusions and recommendations.

## CONCLUSION

Energy audits would allow the Council to successfully help the SMEs decrease their energy usage and to achieve its carbon decreasing goals. Energy Solutions has devised a plan to provide energy audits to SMEs and is proposing a pilot program to test its potential for significant carbon reductions. We have identified 4 main reasons for which this program could work in Brent. First, the SMEs present a strong potential for significant carbon and energy savings. Second, several SMEs are interested in participating in a program like this. Third, the program could yield several benefits to the Borough beyond just carbon savings. Finally, the Council has all the resources necessary to create a full-scale program, should the pilot be successful. For these reasons, we believe it would be valuable to the Council to further explore this idea by carrying out the pilot program, which would complement our findings and allow the Council to decide whether to create a full-scale program or not. Indeed, our estimations for the carbon and financial savings of the program give a good idea of the potential outcome, but due to the lack of data on SME carbon emissions, they contain large assumptions and are not reliable enough to be used as the sole decision factor. Running the pilot program would gather tangible results and bring exact figures for the amount of energy saved and the costs associated with them. Using this data, the Council would be able to get much more precise figures for the potential savings of a full-scale program.

Should the pilot program be successful, the Council would then be able to decide if it is beneficial to expand the program into something bigger. Should the Council decide to carry on with the expansion, we have a couple of recommendations. First, the pilot program should be carefully evaluated to identify its weaknesses and areas that could be improved. For example, the Council should consider targeting industrial SMEs to increase the energy savings. Second, the improved program should incorporate other retrofitting initiatives of the Borough, such as Re:Fit and Salix, to create a unified system aimed at reducing the Borough's carbon emissions. Third, the Council should make some significant efforts toward the marketing of the program. We recommend advertising through various medias and through the Brent's proposed 'One-Stop-Shop' website for business owners. We also recommend designating a single point of contact for business owners to refer to and have contact with. Finally, we recommend investigating as many funding opportunities, including external funding.

Several local authorities across the UK have made efforts to cut their carbon emissions, but there has been an evident lack of efforts in reducing the emissions of SMEs. By attempting to help its SMEs, the London Borough of Brent is putting forward a new initiative in the region. Our findings suggest that the London Borough of Brent has all the resources necessary to successfully achieve its ambitions, which would make the Borough a pioneer and leader in this field.

### Other Points to Consider

- Look into the collection of waste oils from restaurants or other sources for use for biofuel engines. This could help the businesses buy letting sell the oils, while also helping contribute to the push for alternative fuel sources.
- Consider looking into the building owners in the Borough as a possible target for this program. They may be more willing to invest in and improve the fabric of the building.

- Workshops for smaller businesses may be a cheaper and more efficient way to target business owners and teach them simple good housekeeping techniques. This could also point them to possible investments they can pursue themselves.

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# APPENDIX

## Appendix 1. In Council Interview Plan

### Interview Discussion

#### Introduction:

Open up the discussion and begin a conversation.

1. Begin with a discussion on what the interviewee's job exactly entails.
  - a. What do they specifically work on within the Council?
  - b. Examples of past projects they may have worked on.
  - c. What do you specifically feel you are the 'go-to' person for?
2. Move on to a discussion of our project.
  - a. How much do they know?
  - b. Has Joyce spoken about it at all with them?
  - c. Fill in any lack of knowledge on the subject.
    - i. Where our project is now headed as opposed to where they thought it was
3. Discuss the persuasive document that we are looking to construct.
  - a. Talk about what type of information we are looking to gather that would convince the Council to divert some of the fund to this project.
    - i. Types of information:
      1. Projected carbon reductions
      2. Projected energy/financial savings for the SME's
      3. Interest from the SME's
      4. Cost per tonne of CO2 saved
      5. Other benefits such as economic growth and closer relation with the SMEs
  - b. Any arguments from the Council we should cover?
    - i. Is there anything we are overlooking within this area that we should tackle?

#### Objective 1:

**Assess the interest from SMEs for Council assistance to become energy efficient.** This objective would present what SMEs are struggling with, if they are willing to commit to become energy efficient and if they want to collaborate with the Council.

1. What should we consider in making the survey
  - a. How many questions should we limit ourselves to
  - b. What type of questions should we include
2. What should our survey yield information wise
  - a. What key information should we be looking for
3. What are the best ways of approaching and surveying SMEs
  - a. Door-to-Door approach
  - b. Prior email notification of expected visit for an interview
  - c. Survey over the phone

4. Should we approach SMEs individually or altogether as a team
5. How to convince SMEs to take a survey
6. What is an optimal number of SMEs to interview to get persuasive data

Objective 2:

**Identify and analyse carbon reduction technologies that best benefit Brent SMEs and project the resulting savings.** This objective would identify optimal carbon reduction technologies fit for Brent SMEs, based on the results from the previous objective. The carbon reductions and financial savings would be projected by analysing the identified energy efficient technologies.

1. What carbon reduction technologies and strategies is Brent Council willing to invest in?
  - a. Boiler replacement, wall insulation, window replacement, PV systems, LED lights
2. What kind of figures/savings would the Council be looking for
  - a. What percentage of carbon reductions will be expected
  - b. What payback period in terms of carbon reductions does the Council expect

Objective 3:

**Draft possible ways of implementing these investigated technologies and strategies.** This would present possible ways of carrying out the projects, interpretation of audits, and projected savings for the projects.

1. Discuss that we wish to create drafts of possible ways of implementing these technologies and strategies.
  - a. Create possible schemes to use the funds to help the SMEs
    - i. Grants vs. Loans
  - b. An application or selection process must be created for interested SMEs
    - i. Should the SMEs come to the Council or should the Council come to them?
  - c. Energy audits could be conducted to see what scheme an SME qualifies for
  - d. Find ways to raise awareness of the projects to the public
    - i. Publicity
    - ii. Kick-off strategies

## Appendix 2. SME Survey

### Survey Form:

### Helping SMEs Become More Energy Efficient

#### Survey Questionnaire V1.0 03/04/14

Part 1 – by observation – for each business		
Form		
1.1	Postcode	
1.2	Street Name(s), Number	
1.3	Business Name	
1.4	Telephone number	
1.5	Webpage / email address	
1.6	Type of business	
	<input type="checkbox"/> Restaurant	
	<input type="checkbox"/> Pub/bar	
	<input type="checkbox"/> Café/snack bar	
	<input type="checkbox"/> Caterer	
	<input type="checkbox"/> Car repair shop	
	<input type="checkbox"/> Hair dresser	
	<input type="checkbox"/> Dry cleaner	
	<input type="checkbox"/> Other – Specify	
1.7	Main space typology	
	<input type="checkbox"/> Small office type space	Desk-work, on any floor, lower ceiling, <500m <sup>2</sup>
	<input type="checkbox"/> Large office type space	Desk-work, on any floor, lower ceiling, >500m <sup>2</sup>
	<input type="checkbox"/> Workshop type space	Light industrial on any floor, higher ceiling, no loading bay
	<input type="checkbox"/> Small warehouse type space	purpose built shed, loading bay, high ceiling, >500m <sup>2</sup>
	<input type="checkbox"/> Large warehouse type space	purpose built shed, loading bay, double ceiling height
	<input type="checkbox"/> Retail Type Space	usually with public frontage, ground level, higher ceiling <500m <sup>2</sup>
	<input type="checkbox"/> Yard	no or only small building
	<input type="checkbox"/> Other – Specify	
1.8	Unit shared by multiple businesses? (Y/N)	<input type="text"/>
1.9	Approximate number of employees based at this location	
	<input type="checkbox"/> Less than 5	<input type="checkbox"/> 5 - 10
	<input type="checkbox"/> 11 - 15	<input type="checkbox"/> 16 - 20
	<input type="checkbox"/> 20+	
1.10	Notes on business – Observations on character of business and space	
Map		
	Draw business unit outline	
Part 2		
2.1	Is there lighting switched on unnecessarily (Y/N)	
2.2	Is lighting switched off at night? (Y/N)	
2.3	Are windows clean? (Y/N)	
2.4	Could daylight be used more effectively? (Y/N)	
2.5	Are PC's or monitors switched on unnecessarily (Y/N)	
2.6	Are there other electrical equipment left switched on (Y/N)	
2.7	Is kitchen equipment running unnecessarily (Y/N)	
2.8	Are external doors / windows left open (Y/N)	
2.9	What temperature is the thermostat set at?	

2.9a	Is thermostat settings satisfactory 20° C for Heating (winter), 24°C for air conditioning (summer). (Y/N)	
2.10	Are radiators / heaters free from obstruction	
2.11	Is heating turned off at night? (Y/N)	

**Part 3 – Short interview – contextual questions**  
 Explain the study, the survey and what data is for (see consent form)  
 Show and fill consent form at beginning or end

Form

3.1 What is the tenure of your premises?  
 Freehold  
 Leasehold – specify length  
 Tenant  
 Don't know  
 Refused

3.2 What year did your business open at this location?   
 Less than a year     1 – 3 years     4 – 8 years     9 – 15 years     15+ years

3.3 How long do you expect the business to stay at this location?  
 Less than a year     1 – 3 years     3+ years     Indefinitely     Don't know

**Part 4 – Short interview continued – energy efficiency questions**

4.1 How long have you been filing your energy bills for?  
 1 – 3 months     4 – 6 months     7 – 12 months     13+ months     no filing

4.2 How is your energy use metered?  
 Individual meter  
 Shared meter  
 I don't know

4.3 How do you monitor your energy use?

4.4 How active are you in monitoring your energy use?  
 Inactive    Little or no monitoring  
 Moderately active    Generally aware of energy consumption and bills  
 Highly active    Proactive at tracking energy use and trends

4.5 On average, how much rent do you pay monthly?

4.6 On average how much do you spend on energy bills monthly?

4.7 Do you believe the cost of your energy use is hindering your business? (Y/N)

4.9 If yes, how severe is the impact of this cost on your business?

4.10 What kind of efforts have you made to reduce your energy bills?

4.11 Interested in finding out simple, free and cheap ways to reduce your energy bills? (Y/N)

4.12 Interested in a free energy audit from the Council that could lead to a 10% decrease in your bills?(Y/N)

4.12a If yes, would you be interested in participating in a pilot program? (Y/N)   
 If no, would a financial reward encourage you to participate? (Y/N)

4.12b If no, could you tell us the reasons for which this project does not interest you?

Photos	Take photos showing interviewee, business, activities, etc.
Consent Form	Ask interviewee to sign consent form to use data and/or photos for the project
<b>End</b>	

SME Survey Instructions



To whom it may concern

We are students from Worcester Polytechnic Institute conducting an interview to get input from small and medium businesses in order to see their interest in assistance in reducing energy use. Information linked to your identity will never be disclosed. Everything will be kept anonymous. Only statistical data and unidentified quotes will be disclosed.

Contact

For questions please contact:

Andrew Haveles, Juan Ordonez, and Iveri Prangishvili

Tel: 079 1752 9743 Email: lon14dbrent@wpi.edu

Yours sincerely,

Andrew Haveles, Juan Ordonez, and Iveri Prangishvili

Student Researchers

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Consent

I give consent for my survey interview responses to be used for statistical data as part of the student's research.

Name \_\_\_\_\_

Date and Signature \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ X \_\_\_\_\_

*To be filled in by researcher:*

*Business Name, Site and Business ID* \_\_\_\_\_

### Appendix 3. SME Survey Results

<b>Part 1 - Observation</b>				
	Business			
1.1 Type of business	Real Estate	4	Theatre	1
	Market	2		
	Dry Cleaner	2		
	Pub/Bar	3		
	Restaurant	3		
	Liquor store	1		
Total # of business	16			
	less than 5	5+ Years		
1.2 number of employees	14	2		
	# Yes	# No		
1.3 Unit shared	1	15		

<b>Abbreviation</b>	<b>Question</b>
A	Is there lighting switched on unnecessarily?
B	Is lighting switched off at night?
C	Are PC's or monitors switched on unnecessarily?
D	Are there other electrical equipment left switched on?
E	Are windows clean?
F	Could daylight be used more effectively?
G	Is thermostat settings satisfactory
H	Is heating turned off at night?
I	Are external doors/Windows left open?
J	Are radiators/Heaters free from obstruction?
K	Is kitchen Equipment running unnecessarily?

<b>Part 2 - behavioural Questions</b>					
	Yes	No	don't know	inapplicable	
A	3	11	0	5	
B	13	1	0	0	
C	2	7	0	5	
D	6	8	0	0	
E	11	3	0	0	
F	10	4	0	0	
G	3	3	3	5	
H	9	1	0	4	
I	5	9	0	0	
J	3	4	3	4	
K	0	9	0	5	
<b>Part 3 - Contextual questions</b>					
	Freehold	Leasehold	Tenant	Don't know	
3.1 What is the tenure of your premise?	0	7	3		
	less than a year	Less than 4 years	4-8 years	9-15 years	15+ years
3.2 how long is your business at this location		0	3	1	6
	less than a year	Less than 3 years	3+ years	Indefinitely	Don't know
3.3 How long do you expect the business to stay at this location?		0	1	6	3
<b>Part 4 - Energy efficiency Questions</b>	1-3 months	4-6 months	7-12 months	13+ months	no filing
4.1 How long have you been filing your energy bills for?	1	1		7	1
	Individual meter	Shared meter	Don't know		
4.2 How is your energy use metered?	9	1			
	Inactive	moderately active	Highly active		



4.3 How active are you in monitoring your energy use?	5	3	2		
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Abbreviation	Question
A	Do you believe the cost of your energy use is hindering your business?
B	Interested in finding out simple, free and cheap ways to reduce your energy bills?
C	Interested in a free energy audit from the Council that could lead to a 10% decrease in your bills?
D	Would you be interested in participating in a pilot program?

Above Questions	Yes	No
A	6	5
B	6	5
C	6	5
D	6	5

Business Number	#1	#2	#3	#4	#5	#6	#7	#8	#9
On avarege, How much rent you pay monthly?	N/A	N/A	1750	500	3000	N/A	N/A	N/A	N/A
On avarege, How much do you spend on energy bills monthly?	N/A	500	200	340	400	500	900	3000	3000
Average cost of Energy bills	1105								
Average Cost of Rent	1750								



## Appendix 4: Calculations and Assumptions for Brent SME Carbon Production

### Brent SME Carbon and Economic Assumptions and Calculations

Knowns:

*Brent Total Energy Consumption (kWh)* ("Sub-national total final energy consumption statistics: factsheet ", 2012)

- Gas
- Electricity

*UK Total Energy Consumption (kWh)* ("Sub-national total final energy consumption statistics: factsheet ", 2012)

- Gas
- Electricity

*UK total SME Energy Consumption (kWh)* ("Advanced metering for SMEs: Carbon and cost savings," 2007)

*Cost for Gas (£/kWh)* ("Advanced metering for SMEs: Carbon and cost savings," 2007)

*Cost of Electricity (£/kWh)* ("Advanced metering for SMEs: Carbon and cost savings," 2007)

*Gas (kgCO<sub>2e</sub>/kWh)* ("Conversion Factors: Energy and Carbon Conversions," 2013)

*Electricity (kgCO<sub>2e</sub>/kWh)* ("Conversion Factors: Energy and Carbon Conversions," 2013)

$$\frac{[Brent\ total\ Energy\ consumption(Gas)]}{[UK\ total\ energy\ consumption(Gas)]} = [\% \text{ Brent Gas compared to UK}]$$

$$\frac{[Brent\ total\ Energy\ consumption(Electricity)]}{[UK\ total\ energy\ consumption(Electricity)]} = [\% \text{ Brent Electricity compared to UK}]$$

$$\begin{aligned} [\% \text{ Brent Gas compared to UK}] * [UK\ total\ SME\ consumption\ Gas\ (kWh)] &= [Brent\ SME\ Gas\ Consumption\ (kWh)] \\ [\% \text{ Brent Electricity compared to UK}] * [UK\ total\ SME\ consumption\ Electricity\ (kWh)] &= [Brent\ SME\ Electricity\ Consumption\ (kWh)] \end{aligned}$$

$$[Brent\ SME\ Gas\ Consumption\ (kWh)] * \left[ Cost\ of\ Gas\ \left( \frac{\pounds}{kWh} \right) \right] = [Amount\ Brent\ SMEs\ spend\ on\ Gas]$$

$$[Brent\ SME\ Electricity\ Consumption\ (kWh)] * \left[ Cost\ of\ Electricity\ \left( \frac{\pounds}{kWh} \right) \right] = [Amount\ Brent\ SMEs\ spend\ on\ Electricity]$$

$$\begin{aligned} [Brent\ SME\ Gas\ Consumption\ (kWh)] * \left[ Gas\ to\ Carbon\ Conversion\ \left( \frac{kgCO_{2e}}{kWh} \right) \right] \\ = [Brent\ SME\ Carbon\ production\ from\ Gas\ (kgCO_{2e})] \end{aligned}$$

$$\begin{aligned} & [\textit{Brent SME Electricity Consumption (kWh)}] * \left[ \textit{Electricity to Carbon Conversion} \left( \frac{\textit{kgCO2e}}{\textit{kWh}} \right) \right] \\ & = [\textit{Brent SME Carbon production from Electricity (kgCO2e)}] \end{aligned}$$

Category	Electricity (GWh)	Gas (GWh)
UK Energy Consumption(2010)	<b>297,962.9</b>	<b>540,645.0</b>
Brent Energy Consumption (2010)	<b>1,085.9</b>	<b>2,217.4</b>
UK wide SME energy consumption	<b>57,000</b>	<b>153,000</b>

	Electricity	Gas
Brent energy consumption over UK	0.003644509	0.004101333
UK SME energy consumption over UK	0.19129896	0.2829953

#### For all SMEs in Brent

Category	Electricity (GWh)	Gas (GWh)
Estimated Brent SME energy consumption	207.7370235	627.5039799
Assumed unit cost (p/KWh)	6.5	1.8
Gas	Kg CO2 per KWh 0.18404	

Electricity 0.44548

Category	Electricity (KWh)	Gas (KWh)	Total	10% electricity decrease	10% Gas decrease	Total decrease
Brent SME energy consumption (KWh)	207,737,023.53	627,503,979.89	835,241,003.42	20,773,702.35	62,750,397.99	83,524,100.34
Brent SME energy consumption cost (pound sterling)	£ 13,502,906.53	£ 11,295,071.64	£ 24,797,978.17	£ 1,350,290.65	£ 1,129,507.16	£ 2,479,797.82
Brent SME carbon Production (Kg of CO2)	92,542,689.24	115,485,832.46	208,028,521.70	9,254,268.92	11,548,583.25	20,802,852.17
Brent SME carbon Production (Tonnes of CO2)	92,542.69	115,485.83	208,028.52	9,254.27	11,548.58	20,802.85

	Electricity	Gas
Brent total carbon Production (Tonnes of CO2)	483759.4996	408083.9242

**For 1000 SMEs in Brent**

Total SME number in Brent 12,610.00

multiplier portion 7.93E-02

Category	Electricity	Gas	10% electricity decrease	10% Gas decrease	Total decrease
Brent SME energy consumption (KWh)	16,473,990.76	49,762,409.19	1,647,399.08	4,976,240.92	6,623,640.00
Brent SME energy consumption cost (pound sterling)	£ 1,070,809.40	£ 895,723.37	£ 107,080.94	£ 89,572.34	£ 196,653.28
Brent SME carbon Production (Kg of CO2)	7,338,833.41	9,158,273.79	733,883.34	915,827.38	1,649,710.72
Brent SME carbon Production (Tonnes of CO2)	7,338.83	9,158.27	733.88	915.83	1,649.71

Worcester Polytechnic Institute

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