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MANUFACTURERS RESPONSE TO CLIMATE CHANGE

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ABSTRACT

There is now clear scientific proof which indicates that emissions from economic activity, particularly the industrial sector, are the main cause of the change in global climatic conditions. The Stern Review describes climate change as *the greatest market failure the world has ever seen*. UK alone contributes more than 6.5 billion tonnes of the global carbon dioxide emissions every year. This, along with other scientific evidence, has led the UK government to publish Climate Change Bill that aims to reduce the UK overall emissions of greenhouse gases, mainly carbon dioxide, by 60% as early as 2060. The government understands the importance of the set targets and recognises that it will require collaboration from both business and individuals. Credible strategies together with determined implementation will be needed if the set targets are to be met within the timescale. This study analysed manufacturing and related companies and found that many companies have already acknowledged the climate change issue and, seemingly, have begun to tackle it by reducing energy demand through various initiatives. However, evidence of true low-carbon manufacturing companies is not seen and, therefore, this led the research to further investigate and seek for good practices. This study is intended to provide an analysis of compiled strategies learned from different manufacturing sectors in the UK. In addition, the project used a steps-to-change model to provide a wider view of how far the participating manufacturers have gone in responding to climate change. Furthermore, it provides recommendations of how the government can act to help accelerate and encourage UK companies to do much more to help tackle climate change.

ACKNOWLEDGEMENTS

I would like to express my appreciation to Amicus, the union, for the opportunity to undertake such an interesting project. I am thankful for all the assistance given from Janet Gold, Amicus representative, without whom this project would not have been organised let alone proceed according to plan. I am indebted to my supervisor Prof. Stephen Evans, whose time, support and advice has made a real difference to this thesis. Finally, I would like to thank my family and those that I love for their full support, which was the key to my thesis' completion.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS

°C – Degree Centigrade

BMS – Building Management System

CABE – Commission for Architecture and the Built Environment

CCL – Climate Change Levy

CH_4 – Methane

CO_2 – Carbon Dioxide

FMCG – Fast Moving Consumer Goods

GHG – Greenhouse Gas

gWh – Giga Walt Hour

KW – Kilo Walt

M&S – Marks and Spencer

N_2O – Nitrous oxide

ppm – Parts Per Million

PV – Photovoltaic

TUC – Trade Union Congress

TCPA – Town and Country Planning Association

VOC – Volatile Organic Compounds

1. INTRODUCTION

1.1 Research background

There is a growing consensus amongst the scientific community that the Earth's climate is changing rapidly. The basic principles of climate change are well understood, much of which is predominantly caused by human and economic activities, particularly industrial sector, such as burning of fossil fuels and deforestation (Collins, W., August 2007). Today's carbon dioxide (CO_2) concentration level is 380 parts per millions (ppm), and is growing more than 2 ppm each year. The intensive CO_2 level has influenced the earth's average surface temperature to increase by 0.7 degree Celsius (°C) from 1948 to year 2005, *see appendix B1*, and is predicted to rise by a further 2°C as early as year 2035 unless action is taken to reduce these emissions, as summarised in Stern Review 2007. Climate change is seen as a growing threat to the global eco-systems, economies and the way we live. Such an issue demands urgent solutions and response from both businesses and society across the world.

UK (United Kingdom) contributes around 2% of the global man-made CO_2 emissions ((Stern, N. H., 2007.), or equivalent to 6.5 billion tonnes of carbon dioxide per year. This, along with other scientific evidence, led the government to publish Climate Change Bill in March 2007, which set targets to reduce the UK overall emissions of greenhouse gases by around 30% as early as 2020. Credible strategies require to be developed and it will involve businesses as well as individuals if these targets are to be achieved.

Climate change and environmental issue is not new and people are increasingly aware of the impact it brings to their lives. The majority of industrial sectors, seemingly, have begun to develop plans to tackle this issue. However, as credible practices and solutions were unclear, it led this research to further investigations.

The project involved an investigation of possible implications of Climate Change Bill for the UK manufacturing companies. The recently announced Bill makes provision of a credible, long-term framework for UK to achieve its target of reducing carbon dioxide emissions. It was, therefore, important for this project to investigate a number of manufacturing companies and seek for evidence or actions taken to help tackle climate change. It entailed working with the project sponsoring organisation (Amicus, trade union), visiting companies and interviewing industrial representatives and/or members of the workforce.

1.2 Project aim

Consensus of the climatic problem amongst the social and government bodies is fast emerging. Such issue requires immediate attention and, therefore, led the UK government to adopt an ambitious, long-term policy to fight climate change. The project aim is to investigate possible implications for the United Kingdom manufacturing companies of the global debate on climate change.

1.3 Objectives

- To seek manufacturing companies' case examples and see what actions have been taken to date
- To visit UK industrial companies and to learn what actions the have taken in response to the climate change
- To compile and summarise the researched examples into a thesis report

1.4 Industrial context

1.4.1 Organisation background

Amicus is a trade union affiliated to the Trade Union Congress (TUC). The organisation is located in London, UK, with over one million members across the private and public sectors. Its members work in a range of industries including manufacturing, energy, transport, construction, paper, media and, non-profit sectors such as education, local government and National Health Service. The

union formed in 2001 by the merger of Manufacturing Science and Finance Union (MSF) and the Amalgamated Engineering and Electrical Union (AEEU). Amicus is now part of “Unite the Union” after merging with the Transport & General Workers Union, in May 2007. The new union has over two millions members (as “Unite the Union” is relatively new to most people, Amicus is used in this project when referring to the project sponsor).

1.4.2 The service

Amicus represents the workers, in both the public and private sectors, and is dedicated to improving the standard of living and the quality of the members’ lives through effective relationships with organisations and government. It is working to ensure that the members’ interests are supported and heard.

Amicus has 12 regions in total that cover England as well as Scotland and Wales. A region will have several hundred branches, each with its own members, running local campaigns for the benefit of members. Each region has a regional council that meets every 2 months and gives local branches the means to discuss matters of mutual importance.

1.4.3 The problem

Amicus, as a trade union, has representatives working in various industrial sectors all over the UK. It is important for the representatives to be aware of and to keep up to date with the global debate. In order to this, the organisation requires to involve in meetings, seeking for detailed research on different industries and to see who has done or doing what to address climate change. The organisation provided an opportunity for this research to explore various manufacturing industries and gain useful experience during the time of this project.

1.5 Thesis structure

The report structure consists of five chapters.

Chapter 1 reviews the background of the research and the sponsoring organisation. It details the present level of world's carbon emissions and UK's contribution towards global warming. The rest of the thesis report is structured as follows:

Chapter 2 overviews climate change, its effects on the society at large, the government frameworks and past examples of actions that manufacturing companies have taken to date in response to tackle climate change. Case examples have been acquired from various sources such as professional magazines, News articles and annual corporate reports.

Chapter 3 attempts to determine how the thesis is carried out in each stage during the project period, design of interview and questions. The chapter also includes the reason for such approach taken and the challenge which arise during this project.

Chapter 4 examines the strategies used in each participating manufacturing company. A discussion of each company strategy and analysis based on the data obtained is also included in this section.

Chapter 5 concludes and summaries the thesis from introduction to the discussion of the report. It addresses the issues involved in the comparison of the UK manufacturing companies and other sectors such as retailers and construction. The chapter expresses the opportunities and threat which climate change frameworks can bring to the UK businesses. Future work and recommendations are included in this section.

2. LITERATURE REVIEW

2.1 Introduction to climate change

Climate change is often referred to global warming, creating a rise in temperature, sea level and shifting weather pattern (Houghton, John T., 1931-2004.). It refers to the average temperature and weather experienced over a period of time. This includes the rainfall, wind and the earth temperature patterns. The earth's climate is not static and changes in response to a variety of natural causes. These changes, which we have seen over recent years, are the result of human activities rather than of natural changes in the atmosphere.

2.2 Greenhouse gases and its impacts

The earth's atmosphere is a thin layer made of, mostly, nitrogen (78%) and oxygen (21%) gases, which neither absorb nor emit thermal radiation. The other small amount of gases are Carbon dioxide, Methane (CH_4), Nitrous oxide (N_2O), ozone, water vapour and halocarbon, which make up the other 1% of the atmosphere (Houghton, John T., 1931, 2004.). These trace gases have the ability to trap heat from the sunlight within the earth's atmosphere and are called greenhouse gases.

Carbon dioxide accounts for some 60% of the greenhouse effect. CO_2 comes from different sources; naturally i.e. eruption of volcanoes or from human activities such as burning of fossil fuels. CO_2 concentration has reached 80 parts per million (ppm), more than it was a century ago, or round about 35 percent above pre-industrial level, (Collins et al., August 2007). The more CO_2 there is in the atmosphere, the warmer the planet gets, *see appendix C2* for accumulative of temperature for the past 1000 years. The global warming has many side effects, which have already been seen and experienced, such as the melting glaciers in the Antarctica, the changing in weather patterns, coastal flooding and even spreading of diseases.

The impact of the climate change has already been experienced in the UK and across the globe. The summer of 2006 was the longest continuous period of warm weather experienced in the UK since 1990, (BBC News, August 2003). A prolonged heat wave can have consequences for the population's health and comfort. A summary of expected climate change in the UK can be seen in the table 1.1 and figure 2.1 and 2.2.

Summary of expected climate change in the United Kingdom		**Confidence level**
Temperature	- Annual warming by the end of the century between 1°C and 5°C	High
	- Greater summer warming in Southeast	High
	- Increase in the number of very hot days	High
	- Decrease in the number of very cold days	High
Precipitation	- Wetter winters for the whole of the UK	High
	- Increase in winter precipitation intensity	High
	-Substantially drier summers	Medium
Sea level	- There will be significant regional differences in relative sea level rise	High
	-There will be more storm surges for some coastal locations	Medium

Table 1.1 - Climate change scenarios, source: adapted from TCPA

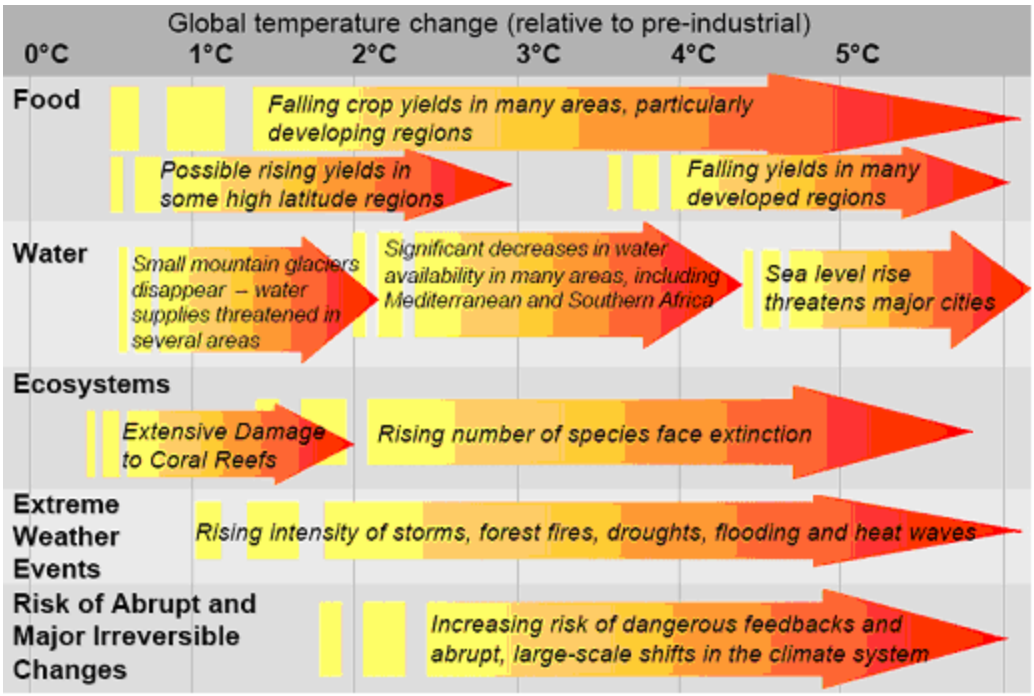

Figure 2.1 – Global temperature change relative to pre-industrial, source: Stern Review, 2006

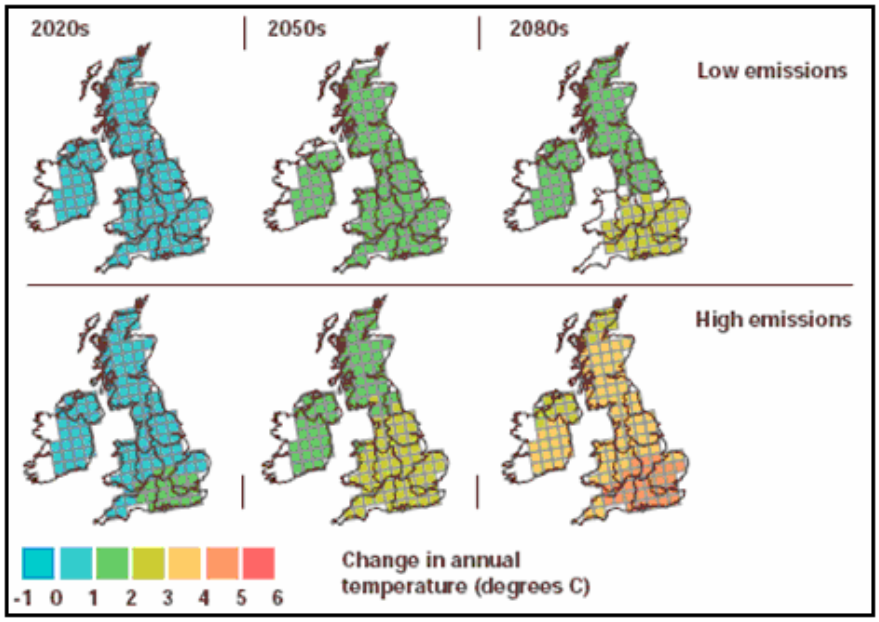

Figure 2.2 – Climate change scenarios across UK, source: adapted from TCPA

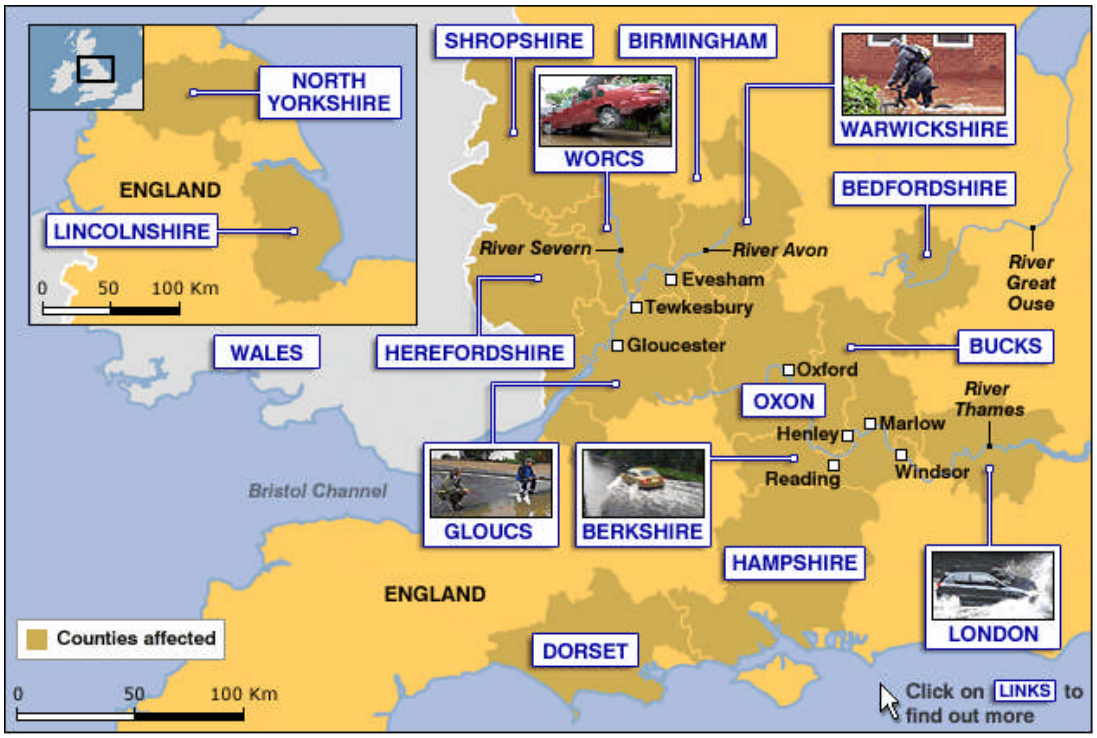

Figure 2.3 – Area affected by floods in summer 2007, source: BBC News

The figures, 2.1, 2.2 and table 1.1 show the projections of changes in climate conditions for the UK for both low and high scenarios. Under certain circumstances, climate change can have some positive effects. For example, UK could enjoy a Mediterranean climate which would bring substantial benefits for agriculture and horticulture, not to mention tourism. However, the rise in temperature that creates the warm climate can give rise to unpredictable weather patterns. The torrential rain across the UK was the cause that left thousands of homes with no electricity or water during the summer 2007. Those that were affected most were those people who lived near to rivers and on flood planes. Areas that were badly affected were Gloucestershire, London, Berkshire, Oxfordshire, Hereford and Worcestershire. The flooding in June and July was costly for businesses and individuals. The heavy rain experienced in the UK was an example of what could happen more often in the future.

According to Stern review, (Stern, N. H., 2007.) extreme weather events have the potential of jeopardising UK trade and financial markets due to disruptions of communications, property damage and the cost of subsequent insurance. Any damage results in the cost of reinsurance being increased for businesses in the future, which can reduce the profit margin as a result.

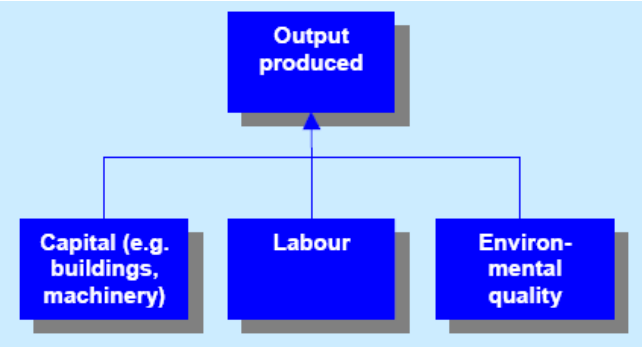

Figure 2.4 – Production function with environment quality, source: The Stern Review

The Stern Review shows the market impact of climate change on economic growth in a simple theoretical structure. Where Y is the output of the economy in year t and it is a function of capital, K, labour, L, and the environmental quality, E. If the net impact of the climate change is to be negative then environmental E will be reduced. Therefore, the potential output with a given supply of capital and labour will be reduced as the result since the output Y is dependant on the three factors of production.

2.2 GOVERNMENT STRATEGIC FRAMEWORK

It is stated in the previous chapter that the CO_2 concentration is growing by 2.5 ppm every year. It is believed that if emissions are frozen at the current rate the earth will still continue to warm up for the next decade or two. However, the worst impacts of climate change can be largely reduced if CO_2 level in the atmosphere is stabilised below 550 ppm. To limit the CO_2 concentration to this level it would require the global emissions to be reduced by at least 25% below the current level.

According to The Stern Review (Stern, N. H., 2007.), it is understood that if the average surface temperature rises by more than 2 degree Celsius above pre-industrial level, which is around 300 ppm of CO_2 concentration, the risks to people and the planet will be inevitable. Therefore, the objective is to limit the global warming to remain below this temperature line. The industrialised and developed countries, such as UK, urgently need to take the lead and look to improve the world's situation.

The UK government has realised the consequences of climate change for the country, citizens and businesses. It has been shown consensus that it will cost less for businesses to invest in low-carbon technologies and to operate in a more sustainable way than to deal with the consequences of doing nothing. The ambitious objectives, which the UK government has set out to achieve in the recently announced Bill, clearly state the commitment to create a low-carbon economy and UK is the first country to have established of such a goal.

Moreover, the UK government understands the needs for all industries to be more energy efficient. Carbon pricing policy has already been introduced alongside measures to help accelerate the development of technologies and to move businesses toward a low-carbon economy.

2.3 Industry in response to climate change

Through literature research to date, there has not been a study on the effects of global warming on UK manufacturing companies. Nevertheless, there are scientific studies and evidence which suggest changes in global temperatures and extreme climatic events will have damaging consequences on economic activity and society at large. The purpose of this section is to review current and past case examples and actions taken to date by various manufacturing sectors. By carrying out a literature research it will provide a better understanding of how companies are responding to climate change.

Many industrial sectors have already begun to set up targets to reduce emissions. Case examples gathered from company websites and online materials are presented below to show various strategies adopted by companies to tackle the global issue.

2.3.1 Case example 1 – Involving new technology

A number of large companies are investing in new technologies. Many have improved an existing product so that it consumes less energy or is more environmentally friendly. Some have modified and renewed their plant facilities to reduce the harmful emissions further. Either innovative methods take immense amount of time and often require considerable financial investment.

Case example 1.1 Daimler Chrysler

Daimler Chrysler introduced its new Mercedes S 400 Hybrid in early 2005. It is the first automobile which has a combined Hybrid technology (can be powered by either fuel or electric source) and powerful drivertrain that offers an attractive performance and appealing comfort, fuel consumption and emission levels. Also, in 2006, the company developed an innovative modular technology (BLUETEC) that is used to remove undesired Nitrous Oxide (NO2) in diesel automobile engines.

Case example 1.2 Ford Rouge centre

Ford centre has transformed its workplace in Michigan, US, into a sustainable working environment by reducing emissions from painting operations. The recent developed technology, Bioreactor system, has been integrated to capture and destroy volatile organic compounds (VOC) from the spraybooths, which are harmful to atmosphere. The system captures harmful fumes and converts them into clean electricity.

2.3.2 Case example 2 – Using and reusing of recycled materials

Every product has its useful life cycle. Yet many old items are thrown away long before the end of their useful life. Between us all, we generate approximately three billion tons of waste a year, excluding construction, agricultural or mining industries. The industries that use the most raw materials are beginning to reverse this trend.

Case example 2.1 Caterpillar

The world's leading manufacturer of construction and mining equipment, diesel and natural gas engines and industrial turbines. It has implemented an advanced form of recycling or remanufacturing, where it returns an end-of-life component to its original same-as-new condition. Such process helps the company to reduce waste and minimises the need for raw materials required to produce a new part.

Case example 2.2 Electrolux

The appliance manufacturers have taken recycling initiative with the introduction of refurbishment of white goods. Many damaged or used products are refurbished at the factory in Luton, UK, and resold. This method has enabled the company to optimise material use and to generate more profits at the same time.

2.3.3 Case example 3 – Collaborating with customer/supplier

Organisations that have a close, long term relationship with suppliers and/or customers often work with their network to help and encourage them to become more environmentally sound within their business.

Case example 3.1 Dell

Dell has a good example for offsetting carbon emissions associated with the use of its IT products. Dell has launched a programme called "Plant a Tree for Me" that allows its customers to donate as little as £1 when purchasing an electric product. Dell will then use collection of the donation and offset the carbon emissions by simply planting a trees for them.

Case example 2.4 Coors Brewers

The need to reduce costs at its' Burton site has led Coors Brewers to collaborate with its water supply, Severn Trent Water. It involved a water review to identify key areas for effluent improvement. The benefits gained from this monitoring influenced a reduction in effluent cost and water usage.

2.3.4 Case example 4 – Use of renewable energy

Using energy efficiently is the easiest thing that a business place can do to reduce its carbon footprint. It takes very little effort and costs hardly anything. By switching to alternative and renewable energy is also another way that many manufacturing companies are looking into in order to reduce CO_2. This is not just to save money but to enhance their reputation and to stay ahead of the government regulation.

Case example 4.1 Interface

The manufacturer of the world leading carpets reduces carbon emissions by using renewable energy sources in its facilities, ranging from solar, biomass and wind resources. It also has a project with the City of LaGrange, US, to provide the company with access to renewable fuel, landfills gas, for its local plant. This provides the company with the cost savings on energy consumption and the opportunity to use greener energy in its manufacturing processes.

Case example 4.2 Johnson & Johnson

The health care and pharmaceutical products provider understands the consequences that climate change brings. It installed a 200 KW solar photovoltaic system in its Neutrogena facility in California. As a result, Johnson & Johnson benefits from reduction in operation expenses CO_2 emissions. Johnson & Johnson is the US's second largest user of PV solar panels, according to World Resources Institute

2.3.4 Case example 5 – Reduce waste through tools and techniques

Waste is generated during the production process and can have a significant impact on a company's profit margin. Vast majority of companies are implementing tools and techniques such as process control techniques that use production data for analysis to identify areas for improvement.

Case example 5.1 C Shippam

A company manufacturing spreadable products and canned ready meals has implemented statistical techniques. By the use of existing data to construct a history of mean fill values and standard deviations has allowed the firm to closely monitor and fine tune its operations. As a result, a reduction of product overfills and waste was seen in a short period of time.

2.3.5 Case example 6 – Collaborating with independent organisation

Carbon Trust is a private company funded by government. Their role is to help businesses operate in a more sustainable way by providing advice and practical solutions to reduce their carbon emissions. By working closely with the Carbon Trust, industrial companies are gaining the benefits of improving energy efficiency and waste reduction every year as well as cost savings.

Case example 6.1 Walkers Cheese & Onion crisps

The UK's largest snack foods manufacturer has been working with Carbon Trust on energy efficiency and carbon management for over two years. Carbon Trust calculated the amount of carbon emissions (carbon footprint) produced by everything involved to make the product, from growing raw materials, production, packaging, distribution, to disposal of the product. This has provided the company with a better insight in terms of how much carbon it is emitting at each stage of the product life cycle, also an opportunity and room for improvement. For example, during the initiative the Carbon Trust has identified a key opportunity relating to the water content of the potatoes when stored in humidified atmosphere. The more water content within the raw material, more

carbon emissions it will emit during the potato frying process. By improving the method of storing potatoes the farmer and Walkers save significant amount of energy usage.

Case example 6.2 Fribrenyle

Fribrenyle is the UK manufacturer of plastic packaging that serves blue chip clients around the UK. The company works with Enviros Consultanting company to minimise its annual energy consumption. Enviros conducted a scope study, so called EnManage, at all of its sites to help identify opportunities for energy cost savings. The independent company, Enviros, also set an energy reduction target that aims to cut down the site energy by 12%. In order to achieve this set target, it formed a project steering group that involved staff from both organisations such as supply chain manager and Enviros project manager, to ensure the programme was successful. The glass manufacturing company achieved the energy reduction target of 12%. The company also reduced its overall environmental impact by saving over 4000 tonnes of CO_2 emissions associated with energy consumption during the programme implementation.

According to the literature research, it appears that the majority of manufacturers are paying attention to environmental issues and have already taken actions to help improve their businesses in terms of cutting down costs and promoting themselves towards environment. However, there are not many companies who are actually paying attention on transforming the way they do business internally, in order to tackle the climate change problem. Most companies' strategies are found to be concerned with fine-tuning its existing/new products, and focusing for example, on the use phase, on using alternative energy sources, and on getting themselves on 'Green' bandwagon to try attract customers. There is a lack of action in reducing demand for energy in their own activities. It seems easier for companies to reduce demand in suppliers, logistics, and customers than tackle their own energy demand.

2.4 TRANSFORMATION STEPS

Change is probably one of the most troubling and challenging tasks an organisation has to face in a dynamic business world. This is because change involves sizeable amount of effort, time and it costs money. Change does not just happen - it has to be driven by a reason or an inspiration either to keep up with the competitors or that a business is obliged to do so. The reason for change to happen can come from outside or within the organisation. This brings the thesis to discuss about what possible steps a company would go through if they are preparing to go extra mile to reducing their carbon emissions. It is indisputably important that a company understands the common stages in which it goes through during the transformation of the factory.

There are two different types of change termed as incremental change and fundamental change, D. E. Hussey, p 13 (Hussey, D. E., 1934-, (1995).). Incremental change is what classed as self-evidence. This particular type of change, the manager is facing different situations through his/her career. It can be change of work methods, processes, new product development, and other situations. The organisation will progress by evolution rather than revolution.

Fundamental change will make a noticeable impact inside and outside the organisation. This particular type of change focuses more on the project. It usually affects the future of organisation operations and confusion can often occur.

URGENCY	RESISTANCE: LOW	RESISTANCE: HIGH
HIGH	Visionary/Charismatic	Visionary/Coercive
	Visionary/Persuasive	Dictatorial

Table 2.1 –Adapted approach to fundamental change, source: D.E. Hussey

Change differs depending upon the situation and there is no single formula or strategy that will work in all situations. However, there are certain common steps and stages in which many companies go through during the transformation process. The following section will provide steps to change which a company can implement in order to transform its business.

2.4.1 Identifying

The first stage is really for the business to identify the main cause that triggers change to happen and accept that it does exist. Many companies will remain in denial and put off any necessary change to their operations.

It is important to make the people within the organisation aware of and recognise the topic that triggers the change to happen. The most common obstacle to successful change is human resistance, so it is equally important that everyone within the organisation is clear and understands where the company is heading. As how Kunter describes in ‘The Change Maters’, p 186 (Kanter, R. M., 1992), the first stage of any change project is to educate and persuade people. Support and ideas can be generated from the staff as well as the management to build on

the next stage of the process. By conducting a set of individual interviews and following by several group discussions will indirectly create a common, shared picture of the organisation's current situation for everyone. The key to well-managed change is to understand the resistance to the change and to design ways to reduce that resistance, as stated in Managing change for success, p16 (LaMarsh, J., 1943- (2004).).

2.4.2 Setting target

The process after realising the need to change exists is to have a set target. The firm needs to have firm objectives and develop a picture of its desired future. It must decide what organisational change is required and how best to achieve it. Gauging and collecting data is useful for an organisation (LaMarsh, J., 1943- (2004).). Using the best available data can provide a better insight of what is required to achieve the set target. It will also give confidence and better predictions on achieving the result.

2.4.3 Strategies

A change requires attention to detail and planning is vital for it to have any success. The purpose of having a plan is to design a path from the organisation's current state to its envisaged future. Without a good plan change can lead to bad consequences and frustrations. A larger project requires greater volume of project plans than a smaller one. Usually, the former often has impact upon thousand or millions of people and other elements that it entails. A common strategy can involve from selecting a number of people to do the job, looking at already-exist strategies which may have been done by the competitors, to developing a new one. However, any business's prime purpose is to make money, Bob Doppelt, p18 (Doppelt, B., 2003.) . Such beliefs, managers and workers focus on the organisational well being, in terms of profit, and not the true drivers. This often generates short-term economic benefits but usually leads to failure in a long run.

2.4.4 Action and sustaining

The strategies and tactics will be put to the test here and, at the same time, monitoring the change process and adjusting the action plan will be required. Keeping a continuous process and improvement is, perhaps, some daunting but fundamental task for any managers and workers to do. To sustain the achieved results, quality or activities is to go back to the beginning, set target, planning and setting tactics to achieve that target, implementing the plan and the whole activity then should repeat.

It is believed that organisational transformation requires mainstay of steering mechanisms that Doppelt (Doppelt, B., 2003.) describes as governance system of an organisation, which must be altered during the transformation. Governance system is the way an organisation distributes power and authority through its information, decision-making and resource allocation mechanisms. It plays an important role of determining the way its members view the world, interact with people and external environment and perform their tasks. Those organisations that successfully make progress toward sustainability are those that comprehend the importance of its members, internal staff as well as external stakeholders.

According to Hussey's approach to fundamental change, UK, and the rest of the world, is clearly in the '*crisis zone*' at the current stage, with relatively low resistance, where the earth's climate is concerned. With much scientific proof of climate change and significant events seen and felt by many, there is no reason why manufacturers should resist tackling it. Unfortunately, there is still little evidence of significant positive change in manufacturing practice.

An analysis of the reported findings is carried out using the model of '*steps to change*' presented in this section. By comparing the stories given by the visited manufacturers using a change management model, it is hoped to provide a bigger picture of where UK industries are in terms of responding to the government's climate change programme.

CHAPTER SUMMARY

The literature study has found that the majority of manufacturers are paying attentions to environmental change. However, many are focusing on the “use-phase” in order to help minimise the CO_2 emissions. This includes fine-tuning the existing and developing a better product that will meet emission requirements criteria without ignoring customer satisfaction. Making change to the existing product shows that the company is going through an incremental change and is not making much of an impact on environmental improvement.

Moreover, many manufacturers have set targets to cut down waste and use more recycled materials to avoid purchasing new raw materials by designing products in a way that they are most suitable for recycling. Many companies appear to choose an easy way to reduce energy demand, for example, encouraging their suppliers, logistics and customers to reduce energy demand. There is a lack of evidence seen from manufacturing companies to show any actions in reducing energy demand in their own activities.

Despite the green-initiatives taken to date by various business sectors, evidence of true low-carbon manufacturing companies is not seen. The project will take further action to look for good low-carbon manufacturing strategies and case examples. In addition, an analysis and summary of strategies found will be compiled and included in the project for future public use.

3. METHODOLOGY

The thesis process was divided into stages. Firstly, a series of literature review on the climate change was studied. Also, a reasonable amount of time was spent searching for the past examples of actions taken by manufacturing companies in the first period of the project. Design of questions for interviews was done in the second stage, before arranging meetings with the manufacturing companies. In the final stage, the data obtained was used for strategies analysis and recognising the trend of where the UK manufacturing companies are heading in responding to climate change.

Since the topic of this particular thesis is new, it is important that the project method and plan is made clear. More detail of the research strategy can be seen in figure 3.1 and project plan in *Appendix A*.

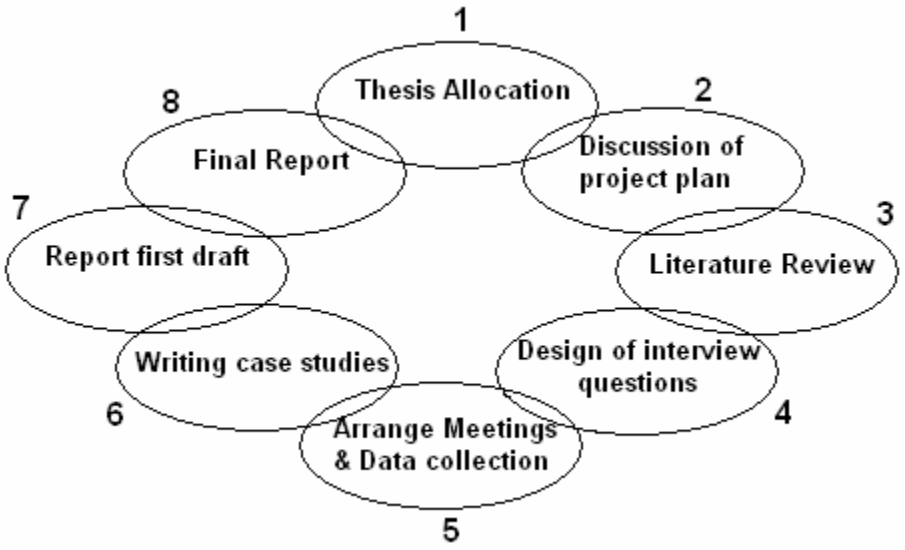

Figure 3.1 – Steps in conducting the research

3.1 LITERATURE REVIEW

An extensive literature review makes such an important contribution to this report since it allows for an overview of the topic to be broadly explored as well as provides a better insight about strategies used by different organisation sectors.

3.1.1 Climate change review

In order to get a good understanding of what climate change really is and the consequences it brings to mankind and the economy, it was important for this project to explore a various literature research on this topic. Not only could the present detail on climate change be obtained from the literature, but there will be an opportunity for the project to review the past online publications and discussions. The easiest and most effective resource for searching for the relevant information was websites and electronic publications. Scholar published papers are proven to be reliable source of information, which found to be very useful and adding value to the project. Moreover, electronic copy can be saved directly onto the computer for further use and it is readily available.

3.1.2 Company case examples review

The nature of this particular research required sources of true recorded evidence and good practices carried out by manufacturing companies in order to address the global issue. Therefore, the review of the company case examples has to rely on company publications through a number of websites.

The information available via companies' corporate reports was found useful to this thesis literature review. The annual reports show details of environmental corporate strategies which companies have adopted to use in their operations. Each company's background could also be found within the annual reports which provide general information on the industrial sector.

The strategic measures which manufacturing companies have taken to address climate change were grouped in categories; investing in technologies, working with customers, making use of recycled of materials, employing renewable energies, implementing lean techniques and working with independent organisations. The purpose of categorising tactics into groups was to help analyse the trend further on in the next chapter, discussion of findings, and to help the reader to see a bigger picture.

3.2. Company meetings establishment

First of all, a number of UK manufacturing sectors were selected and passed on to the sponsoring organisation's representative. By listing the manufacturing sectors, e.g. Aerospace, Food& Drink, Chemical, it allows a list of company names under each sector to be generated. The selected manufacturers were mainly those that are well respected and likely to have interesting stories. Choosing companies within reach and only required 1 day travel means it is less time consuming and more cost effective. The list of companies was then narrowed down and passed onto the Amicus representative. The sponsoring union's representative then acted on behalf of the research to acquire as many contacts as possible. Once the contacts were established, then a series of electronic mails, see *appendix B*, were sent to those representatives for mutually agreeable meeting dates.

A designed flyer, *see appendix C*, which described the nature of the thesis and what it required from the contacted companies, was also attached with the very first electronic mail sent to each company. The purpose of the flyer was to give each company's representative an overall picture of what the research expected from them so that necessary, relevant work could be prepared and organised for the interview. This particular method was found to be very effective and that it provided an opportunity for the representatives to participate better during the meeting, since the purpose of interview was made clear to them.

3.3 Design of interview questions

Gathering various case studies, from organisations or official websites, provided some ideas of how stories should be complied and structured for the project. Scanning through different case studies also provided an overall picture of what needed to be included within the case study context and helped speed up the questions design process. However, the questions were designed to be as open as much as possible to give the interviewee the opportunity of giving answers freely without being manipulated so much by designed questions, *see appendix D*. In addition to this, open questions, in general, leave an opportunity for more questions as the interview process goes on which can lead to an interesting conversation, hence good answers obtained.

3.4 Establish of contacts with industry

This is relatively important as the thesis discussion and findings, since everything within the thesis findings is dependant upon the success of the meetings with selected companies.

Where confidentiality is concerned, getting a meeting with a manufacturing company can be somewhat difficult and challenging for any research student. Using most effective method in approaching company representatives is the key to successfully establish a meeting date and obtaining valuable information, which is very much required to complete the set objectives.

It has been fortunate for this thesis to have a sponsor that has representatives working in manufacturing companies across the country. Assistance given from Amicus, on getting in touch with selected companies, helped make the thesis process go smoothly and according to plan.

3.5 Data collecting

Real world research, as Robson, (Robson, C., 2002.) describes as "*an invitation to come out of the laboratory closet*", was the option forward for this particular

type of work. This project requires more than just sitting in the library and reading books, in order to accomplish the project aim. This is not a research based thesis but, instead, it requires real data, most of which in this thesis achieved by talking to people in industry. Qualitative data collecting, or in the form of words, method was used during the interviews. By visiting people at their offices not only provides a better insight of their culture and how people operate on a daily basis, but also an opportunity to obtain information in more details during the visits.

Collecting all of the relevant information, given by the companies' representatives, was the key element to contributing towards the success of this project. A digital tape recorder was used as part of conducting the interview process. This method allowed the conversation to flow smoothly as oppose to writing down everything that was being said during the meeting. However, this method was made clear to each of the contacted company before the interview began. The main benefit of such method was that it allowed all of the given answers to be traced back whenever necessary, and precise information could be extracted from the recorded file for compiling the case studies.

3.6 Findings and discussion

The method of data collecting used in the project was completed by a series of company interviews. The time scale given for the project was tight and there were no key manufacturing companies that were particularly preferred or selected by the project. Food & Drink, chemical, and defence sectors were successfully contacted for interviews. The full case studies can be found in the appendices in this report, special thanks to those interviewees for their time and valuable contributions to this study, as well as the thesis sponsoring company for the continued support. The purpose of qualitative data collecting, i.e. interviews, was to collect perceptions about consequences, or possibly opportunities, faced in the changing climatic conditions by those manufacturers.

For the report discussion, the analysis of strategies did not only focus on the interviewed sectors, but also those from public articles and refereed documents were used to acknowledge a wider range of manufacturing sectors in responding to climate change. An analysis of companies' progression in response to climate change and the transformation steps model, *see table 2.2*, was included as part of the discussion. Under this analysis, it will provide a better understanding of where the UK manufacturing companies are in terms of addressing climate change.

CHAPTER SUMMARY

The chapter describes the methodology and approach taken to complete the set objectives of this project. Online materials made it possible for the project to achieve set objectives since the nature of this particular project requires more than just literature review from books and journals. The project relies very much on case examples and real evidence from different manufacturing companies. The method of obtaining materials from scholar online sources was found to be effective and efficient. The project sponsoring organisation acted on behalf of the research to help establish meetings with selected companies. Electronic mail was the tool used for communication during companies meeting establishment. Digital tape recorder was a vital piece of device used to record the conversations during the meetings. This allowed the obtained information to be extracted from the device whenever necessary. The method also allowed accurate data to be added to the case studies.

Strategies analysis was carried out in line with transformation steps model. This method was believed to lead the report to a better understanding of where the UK manufacturers are standing in terms of addressing climate change.

4. FINDINGS AND DISCUSSION

Findings of all the data collected from all contacted companies are put together in this chapter. The chapter summarises strategies used by each company to minimise its carbon footprints embedded in their service/products and in response to tackling the changed climatic conditions.

4.1 Unilever

4.1.1 Unilever, Food & Drink

The company is governed by the Climate Change Levy (CCL), which means it must obey the energy usage limits sets by external auditor - Enviros. The site gains up to 80% discount on the CCL in return for meeting energy or carbon saving targets. It has adopted BMS, Building Management System, to effectively optimises the site equipment by monitoring its operations and ensuring the output matches the set target. In addition to this, the site has involved its employees in a programme to further reduce the energy consumption by encouraging staff to be more environmental conscious about what they do in the workplace. A new lighting system that can switch on/off automatically has been installed.

4.1.2 Unilever, Chemicals

The site uses a large amount of steam during its operations. The electricity used to generate the steam costs the site millions of pounds each year. The plant has looked into acquiring renewable energy from wind turbine. Its plan for deploying such green energy source is not only to cut its heavy electricity bills, but also to symbolise a green approach towards its corporation operations.

An external consulting body, Enviros, has been commissioned to identify opportunities to reduce energy consumption within the site’s operations such as monitoring energy losses through a comprehensive energy monitoring and targeting system. A more efficient cooling water pump controller has been proposed to save electricity, £40,000 per annum saving expected.

Energy reduction strategy has been set up at this very site. “Switch off if not needed” programme involves key people to lead by example in turning off equipment in unmanned areas. The programme also considers motion detection or timed-out lighting system. Energy saving procedures during meal breaks and unplanned stops, in excess of 10 minutes, are carried out in the plant to further reduce the site energy consumption.

It seems that Unilever is currently doing what it can, from as little as encouraging people to turn off the lights when not in used to investing in green technology, to ease its current energy usage. The drive for Unilever to go though the trouble of cutting down energy consumption is, predominantly, to improve the business competitiveness through cutting costs. Seemingly, the manufacturer is seen to gain benefits of saving the emissions from the energy reduction initiatives. However, it appears that the company’s main concern is to comply with the legal policy and to commit to its sole goal, to be profitable. At the outset, the research expected the manufacturer to be dedicated to climate change and that it takes the issue to the level by innovatively transform its factory operations internally. However, as green as it may sound, Unilever has invested in renewable energy to use within its plant rather than minimise its emissions internally.

4.2 BAE Systems, Defence

BAE Systems is one of the energy intensive sectors that employs a large number of staff members. In addressing the climate change, it has annual target for reducing carbon emissions by using energy as efficiently as possible. It believes the most effective way of achieving this target is to involve all employees by raising environmental awareness through campaigns and trainings. The company runs energy shutdown initiative during the holiday period to minimise the energy consumption while the site is idle.

The manufacturer, Submarine Solutions plant, has cut down energy costs on its shipyard foyer by using green energy from a renewable source wind turbine. It has a network controller infrastructure installed to monitor the energy and water consumption across the site.

For certain, BAE Systems is truly the largest European defence company with 100 new inventions every year. Despite these key facts, it lacks initiative of addressing climate change. It is understandable that new technologies can be expensive to introduce in order to help reduce the company's existing greenhouse gas emissions. However, BAE Systems is a well respected, established company that has thousands of highly skilled people and, yet, it is unclear that the company does enough to save its emissions.

According to the literature review on transition process, see section 2.4, it seems that the company is in an early stage of responding to climate change. It has identified the drive for company's shift toward energy and emission savings, and it has involved its people in the process. Its internal key people and the environmental department have embarked on environment training programme keeping the employees in the picture of possible impacts each individual can have towards the global warming, during business hours and at home. Also, this tactic engages people and makes them aware of the implications which company has toward UK overall CO_2 emissions. Referring to Kanter (Kanter, R. M., 1992.), such strategy places a good foundation for future plan development. Moreover, engaging people is the way forward, as far as Kanter is concerned, in order to take a step further in transforming the company toward sustainability. Despite all the positive things that are going on within the company, it does not appear to be doing enough toward minimising its carbon footprint. Its people need to be more enthusiastic about running their business differently than just doing their bits efficiently enough to get by.

4.3 Marks & Spencer

Marks & Spencer (M&S) has a five year plan to change the way it does its business and help reduce the impact on the diverging climate. *'Plan A is our five-year, 100-point plan to tackle some of the biggest challenges facing our business and our world. It will see us working with our customers and our suppliers to combat climate change, reduce waste, safeguard natural resources, trade ethically and build a healthier nation. We're doing this because it's what you want us to do. It's also the right thing to do. We're calling it Plan A because we believe it's now the only way to do business – There is no Plan B'*, (M&S News).

The retailer company is not looking to offset their carbon emissions but, instead, it looks to minimise emissions by selecting renewable and sustainable sources, as well as integrate greener practices within its products. The main areas, which the company wants to achieve by 2012, are carbon emissions, waste, raw materials, fair-partner and health.

In accordance to the proposed plan, there has been some action already evident via its main website. The air freighted food label, *see Appendix E*, has already been seen on its food products. The purpose of the label is for the company to tackle food miles. Where renewable source of power is concerned, M&S has secured some 100 gWh of electricity from NPower, UK energy supplier, to use with its Simply Food stores in England and Wales.

4.4 Tesco

Tesco is amongst many other retailers who acknowledge that the climate change is happening. It has a comprehensive plan in place to work with its suppliers to help deliver affordable greener products to its customer. It looks to measure and make drastic reduction of its greenhouse gas emissions and to help develop new low-carbon technology through out its supply chain.

Tesco established some investment funds for sustainable technology to help put its business in a better position of being energy efficient business. It has targeted reducing the packaging waste and identifying ways to tackle the problem of food waste. The company has shown its commitment to reduce the scarce resource such as energy. It has pledged to cut half of its energy usage by next decade. Some of the actions that have been taken in order to achieve this are efficient lighting and motion detector system, efficient ovens and redesigned refrigerant, which contributed over half of Tesco UK carbon emissions as of 2007, *see Appendix E5*.

The new retail store built in Wick, Scotland, is said to be the greenest supermarket in the UK, and possible the world. The store building has some pioneering features that include wind turbine, photovoltaic roof cells the generates power for the tills, roof rainwater collection system for use in toilets and car washes, and the eco-designed building which has wood rather than steel with a lower roof to reduce the energy used to heat the store.

Tesco is, also, committed to the reduction of transport emission. In April 2007, it launched the UK's first fleet of battery powered home delivery vehicles. It has also changed from transporting some goods by road and switched to rail as Tesco is hoping to cut down its carbon footprint still further with this initiative.

4.5 Sainsbury's

The company has an energy performance plan in place and has already reduced its carbon emissions through using green energy such as wind turbine that was installed at its Distribution Centre in Kilbride, (J Sainsbury plc corporate responsibility, 2007). It is also working with the Carbon Trust, to look at reducing CO_2 emissions by improving current practice in energy and waste management. Further more, the retailer followed with a sustainable building, its new depot in Northampton site in UK, which has been designed to save energy and water usage. It looks to further reduce 25% of its carbon emissions by 2012. This

includes improvement of transport efficiency. However, there is no evidence of further strategies set to meet such target.

4.6 Wal-Mart

Wal-Mart understands the critical need for action to address the climate change. The world's largest retailer unveiled "sustainability 360" on February 2007 to widen and emphasis on sustainability. It has established three goals in its sustainability agenda; one is to have 100% supplied renewable energy, to create zero amount of waste, and to only sell products that sustain resources and environment.

It has begun some work to improve its logistical efficiency in the US by working with the truck manufacturers, and also its suppliers to reduce packaging waste. The company, like many other retailers, has also looked into building energy efficient and environmental friendly facilities and hoping to achieve this less than half a decade, (Wal-Mart Sustainability 360).

Summary (retailer)

The UK major retailers have certainly acknowledged the potential adverse results which global warming can bring to the economy. The majority have a set target to achieve with carbon footprint reduction in the near future, but not all have clear strategies and action plans to support this target. However, by comparison, Fast Moving Consumer Goods sector (FMCG) has gone a step further than the manufacturing industry. A number of actions, corresponding to set targets, have already been seen in the FMCG sector.

UK retailers are very much dependent upon their supply chains especially with a significant proportion of their goods coming from overseas. In addition to managing the chain to minimise risks, the retailers will also have to seek significant reductions in CO_2 emissions in this very diverse area.

Unquestionably, this particular sector appears to be enthusiastic and moving things faster in terms of tackling the global warming issue. It is clear to the sector that the cost of doing nothing will be greater than starting to change the way it does its business, internally and externally. Extreme weather conditions can and will lead to major problem for this particular sector. Disruptions along its network and supply chain, transportations and communications for instance, can lead to chaos and supply shortages.

4.7 Construction sector

The '*Building a Greener future*' policy has the intention of ensuring that all newly built homes are carbon neutral. This provides construction companies with incentives and a variety of opportunities. The built environment accounts for half of all UK's CO2 emissions. Therefore, the importance of building design and planning should not be neglected.

CABE (Commission for Architecture and the Built Environment) provides free advice to public and private sector companies that wish to pay careful attention to good building design. It believes that a good design is about fit-for-purpose, using resources efficiently, soundly constructed uses resources efficiently and is adaptable to future needs. It uses design review service and national audit (The Building for Life criteria) to influence significant building developers to focus on using design quality to generate development value.

Housing Green Paper, launched in July 2007, states that a quarter (150 million tonnes of CO_2 each year) of UK's emissions come from households. It realised the challenge of climate change and established targets to focus on new homes including zero carbon built homes from 2016. It states also that there will be a need for a revolution in the way buildings are designed and built in order to deliver the carbon neutral standard. The Building Regulations that affect all buildings have also been amended to reflect the changing needs.

Carillion, UK construction company, is a good example of a company that is in the forefront of embarking upon green building designs. It has already incorporated principles of sustainable and energy efficiency designs into many of its construction projects. The sustainable designs consider all relevant elements which go into the construction, planning, location, structure, systems and demolition of the project. In addition, it has begun to tackle its carbon emissions with a process of collecting data that enables the company to understand its carbon footprint; the main areas include energy usage, waste disposal and the employees' travelling. This method would also give a baseline to set reduction targets for the future. It is planning to identify the main products and commodities that it uses across the business and understand how a full life cycle of a product impacts on the environment as well as to develop a strategy to manage this.

Summary (construction)

The evidence shows that there are ambitions to improve the environmental standards within the construction sector, both public and private. There is a consensus amongst the sector itself that there is a challenge and in response to tackling this it must go further to ensure that newly developed buildings are sustainable and energy efficiently sound.

The challenge placed upon the construction sector is that it needs to provide sustainable and greener buildings. New UK housing will need to be 100% built in different way that satisfies the building regulations of neutral-carbon homes in less than a decade from now. The construction sector is very much governed by the Building Regulations but it has gone an extra mile to address the climate change. Carillion is a good example for the construction sector to follow and demonstrates that it is committed to reduce its impact on the environment, by looking at all angles of the whole life cycle of its projects – from cradle to cradle.

CHAPTER SUMMARY

It is noticeable that manufacturing companies and other industrial sectors are alert to the climate change issue. As demonstrated in table 4.1, the acquisition of green energy sources, such as power generated from a wind turbine, seems to be the most common strategy which is being used across all sectors: manufacturing, retailers and construction. Moreover, all sectors are seen to have switched from low-energy to more energy efficient equipment and systems. Working with individuals, suppliers and their own employees, is also a usual, first choice tactic to be implemented by many companies for addressing the environmental issue. Building of better and more environmentally friendly facilities appear to be more in favour with both retailers and construction sector. The reason is maybe because the nature of the business differs from that of manufacturing companies. Construction and retailer sectors are more dynamic in terms of facility expansion and development, therefore it gives these individual companies the opportunity to integrate green technology such as solar panels and sustainable development principles within its facilities. The main drive for climate change initiatives is seen to be from the rising demand of environmental standards and the regulations which are set to force companies of all sectors to act and limit their impact on global warming. It is true that there is some activity in industry and that there are some ambitious actions being taken toward tackling climate change by manufacturers and other companies. However, the table below (Table 4.1) shows that there is not much action or fundamental shift in operations seen from either manufacturers or other companies.

	Manufacturing companies		Retailers				Construction
	Unilever	BAE Systems	M&S	Tesco	Sainsbury's	Wal-Mart	CABE/Carillion
Green energy Investment	wind turbine	wind turbine	purchased green electricity from supplier	established investment funds for sustainable technology	wind turbine	renewable technology investment funds	incorporate sustainable design principles into new buildings
Control & Monitor of equipment	working with Enviros	yes	yes	store managers required to monitor energy use regularly	working with Carbon Trust, Envirowise	yes	no
Switch to more Efficient Equipment	efficient lighting, variable speed pump	switched to more energy efficient lightings	energy efficient lightings	refrigerant, lightings	new lightings	new lightings	incorporate sustainable design principles into new buildings
Energy efficient buildings/ facilities	no	no	ongoing	yes	yes	yes	yes
Involve Staff/suppliers	environment training/briefing	environment training/briefing	working with suppliers to ensure affordable green products	energy awareness campaign, involve suppliers	Save-It campeign, renewed energy supplier agreements	sustainable value networks which involves the supply chain	minimising raw materials transport
Climate Change Alert	yes	yes	yes	yes	yes	yes	yes
Climate Change Levy	yes	no	no	no	no	no	no
Future plan for CO_2 reduction	yearly set target	yearly set target	5 year plan (Plan A) which focuses on reduction of CO_2	looking to use more renewable energy from wind and solar power	25% reduction of carbon emissions by 2012	plan to retrofit with innovative power systems, build new energy efficient stores	consider more sustainable design principles and forward thinking
Action plan to support future plan	not seen	not seen	working on Bournemouth store to improve energy efficiency	not seen	not seen	not seen	to incorporate sustainable design principles into new buildings
Operational change	not seen	not seen	not seen to date	not seen to date	not seen to date	not seen to date	incorporating sustainable design principles into new buildings

different
common
non manufacturing

Table 4.1 – Company climate change strategies analysis

5. CONCLUSION

The set objectives were met well within the timeframe of the project plan. Published past examples of various manufacturing companies were gathered and used in the project literature research. Four different UK manufacturing sites and one organisation (Chemical Industries Association) were interviewed for necessary data in order to help satisfy the project aim. The strategies obtained from the visited companies were analysed and compared with other industry sectors in order to observe the patterns. Although, the research only managed to collect information from five sources, it is considered to be valuable and sufficient for the research to comment on how much UK manufacturers are doing to address climate change. By visiting companies and investigating their strategies, in response to climate change, the project provides us with a better insight into possible implications for the UK manufacturing companies of climate change. The project aim was achieved successfully in a timely manner.

The literature research established that the earth's climate is indeed complex and depends on the interaction of many factors from anything as big as the sun to microscopic organisms. Scientific evidence has demonstrated that the world is warming, and this is due to increasing level of greenhouse gases caused by human activity. It is expected that the earth temperature will continue to rise with ever more serious consequences than the world has already experienced if no strong action is taken to reduce CO_2 emissions (Stern, N. H., 2007). It is acknowledged that there is a consensus between scientists and the governments that climate change is real. The literature review also suggests that the majority of respected researchers believe potential effects from climate change are likely to damage the world economies. The UK government is determined and already has a long-term plan in place that sets frameworks to reduce greenhouse gases, mainly $CO_{2,}$ by 60% by 2050. Such frameworks create both opportunities and a significant challenge for many industrial sectors.

The literature study also suggests that manufacturing and other companies have already acknowledged that it will cost less to act upon the global warming than to deal with the consequences. Different companies have different approaches and their own solutions in tackling climate change. The strategies evidenced through literature study were categorised in six different groups, namely adding technology to the existing/new product, involving suppliers/customers, using renewable energy, implementing lean techniques, recycling/reuse materials, and involving independent organisations. One of these approaches maybe more suitable to one company than another depending upon the nature of the business. For example, an energy intensive industry will find it more appropriate to bring in an independent consultancy to help with identifying areas for energy improvement than to embark upon material recycling regime.

The studied manufacturing companies have shown restrained, holding-back enthusiasm towards the climate change issue. The action taken to help minimise energy consumption is mainly through no- or low-cost initiatives. The methods used include involving staff in environmental awareness training where individuals are encouraged to help reduce unnecessary energy usage while at work. Turning off equipment and lighting when not in use is one of the no-cost methods spoken to be effective, requires little effort, and everyone can be involved. Renewable energy technology methods such as installing a wind turbine are found to be the most common strategy implemented in addressing climate change. Such renewable technology, is reported to be efficient and acceptable for energy saving. The energy generated from wind turbine can be distributed to power operations or sold back to energy supplier for profit. Further more, the green technology can be seen as a highly visible symbol indicating a company is focusing on the environment and it is often used to attract customers.

These participating manufacturers are dedicated to reducing their operating costs. The strategy taken to help cut down costs is through opportunity studies that are carried out by external auditors or independent organisations. The

strategy often involves monitoring and controlling of plant equipment. This method allows the manufacturers to identify any gaps for improvements such as replacing old equipment for optimum output per unit of power used. Unilever, especially the chemical site, is seen as being more of an energy intensive manufacturer than BAE Systems. Unilever is, therefore, governed by the Climate Change Levy whereby the amount of carbon emissions allowance which the company can have per certain outputs per annum is restricted. Nonetheless, both manufacturing companies are heading in the same direction to tackle CO_2.

By comparison, the other researched sectors, retailers and construction, seem to have taken a different approach to addressing climate change. Both construction and retailers have been paying attention to improving buildings and newly built facilities. Building of better and more environmental friendly facilities appears to be more in favour for both retailer and construction sectors. The reason is maybe because the nature of the business differs from those of manufacturing companies. Construction and retailer sectors are more dynamic in terms of facility expansion and development, therefore giving these individual companies the opportunity to integrate green technology such as solar panels and sustainable development principles within its facilities. By contrast, manufacturers are more likely to stay with what they have as renovating existing manufacturing sites may be seen as challenging, creating additional work and expense without any profit

Media articles often emphasise on "*green manufacturers*", who are enthusiastic about operating their businesses differently to tackle climate change, (e.g. Engineering & Technology, July 2007, p10). This research has established this to be too optimistic. As the study suggests, UK manufacturers, on the whole, are doing something to address climate change but the strategy used is not spectacular and no more than reducing CO_2 emissions through energy reduction. All anticipating manufacturers and organisation appear to have set future plans that look to cut down the amount of emissions emitted annually. They have taken

actions to minimise the energy consumption. However, these actions do not appear to be innovative nor have made any fundamental shift in the existing operations, which is rather important for the business in the long term. The UK manufacturing products often have high costs associated within it; cost of labour, energy, research and development. In the view of the manufacturers, these costs may need to be pushed up to a higher level if any changes were done internally. Making fundamental changes to processes/operations not only add costs, it is also seen as a risk of losing competitiveness. Since a high cost operating manufacturer is in a more difficult position to offer cheap products or services to customers, therefore, it is seen as a barrier and disadvantage to competitive companies. In addition, making any fundamental change requires time, effort and involves people. When people are involved there will be fundamental shifts in attitude, which is a challenge in itself, and may be seen as a barrier to most companies who wish to transform their businesses. Climate change will bring risks to those manufacturers who are unprepared. However, it will provide business with new opportunities at the same time. Government policy can lead to enormous investment in alternative technologies and processes. These can be potential sources for growth for manufacturers and sectors. Climate change will create new opportunities for start-up, small and medium enterprises.

UK manufacturing has certainly acknowledged the importance of tackling climate change. It is seen to be in a stage where it has already identified and set targets for reducing its emissions. It now needs to transform and do business differently toward a more sustainable way. The approach it must take now is to consider a change from its inside out and it must consider the three pillars of sustainability – society, economy and environment. UK manufacturers must be at the forefront and commit to cut down CO_2 emissions. While deploying a wind turbine next to its factory will help the energy costs in the medium term, it will not make much difference to the emissions it is already emitting. Turning off equipment when not occupied does make good business sense. Nevertheless, the UK manufacturers will need much more than no- or low-cost techniques to be able to make a

fundamental change to the climatic conditions that are likely to happen in the future.

The potential consequences of climate change for UK manufacturing companies and other businesses are unimaginable. The direct impact, such as loss of supplies, on UK manufacturers can only be estimated. The damage that climate change already caused cannot be rectified, but UK manufacturers can still play an import role in helping to prevent further damage. Possible implications of climate change are likely to be disruption of business networks internally and externally. The UK manufacturing companies that depend upon foreign suppliers and sources will feel the greatest impact. Disruption along the supply chain or networks means shortage of products; hence business is not fully functional. Referring back to *Figure 2.1, Global temperature change relative to pre-industrial*, the most worrying scenario is when average temperature reaches 2°C, which is likely within 3 decades. When this does happen there will be a major shift in weather patterns and irreversible change in climate system. UK economic and business structures will then become increasingly exposed to the direct impacts of the change in climate on process performance, asset value as well as the indirect impacts on growth and return.

Climate change certainly calls for very positive action. Many UK manufacturers, including other studied companies, are found to have been taking the easy route. It is now time UK manufacturing companies stepped up and move on to the next level and take climate change more seriously. The government can be an important part when it comes to encouraging UK manufacturers to move to the next level of reducing carbon emissions. Amicus as an organisation can play an important role in assisting the government to come up with low-carbon solutions that will help stimulate and accelerate UK manufacturers to move from doing-the-easy-things stage to the next level. Things that can help stimulate manufacturers to act more quickly are carbon pricing through Tax and trading policy, and providing incentives such as funding and better practice education to

manufacturing advisors. A solution that can bring manufacturers together to share best practices through communication or open innovation can also be effective. Such solution can have a large impact on climate change by allowing companies to learn more from each other by communicating the science, the solutions, and spreading effective messaging to mitigate emissions and combat climate change, internally within an organisation and externally to other companies. Martin-Baker, manufacturer of ejection seats, has a policy for selecting component suppliers. The firm has quietly made sure that all its suppliers are within a 15 mile radius of its seat manufacturing plant. Not only does this have significant implications for manufacturing, but also reduces the GHG emissions during the transportation of spares. This type of tactic may, comparatively, help reduce small amount GHG emissions, but with other companies around the UK doing the same it can have a greater impact on climate change. It is accepted that such a huge reorganisation and disruption to the industry might not even be possible on a large scale. However, this could be a great opportunity for Amicus and other unions to get together with manufacturing companies to explore the possibilities. Also, by having more examples can be the key to stimulate manufacturing companies to do much more to address climate change since it will reduce cost and risk of taking the first step alone. Just as important, UK manufacturing industry needs support from the government. It is important for the government to be fair, consistent with bringing measures to reduce carbon emissions, and set clear direction for the long term plan. Without these most UK manufacturers may remain reluctant to act quickly and embrace any fundamental changes.

6. REFERENCES

Bernotat, W. H. (2007), "Take Responsibility for Climate Change", *Harvard business review,* vol. 85, no. 7, pp. 58-59.

Brahic, C., Chandler.L, D., Page, M., McKenna, P. and Pearce, F. (2007), "Climate myths", vol. 194, no. 2604, pp. 34-35,36,37,38,39,40,41,42.

Braungart, M., 1958- (2002.), *Cradle to cradle : remaking the way we make things,* 1st ed, North Point Press, New York.

Chapman, J., (2006 (accessed July 2007)), *Climate change: Global warming*, Daily Mail.

Collins, W., Colman, R., Haywood, J., Manning, M. R. and Mote, P. (August 2007), "The Physical Science behind CLIMATE CHANGE", vol. 297, no. 2, pp. 64-71.

Doppelt, B. (2003.), *Leading change toward sustainability : a change-management guide for business, government and civil society,* Greenleaf Publishing, Sheffield.

Hester, R. E. (. E.)., Harrison, R. M., 1948-, Royal Society of Chemistry (Great Britain) and Knovel, (. (c2002.), *Global environmental change [electronic resource],* Royal Society of Chemistry, Cambridge, U.K.

Hon, B., University of Liverpool. and International Conference on Design and Manufacture for Sustainable Development (1st : 2002 : Liverpool) (2002.), *Design and manufacture for sustainable development : 27-28th June 2002 at the University of Liverpool, UK,* Professional Engineering, Bury St Edmunds.

Houghton, John T., 1931- (2004.), *Global warming : the complete briefing,* 3rd ed, Cambridge University Press, Cambridge.

Hussey, D. E. (David Edward), 1934- [Main author] (1995.), *How to manage organisational change,* Kogan Page, London.

Gore, A., 1948-, Guggenheim, D., David, L., Bender, L., Burns, S. Z., Skoll, J., Chilcott, L., Richman, B., Cassidy, J., Swietlik, D., Brook, M., musician., Participant, P., Carbon, N. P., Paramount, C. (. and Paramount Pictures Corporation. (c2006.), *An inconvenient truth [videorecording] : a global warning.* Widescreen. ed, Paramount, Hollywood, Calif.

Kanter, R. M. (1992.), *The change masters : corporate entrepreneurs at work.* Rev. ed, Routledge, London.

LaMarsh, J., 1943- (2004.), *Managing change for success,* Duncan Baird, London.

Lovins, A. B., 1947-, Lovins, L. H., 1950- and Hawken, P. (2005.), *Natural capitalism : the next industrial revolution,* New ed, Earthscan, London.

Paton, R. and Paton, R. (1992.), *Change management : a guide to effective implementation,* P. Chapman Pub., London.

Reevely, D. and Citizen, O., (2007), *Baird out of step on the need for emission charges*, Times Colonist.

Robson, C. (2002.), *Real world research : a resource for social scientists and practitioner-researchers,* Blackwell, Oxford.

Shaw, R., Colley, M. and Connell, R. (2007), Climate Change adaptation by design: A guide for sustainable communities, , TCPA, London, UK.

Stern, N. H. (. H., Great, B. T. and Great, B. T. (2007.), *The economics of climate change : Stern review on the economics of climate change.* TSO on behalf of HM Treasury, London.

Engineering & Technology. (2007)., Monthly Magazine of the Institution of Engineering & Technology

Homes for the future: more affordable, more sustainable, (2007), , Crown.

International Energy Outlook, (2007), DOE/EIA-0484(2007), Energy Information Administration.

J Sainsbury plc Corporate responsibility report, (2007), , J Sainsbury plc.

BBC News, available at: http://news.bbc.co.uk/1/hi/uk/3132397.stm (accessed July 2007).

CABE, available at: http://www.cabe.org.uk (accessed July 2007).

Carbon Trust carbon case studies, available at: http://www.carbontrust.co.uk/solutions (accessed May 2007).

Carillion, available at: http://www.carillionplc.com/ (accessed July 2007).

Company case studies, available at: http://theclimategroup.org/index.php/reducing_emissions/case_studies/ (accessed June 2007).

DaimlerChrysler BLUETEC initiative, available at: http://www.greencarcongress.com/2006/01/daimlerchrysler.html (accessed July 2007).

Department for Environment Food and Rural Affairs, available at: http://www.defra.gov.uk (accessed June 2007).
Energy saving trust, available at: http://www.energysavingtrust.org.uk/ (accessed July 2007).

Enviros Case studies, available at: http://www.enviros.com/ (accessed June 2007).

Envirowise, available at: http://www.envirowise.gov.uk (accessed July 2007).

Ford Rouge Renovation, available at: http://www.ford.com/en/goodWorks/environment/cleanerManufacturing/rougeRenovation.htm (accessed July 2007).

Global Warming, Early warning signs, available at: http://www.climatehotmap.org (accessed June 2007).

M&S News, available at: http://www.marksandspencer.com/gp/node/n/50890031/202-0624370-7945465?ie=UTF8&mnSBrand=core (accessed July 2007).

P&G Sustainability report, available at: http://www.pg.com (accessed July 2007).

Wal-Mart Sustainability 360, available at: http://www.walmartstores.com/GlobalWMStoresWeb/navigate.do?catg=691 (accessed July 2007).

7. APPENDICES

Appendix A: Thesis plan

ID	Task Name	Duration	Start	Finish
1	Project Duration	97 days	Tue May 1, '07	Fri Sep 7, '07
2	Project Allocation	1 day	Wed May 2, '07	Wed May 2, '07
3	Discuss plan with Supervisor	1 day	Wed May 9, '07	Wed May 9, '07
4	Research for case examples	50 days	Thu May 10, '07	Wed Jul 18, '07
5	Holiday	21 days	Fri May 18, '07	Fri Jun 15, '07
6	Meeting with Amicus	1 day	Wed Jun 13, '07	Wed Jun 13, '07
7	Write up Introduction	25 days	Mon Jun 18, '07	Fri Jul 20, '07
8	Write up Industrial Context	3 days	Mon Jun 18, '07	Wed Jun 20, '07
9	Write up Literature Review	25 days	Mon Jun 18, '07	Sun Jul 22, '07
10	Meeting with Carbon Trust	1 day	Thu Jun 28, '07	Thu Jun 28, '07
11	Company contacts establishment	32 days	Mon Jun 18, '07	Tue Jul 31, '07
12	Meeting with Unilever (Food&Drinks)	1 day	Tue Jul 3, '07	Tue Jul 3, '07
13	Meeting with BAE Systems (Submarine)	1 day	Mon Jul 16, '07	Mon Jul 16, '07
14	Meeting with BAE Systems (Air)	1 day	Tue Jul 17, '07	Tue Jul 17, '07
15	Meeting with Unilever (Chemicals)	1 day	Wed Jul 18, '07	Wed Jul 18, '07
16	Write up case studies	4 days	Mon Jul 23, '07	Thu Jul 26, '07
17	1st Draft duration	20 days	Mon Jul 23, '07	Thu Aug 16, '07
18	Have a think of Thesis structure, context, etc	1 day	Mon Jul 23, '07	Mon Jul 23, '07
19	Check/update chapters that are done so far	1 day	Tue Jul 24, '07	Tue Jul 24, '07
20	Write up Methodology	3 days	Wed Jul 25, '07	Fri Jul 27, '07
21	Write up Discussion	7 days	Sat Jul 28, '07	Tue Aug 7, '07
22	Write up Conclusion	5 days	Wed Aug 8, '07	Mon Aug 13, '07
23	Meet with Steve to discuss 1st Draft	1 day	Wed Aug 15, '07	Wed Aug 15, '07
24	2nd Draft duration	5 days	Wed Aug 15, '07	Sun Aug 19, '07
25	More work on Discussion and Conclusion	3 days	Wed Aug 15, '07	Fri Aug 17, '07
26	Check English and correct	2 days	Sat Aug 18, '07	Sun Aug 19, '07
27	Meet Steve to discuss 2nd Draft	1 day	Mon Aug 20, '07	Mon Aug 20, '07
28	Meeting with CIA	1 day	Wed Aug 22, '07	Wed Aug 22, '07
29	Finish off Thesis	11 days	Thu Aug 23, '07	Thu Sep 6, '07
30	Prepare Draft PowerPoint Presentation	3 days	Mon Aug 27, '07	Wed Aug 29, '07
31	Finish off Presentation slides	3 days	Wed Aug 29, '07	Fri Aug 31, '07
32	Present results to Amicus	1 day	Mon Sep 3, '07	Mon Sep 3, '07
33	Make change to presentation slides	1 day	Tue Sep 4, '07	Tue Sep 4, '07
34	MSc Presentation	1 day	Tue Sep 4, '07	Tue Sep 4, '07
35	Thesis Submit ion	1 day	Fri Sep 7, '07	Fri Sep 7, '07

Appendix B: Company contacts establishment

Appendix B1: Unilever (Food & Drink)

From: Seddont, Julie [mailto:julie.seddon@unilever.com]
Sent: Friday, July 13, 2007 8:22 AM
To: Rattanakit, Rattanachai
Subject: Re: Meeting with Unilever Environmental Advisor

Hi Kae
Sorry for the delay
Some of the projects carried out to reduce energy/ water use are

Sensor lighting/ zone lighting
Sensor toilet flushing
Compressor software to enable optimising air pressure during shut downs
Policing of shutdowns to ensure procedures are being followed
Installation of new BMS (Building Management System)
Installation of new Humivap air Handling system
Installing new chiller system this year

Hope this helps

Regards

Julie Seddon
Environmental Advisor
Trafford Park
0161 888 1475
0161 888 1401

Unilever Best Foods UK Ltd
Registered in England & Wales Company number 43520
Registered office: Brooke House, Manor Royal, Crawley,
West Sussex. RH10 NRQ

From: Seddon, Julie[mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Wednesday, July 04, 2007 4:20 PM
To: Rattanakit, Rattanachai
Subject: Report & Action plan

Hi Kae

Apologies but we are not able to submit reports from external audits to external bodies carrying out them out and data protection. I have been in meetings all day today so I will list some actions being carried out to reduce energy usage at Trafford. Please can I also request a copy of
the report that you send to amicus as well as what they are going to do with your report.

Regards

Julie Seddon
Environmental Advisor
Trafford Park
0161 888 1475
0161 888 1401

Unilever Best Foods UK Ltd
Registered in England & Wales Company number 43520
Registered office: Brooke House, Manor Royal, Crawley,
West Sussex. RH10 NRQ

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Tuesday, July 03, 2007 11:27 PM
To: Seddon, Julie
Subject: Report & Action plan

Julie

Could you please, if at all possible, let me have a copy of your recent report, submitted to external auditor, and the action plan (showing how/what needed to be done to help achieve the set target - waste/energy
consumption reduction etc).

Regards

Kae

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Monday, July 02, 2007 7:59 PM
To: Seddon, Julie
Subject: RE: Meeting with Unilever Environmental Advisor

Dear Julie

This is my mobile number 07887923312, in case you need to speak to me. I
will see you tomorrow (Tue 3rd July) at around 3pm.

Regards

Kae

From: Seddon, Julie [mailto:Julie.Seddon@unilever.com]
Sent: Thu 6/21/2007 3:27 PM
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever Environmental Advisor

Hi Kae

Have you booked the ticket for the train yet, if not I may have to make it the afternoon as I am tied up 11:30 - 13:00. Will this cause you a problem.

Regards

Jules

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Thursday, June 21, 2007 3:20 PM
To: Seddon, Julie
Subject: RE: Meeting with Unilever Environmental Advisor

Julie

I probably need 1 to 11/2 hour of your time on the day.

Thanks

_____

From: Seddon, Julie [mailto:Julie.Seddon@unilever.com]
Sent: Thu 21/06/2007 15:15
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever Environmental Advisor

Hi Kae

Have you any idea how long you will need me for

Regards

Julie Seddon
Environmental Advisor
0161 888 1475
0161 888 1401

Unilever Best Foods UK Ltd
Registered in England & Wales Company number 43520 Registered office: Brooke House, Manor Royal, Crawley, West Sussex. RH10 NRQ

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Thursday, June 21, 2007 2:58 PM
To: Seddon, Julie
Subject: RE: Meeting with Unilever Environmental Advisor

Hi Julie

My train will get into Piccadilly station at 10.24am on 3rd July. I

will
get a Taxi from the station to you.

Regards

Kae

_____

From: Seddon, Julie [mailto:Julie.Seddon@unilever.com]
Sent: Thu 21/06/2007 14:34
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever Environmental Advisor

Hi Kae

Could you let me know a time when you aim to be arriving so I can make sure I am free.

Regards

Julie Seddon
Environmental Advisor
0161 888 1475
0161 888 1401

Unilever Best Foods UK Ltd
Registered in England & Wales Company number 43520 Registered office: Brooke House, Manor Royal, Crawley, West Sussex. RH10 NRQ

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Thursday, June 21, 2007 1:24 PM
To: Seddon, Julie
Subject: RE: Meeting with Unilever Environmental Advisor

Julie

Please accept my apologises ! On looking further to my diary, I realised
that I have to attend a study tour to factories organised by the university on Tue 26th - Wed 27th June. Can we make it the following week? Could you please also let me know the name of the nearest train station to your site.

Regards

Kae

_____

From: Seddon, Julie [mailto:Julie.Seddon@unilever.com]
Sent: Thu 21/06/2007 11:16
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever Environmental Advisor

Hi Kae

The 27th June will be fine

Regards

Julie Seddon
Environmental Advisor
0161 888 1475
0161 888 1401

Unilever Best Foods UK Ltd
Registered in England & Wales Company number 43520 Registered office: Brooke House, Manor Royal, Crawley, West Sussex. RH10 NRQ

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Thursday, June 21, 2007 10:47 AM
To: Seddon, Julie
Subject: RE: Meeting with Unilever Environmental Advisor

Dear Julie

Please see attached Flyer which will give you some idea of what my research is about, and some questions.

Is Wednesday 27th June or Tuesday 3rd July any convenient to you?

Regards

Kae

_____

From: Seddon, Julie [mailto:Julie.Seddon@unilever.com]
Sent: Wed 6/20/2007 8:26 AM
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever Environmental Advisor

Hi Kae

Apologies but I am on site for the next 2 to 3 weeks so it would be best
if you could come to site. Is there any chance you could also let me know what you want to chat about so I can get something prepared for you.

Please let me know a couple of dates and I'll get back to you.

Regards

Julie Seddon
Environmental Advisor
0161 888 1475
0161 888 1401

Unilever Best Foods UK Ltd
Registered in England & Wales Company number 43520 Registered office: Brooke House, Manor Royal, Crawley, West Sussex. RH10 NRQ

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Tuesday, June 19, 2007 8:58 PM
To: Seddon, Julie
Cc: Evans, Stephen
Subject: Meeting with Unilever Environmental Advisor

Dear Julie

It would be great if we could meet and have a conversation. Are you in South East at all from next week onwards? Colworth is very close to Cranfield. If not, I can come to your office. Please let me know the date and time that suits you.

Regards

Kae

_____

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Fri 6/15/2007 1:30 PM
To: Rattanakit, Rattanachai
Subject: FW: Climate Change

Hi Kae, the email below is the other half of the Unilever equation. This is the rep (Julie Seddon) at the Food and drink side.

As you can see Julie is willing to meet with you and her contact details
are in the email.

Please do ring or email Julie and make an arrangement to talk or meet with her. This will give you the story from both sides of the organisation.

I am currently waiting confirmation of dates from the TUC and the Carbon
Trust, hope to have some news for you by next week, best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street

London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

From: Mitchell, Sheena [mailto:Sheena.Mitchell@unilever.com]
Sent: 15 June 2007 10:31
To: Golds, Janet
Subject: RE: Climate Change

Hi Janet

Apologies for the delay in replying - been really busy with external auditors all week.
I know that we have taken great strides in reducing energy usage and increasing the amount of recycling, but anyway, I have spoken to our Environmental Advisor, Julie Seddon and she has agreed that Chai may ring her or email her for more info. julie.seddon@unilver .com telephone 0161 888 1475.

hope this helps

regards
Sheena

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Thursday, June 14, 2007 11:51 AM
To: Mitchell, Sheena
Subject: Climate Change

Hi Sheena, I wonder if you would be prepared to talk to a Cranfield university Masters student about what is happening at Unilever regarding
any initiatives they may be introducing to address the climate change problem. It is interesting in your company as we have reps in both the food and drink side and the chemicals side so the views of both of you would be very useful to have.

As I am sure you will appreciate some companies say they are doing loads
to facilitate a change to their energy usage etc but it is often the staff who know what is really going on.

Chai (the student) has a very tight time frame to produce his thesis so a prompt response would be really appreciated even if it is to say you cannot help.

Hope to hear from you soon, best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

_____

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solely for the use of the individual or entity to whom they are addressed. If you have received this e-mail in error, please return it to the address it came from telling them it is not for you and then delete it from your system.

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solely for the use of the individual or entity to whom they are addressed. If you have received this e-mail in error, please return it to the address it came from telling them it is not for you and then delete it from your system.

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Appendix B2: Unilever (Chemical)

From: Stewart, Jane [mailto:Jane.Stewart@unilever.com]
Sent: Fri 06/22/2007 4:36 PM
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever rep

I'll have to get back to you next week. Ill probably be able to sort something. What time are you seing her cos manchester is only an hour away. I'm not in Mon or tues but I will sort something out I promise. You can contact me on my mb 07720783809.

Jane
-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Friday, June 22, 2007 3:43 PM
To: Stewart, Jane
Subject: RE: Meeting with Unilever rep

Dear Jane

Unfortunately, I am visiting Julie Seddon, Unilever Environmental Advisor at Trafford Park, on that day. Any other date?

Kae

_____

From: Stewart, Jane [mailto:Jane.Stewart@unilever.com]
Sent: Fri 6/22/2007 3:30 PM
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever rep

Hi Kae
After looking at your flyer I have managed to sort you out with a visit to Unilever Manufacturing site in portsunlight. The best Date for us is 3rd of July. Can you make this?

Jane

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Friday, June 22, 2007 10:50 AM
To: Stewart, Jane
Subject: RE: Meeting with Unilever rep

Hi Jane

Thank you for taking the time to try and sort out something for me. Please see attached Flyer, description of what my research is about and some questions. I am busy all next week but the following week, beginning of July, should be fine.

Thanks

Kae

_____

From: Stewart, Jane [mailto:Jane.Stewart@unilever.com]
Sent: Fri 6/22/2007 9:46 AM
To: Rattanakit, Rattanachai
Subject: RE: Meeting with Unilever rep

Hi Kae
I am trying to sort out with the site a day you could come up. Unfortunately colworth is not a unionised site however it does drive the company's environmental programme. I am not exactly sure what it is you are wanting is it a corporate view or how the trade union reps push the environmental agenda.

Jane

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: Tuesday, June 19, 2007 8:57 PM
To: Stewart, Jane
Cc: Evans, Stephen
Subject: Meeting with Unilever rep

Dear Jane

It would be great if we could meet and have a conversation. Are you in South East at all from next week onwards? Colworth is very close to Cranfield. If not I will come to Port Sunlight. Please let me know the date and time that suits you.

Regards

Kae

_____

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Fri 6/15/2007 11:32 AM
To: Rattanakit, Rattanachai
Cc: Evans, Stephen; Jeary, Roger
Subject: FW: Climate Change

Dear Kae, please see email below from Jane Stewart.

Jane is an NEC member of Unite (Amicus Section) and works in the Chemicals side of Unilever. As you can see Jane is willing to meet with
you but would prefer it if you could go to the Unilever site where she works.

To facilitate this would you either email or telephone Jane to make the necessary arrangements, email as below, telephone number is:
0151-641-3075 (work)

Please let me know that you have received this email, whether you are willing to meet with Jane and will make the necessary arrangements.

If you do decide to meet with Jane it would be useful for you to email Jane a list of topics/questions that you will be asking so she can prepare her responses.

With best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

From: Stewart, Jane [mailto:Jane.Stewart@unilever.com]
Sent: 15 June 2007 11:17
To: Golds, Janet
Subject: RE: Climate Change

Hi Janet
I would be more than happy to meet with him but I also have lots of commitments so It will be tight. I am at policy conference next week so maybe we can make a date after that. It might be helpful if Kae could come to the Unilever site and I could arrange for him to look at some of
our activities. We have recently had a presentation on an Inconvenient Truth the al gore film on global warming and how unilever intends to operate into the future.

Let me know what he thinks and Ill try and arrange something.

Jane

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Thursday, June 14, 2007 3:44 PM
To: Stewart, Jane
Subject: Climate Change

Hi Jane, I have been given your contact details by my colleague Steve Martin - he is the research officer for the Chemicals industry.

Unite (Amicus Section) is supporting a student at Cranfield university (we have set the student a question about the impact of the Climate Change Bill on manufacturing industry)

The student (Kae) is keen to talk to a number of employers and reps working for a range of manufacturing companies. As you know we also have reps in the food and drink side of Unilever so it is interesting for him to meet reps from both sides of the Unilever company. He will be
looking to find out what Unilever are/have done to address the climate change issue, and also to see whether you agree with their corporate response and also what happens inside the organisation with the staff and 'greening the workplace'.

Would it be possible for him to meet with you at some point in the very near future - we are on quite a tight time schedule as Kae has to complete his research and thesis by the end of August.

Please let me know if you would be willing to meet with Kae, with best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

Appendix B3: BAE Systems (Submarine solutions)

From: Samms, Harold [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: 09 July 2007 9:58
To: Samms, Harold (UK)
Subject: Meeting with BAE Systems

Dear Kae,

Sorry I have took so long to get back to you but I was off site last week and am just catching up with my e-mails!
I may be in London on the 16th for a meeting with Lord Drayson.This should be confirmed to-day.If so I will stay overnight. I could meet you at night or the next day.

Regards,

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: 05 July 2007 11:14
To: Samms, Harold (UK)
Subject: Meeting with BAE Systems

Dear Azza

I have been informed by Janet Golds, Amicus, that you will meet with me and that I arrange a date for us to meet. I will be happy to come to your site in Barrow any day from next week onwards. However, if you are down South any time during next week, the week after etc, I can arrange with Janet to book a room at her office in London for us both to meet there.

I look forward to hearing from you

Regards

Kae

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Thu 05/07/2007 10:41
To: Rattanakit, Rattanachai
Cc: Harold Samms
Subject: RE: Meeting with Azza Samms (British Aerospace)

Hi Kae, he is on short hours at the moment so you may just have missed him, he does respond to emails but it sometimes takes a couple of days, here is his email address harold.samms@baesystems.com

Best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

-----Original Message-----
From: Rattanakit, Rattanachai [mailto:r.rattanakit@Cranfield.ac.uk]
Sent: 05 July 2007 10:33
To: Golds, Janet
Subject: RE: Meeting with Azza Samms (British Aerospace)

Good morning Janet

Could you please email me Azza's email address again. I feel the last email I sent him did not go through. I've also been trying to get hold of him via work and mobile phone but no answer.

Thanks

Kae

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Mon 02/07/2007 10:35
To: Rattanakit, Rattanachai
Cc: Harold Samms
Subject: Meeting with Azza Samms (British Aerospace)

Hi Kae, hope you are well, as you will have seen from previous emails Azza has agreed to meet with you and is happy for it to be either here or for you to go up to Barrow.

Under the circumstances I think it is best that you correspond personally with Azza to arrange a date that suits you both best.

If you would like to meet here then of course let me know and I will book a room etc.

I have cc'd this email to Azza so that you will have his email address, his other contact details are as follows, please consider these as confidential.

Best wishes, Janet

Azza Samms
Tel Work: 01229-875517
Tel Mob: 07793425136

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

_____

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: Fri 29/06/2007 10:28
To: Rattanakit, Rattanachai
Cc: Harold Samms
Subject: Meeting with BAE Systems

Hi Kae, I have heard back from my rep at BAE Systems in Barrow-in-Furness. He works on the new Astute submarine platforms.

His name is Azza and he is willing to meet with you. If you could give me a couple of dates when you know you are free, he is away for the whole of next week so if you could give the dates for week beginning 9th July and 16th July we can go from there.

I have asked Azza to clarify whether you will be meeting with him in Barrow or in London.

With best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

Appendix B4: BAE Systems (Air solutions)

From: Golds, Janet [mailto:Janet.Golds@amicustheunion.org]
Sent: 06 July 2007 8:26
To: Rattanakit, Rattanachai
Subject: FW: Cranfield Research Student

Hi Kae, please see note from Eddie saying he will meet with you, his contact details are in the email, best wishes, Janet

Janet Golds
Research Officer
Unite (Amicus section)
33-37 Moreland Street
London EC1V 8HA

TEL: (w) 020 7780 4008
(m) 07817-103909

From: Burke, Eddie (UK) [mailto:Eddie.Burke@baesystems.com]
Sent: 05 July 2007 16:57
To: Golds, Janet
Subject: RE: Cranfield Research Student

I am O.K. to meet. My works Phone Number is 01772854658 or 55921. - My mobile number is 07895 438888

Appendix C: Project flyer

Cranfield UNIVERSITY

amicus the union

Climate Change and Manufacturing

The Research

We are studying the implications of climate change on UK manufacturing by seeking examples and evidence from UK industry.

What we will do

We will visit your factory to learn about any actions you might have taken to tackle climate change. We are interested in any actions, from moving the factory to turning the lights off. We will ask questions of one or two staff who have taken part in your actions, for up to one hour each.

We will then write this into a short (1-page) case study, which we will return to you for factual checking and approval to use or not use in public.

The university and the research sponsor will cover all the expenses involved.

Outcome

This study is part of a joint research programme established by Cranfield University with Amicus the Union. We will be compiling a list of strategies and actions taken to date by UK manufacturing companies; and writing this into a Masters thesis and a report. We hope and expect that the report will be useful to the companies taking part, and to those manufacturers who are considering how they might respond to climate change.

Climate Change

The Earth's temperature is rising, predominantly because of human activity. The carbon dioxide concentration in the atmosphere has reached more than 380 parts per million since the beginning of industrial times.

With the recently announced Climate Change Bill, it is becoming increasingly important for manufacturing companies to know what strategies and tactics are already being used by the pioneers, to help develop their own response.

If you are interested in collaborating, then please contact us to arrange a visit:

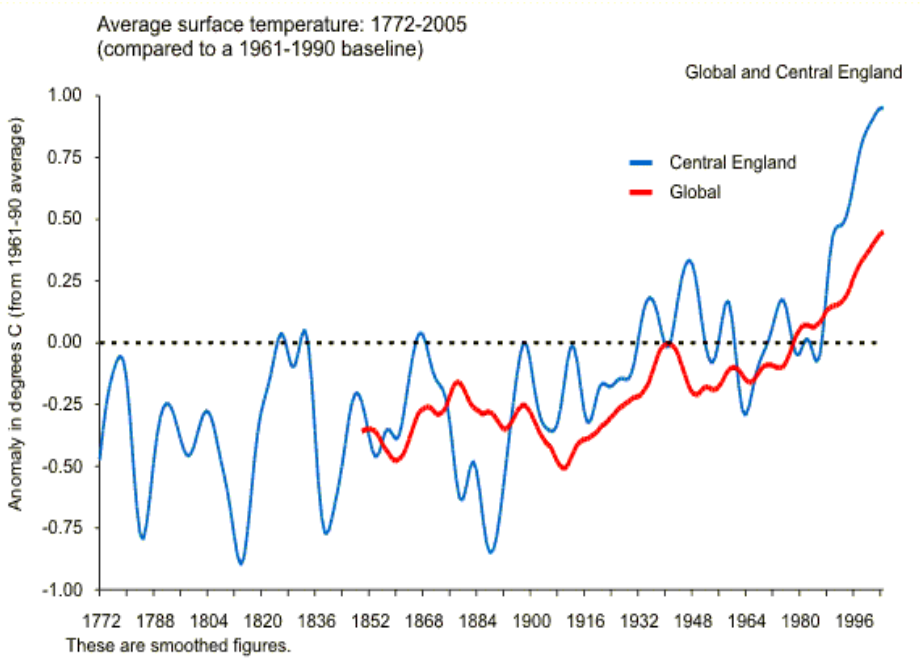
Rattanachai Rattanakit (Kae),
Manufacturing, Building 50, Cranfield University, Bedford, Bedfordshire, MK43 0AL
Email: r.rattanakit@cranfield.ac.uk
or
Steve Evans
Professor of Life Cycle Engineering
Manufacturing, Building 50, Cranfield University, Bedford, Bedfordshire, MK43 0AL
Email: steve.evans@cranfield.ac.uk

Appendix D: Designed questions

1. What did you do/ what are you trying to do now
2. What does that involve (describe your programme)
3. Where does the initiative come from, what encourage it to happen
4. What was challenging
5. Benefits to the organisation
6. Lesson learned/ what might have been done differently/what might you say to other companies
7. What next

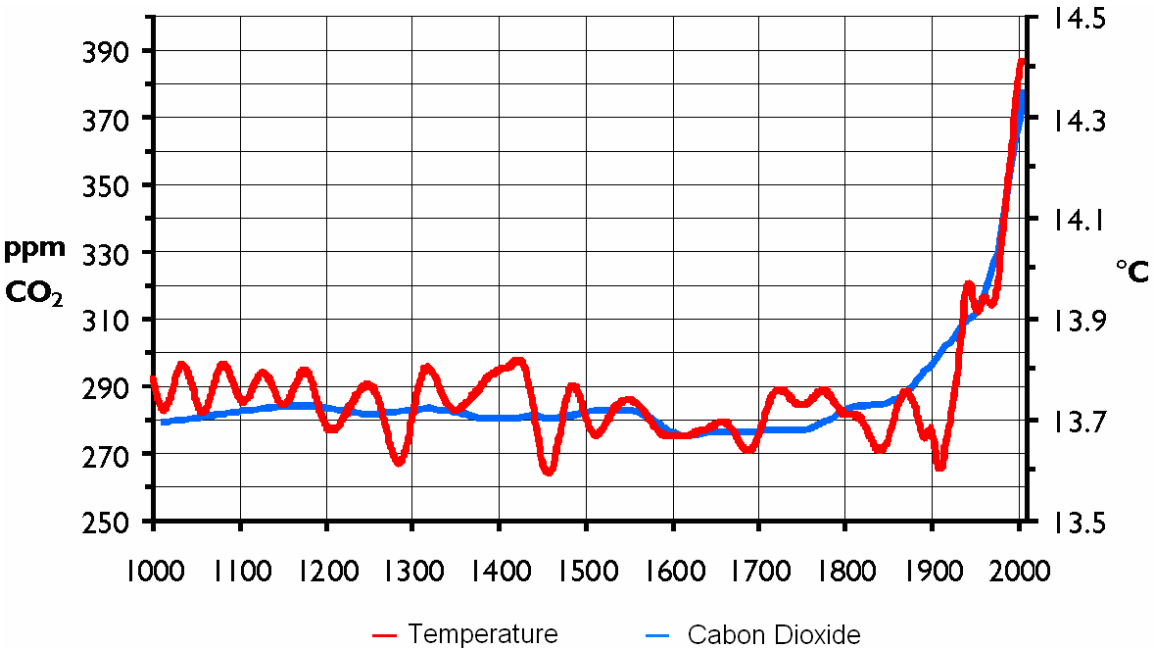
Appendix E: Figures

Appendix E1: Global average surface temperature



Source: Defra, accessed Jun 2007

Appendix E2: CO_2 concentration related to global average temperature

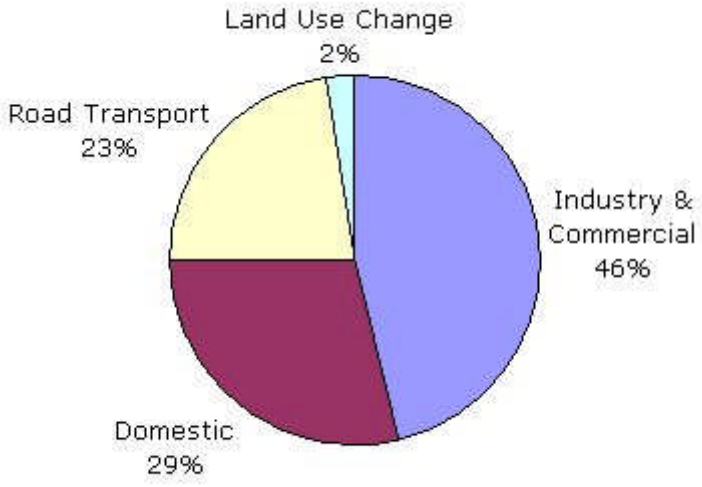


Source: IPCC; accessed Jun 2007

Appendix E3: Freighted food label

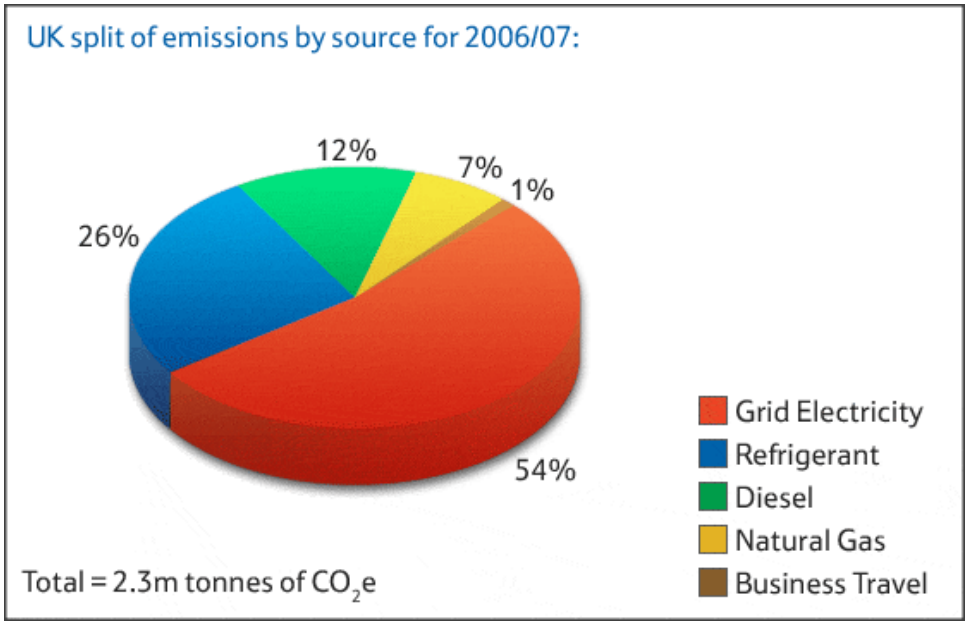
Source: M&S; accessed July 2007

Appendix E4: UK CO_2 emissions by sector



Source: Department for Environment Food and Rural Affairs; accessed June 2007

Appendix E5: 2006/2007 Tesco UK split emissions by source



Source: Tesco; accessed July 2007

Appendix F: Case studies

Appendix F1: Unilever, Food & Drink

Company: Unilever

Sector: Food & Drink

Location: Trafford Park, Manchester, UK

Who they are

Unilever is a well known established multi-national company that owns and supplies many of the world's fast consumer goods ranging from house hold care to foods and beverages. The company employs around 180,000 people in 100 countries worldwide. It touches over one hundred millions of people's lives everyday, some of its well known brands are Magnum ice-cream, PG tips tea, Sunsilk shampoo, Knorr stock cubes, and many more.

What they do

Unilever Trafford Park site produces and packages PG Tips tea brand.

The challenge

Large amount of solid waste generated each day is recognised as a problem at Trafford Park Food and Drinks site. Moreover, the site manufacturing operations use key environment performance parameters for reporting emissions and setting future reduction targets, for waste and energy, per year. This means the company is governed by law to develop an action plan in order to meet the yearly set target, set by the Food and Drink Federation. Action plan and objectives must be provided by Unilever once the yearly target has been established. The site performance of the factory throughput and energy usage is put together as a report and submitted back at the end of the yearly target, which starts from October and ends in September.

Action

Even though the energy usage is small at Trafford Park site, the company shows no sign of neglect in reducing energy consumption. Lighting and

sensor system has been introduced at the Trafford Park site to cut energy costs. In additional to this, it implements Building Management System (BMS) which helps monitor equipment used within the plant and to ensure that all equipment is running at its highest optimum level. Unilever acknowledges the importance of staff's environment awareness and it is putting together trainings to encourage people to become more environmental friendly in the way they do things at work.

Outcome

The company has seen positive benefits gained from being an environmentally responsible site, since the customers are increasingly aware of the global issue and are becoming more sensible about what they are buying. By consuming less energy they have not only reduced the site carbon emissions, but also the operation costs.

Appendix F2: Unilever, Chemical

Company: Unilever

Sector: Chemical

Location: Port Sunlight, Liverpool, UK

What they do

The site produces UK home and personal care brands ranging Persil, Comfort, Surf, Domestos and Robijn.

The challenge

Unilever's Port Sunlight site spent somewhat over £4 million in 2005 for its energy bill. With the UK energy prices at its highest peak, the company has recognised that the site needs immediate action and development of strategy to help cut the energy costs.

Action

The site is committed to reducing energy usage and is willing to promote itself as 'green'. It has commissioned Enviros Consulting energy management team to carry out an energy survey at Port Sunlight. The main task is to identify the opportunities to reduce energy consumption through the site's operations, one of which is to use energy monitoring and targeting principles to identify, monitor and reduce energy losses. Other activities include reducing of steam consumption through heat recovery, implementation of variable speed drives for better control of cooling water pumps and fans to save electricity. Port Sunlight is planning to install a source of renewable energy, an Ecotricity windmill, on site at the end of July 2007 to promote itself and show to its customers that it is committed to the environment.

Outcome

Ecotricity conducted feasibility studies on site and vowed to provide Port Sunlight with flat rate energy from day one. In additional to this, it will protect the site from a volatile and rising wholesale energy market. Ecotricity windmill will symbolise a green approach which it believes to be important to its customers.

The savings achievable through Monitoring and Targeting system are expected to be £100,000 per year. The potential financial savings which will bring to Unilever Port Sunlight through reducing of steam consumption is around £186,000 per annum. Also, with the variable speed driver pumps installed around the site will save over 700 MWh/year which is approximately £40,000 per annum.

Appendix F3: BAE Systems, Air solutions

Company: BAE Systems

Sector: Military of Defence, Air solutions

Location: Warton

Who are they

BAE Systems is a global company involved in the development, delivery and support of advanced defence and aerospace systems.

What they do

BAE Systems at Warton operates and maintains of Air systems.

Challenge

The yearly energy usage, especially electricity, on site is overwhelming. With thousands of people working on base and all of the equipment uses a lot of power each week, not to mention the power that needs to power the base, ensuring that everyone helps to save energy consumption and drive the costs down is quite a challenge.

Activity and plan

BAE Systems at Warton ensures there are further improvements on environmental performance and the impact that its operations have on the environment every year. It set itself an annual target to reduce energy consumption, gas and electricity, by 5% in the beginning of 2006. The successful result was achieved through everyone's efforts. One of the methods used to help achieve the set target was publishing good practice and examples on how to save energy on BAE specific website or message board for everyone to follow. In addition, the site runs energy shutdown initiative during holiday period in 2005 and a simple routine of switching off lights and non-essential equipment such as printers and photo copiers. Moreover, the site environmental advisor is looking to

establish contacts with external suppliers to get discounts on home isolations, such as double glazing windows, for its employees so that they can reduce their energy usage individually in their homes. The car-share and bicycle-to-work scheme has been introduced to the staff at Warton site to encourage people at work to be more environment conscious in everyday activities during and outside business.

Appendix F4: BAE Systems, Marine solutions

Company: BAE Systems

Sector: Military of Defence, Marine solutions

Location: Warton

Location: Barrow-in-Furness

What they do

BAE site based in Cumbria, North West of England, develops, designs and provides submarine solutions to naval activities.

The challenge

BAE submarine solutions site at Barrow-in-Furness is at the forefront in reducing the impact on the environment. It is well aware and understands the UK government's Climate Change Programme and how the UK plans to deliver its international obligation to minimise greenhouse gasses by 20% below 1990 levels by 2010. Its ISO 14001 accreditation will push it to being more energy efficient with its operations. It also operates under Climate Change Levy, European Emissions Trading scheme and Integrated Pollution Prevention and Control.

Plan and action

The site has recently acquired a green energy source, a 6kW wind turbine, to provide power to its main shipyard reception foyer such as lighting and computers. It launched energy awareness campaign in 2007 across the site. Energy Management checklists were issued to every employee working on the site as a way to communicate and advise steps which can be taken to reduce energy consumption as well as to highlight the difference each individual can make, both at work and at home. More to this, posters were produced highlighting the effects of CO_2, has on the environment and how it causes the

change of the global climate. The site has embarked upon energy management and monitoring of the site consumption of gas, electricity and water by installing a network-infrastructure controller package.

Outcome

The energy shutdown initiative saw the site saved carbon emission by 365 tonnes. The business certainly has gained benefits from the moral and financial perspectives. Comment was added during the case study interview that by keeping things fresh and letting people know the p9ositive impact they have made toward the outcome are the keys to success. By doing this allows them to see that the company is serious and that the management walk the talk.