CO_2 Market Design and Operation

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Declaration: This dissertation is entirely my own work and has not been submitted in substantially the same form for the award of a higher degree elsewhere.

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ABSTRACT

This dissertation examines market design and operation within the empirical context of CO_2 markets. Six case studies are presented which describe business interactions during the design and operation of the Kyoto Protocol, the European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. The case studies were developed through participant observation between October 2006 and June 2010. The research developed a conceptual framework for the study of CO_2 market design and operation. Network-level aspects of CO_2 market design and operation were captured by exchange, representational and normalising practices. Macro-level aspects of CO_2 market design and operation were captured by technical, temporal and uncertainty based considerations. The conceptual framework was used to analyse the six cases, exploring why CO_2 markets have not yet significantly influenced businesses' behaviour. This research should help businesses and regulators to better understand the challenges faced during CO_2 market design and operation. Market based approaches to environmental protection are receiving increasing interest in the marketing literature. The conceptual framework and six cases further the study of what is actually happening during CO_2 market design and operation, as opposed to previous approaches which have emphasised the intricate theoretical aspects of CO_2 market design.

KEYWORDS

Market Design, Market Operation, Climate Change, CO_2 Market, Kyoto Protocol, European Emission Trading Scheme, Carbon Reduction Commitment

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GLOSSARY OF TERMS

Discussions of CO_2 markets involve a number of technical terms which are often abbreviated. This dissertation avoids the use of these abbreviations. However, for reference purposes with regards to other research and publications, the abbreviations are given below. Further guidance is available from the United Nations' exhaustive list of Climate Change related acronyms (United Nations, 2010: 107).

AMR	Automatic Meter Reading, the level of coverage of AMR is one of the Carbon Reduction Commitment's Early Action Metrics.
CBI	Confederation of British Industry
CCA	Climate Change Agreements. United Kingdom Climate Change regulation.
CCL	Climate Change Levy. United Kingdom Climate Change regulation.
CCS	Carbon Capture and Storage. A CO_2 abatement technology.
CER	Certified Emission Reduction Unit. A CO_2 permit from the Kyoto Protocol.
COP	Conference of the Parties. Annual United Nations Climate Change negotiations.
CO_{2e}	Carbon dioxide equivalent, the common metric for a number of different greenhouse gasses' Climate Change impacts.
CRC	Carbon Reduction Commitment. United Kingdom CO_2 market.
CTS	Carbon Trading Scheme, an informal acronym for a CO_2 market.
EAMs	Early Action Metrics of the Carbon Reduction Commitment. Namely, the level of coverage of Automatic Meter Reading (AMR) and the level of coverage of the Carbon Trust Standard.
EU ETS	European Emissions Trading Scheme. European market for CO_2.

ETS	[CO_2] Emissions Trading Scheme, an informal acronym for a CO_2 market.
GHG	Greenhouse Gas. CO_2 plus other greenhouse gases, which are normally expressed in equivalent CO_2 emissions, or CO_{2e}.
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-hour / unit of energy consumption (1,000 kWh = 1MWh)
LPG	Liquid Petroleum Gas, an alternative low CO_2 transport fuel.
MWh	Megawatt-hour / unit of energy consumption (1,000 kWh = 1MWh)
NAP	National Allocation Plan: Assigns national emissions targets for each participant country within the European Emissions Trading Scheme.
NGO	Non-Governmental Organisation
PPM	Parts per million, the measure of atmospheric concentrations of CO_2
RGGI	Regional Greenhouse Gas Initiative. State level CO_2 market in 10 states in USA.
ROCs	Renewables Obligation Certificates
UNFCCC	United Nations Framework Convention on Climate Change
WCC	World Climate Conference

CHAPTER 1:

INTRODUCTION

1 INTRODUCTION

1.1 Background to the research

This dissertation examines market design and operation within the empirical context of CO_2 markets. Advocates of market design state that *"businesses can create markets where there were none, or fix them when they go wrong."* (Roth, 2007a: 118). Such approaches have been applied to the development of a diverse range of markets, including those for radio frequency bandwidths, kidney transplants, sulphur dioxide reductions and even school places (Carmona et al., 2010; Coase, 1960, 1988; Dales, 1968; Demsetz, 1966; Hurwicz, 1973; MacKenzie, 2009; McMillan, 2003; Myerson, 1979, 1983; Roth, 2008). This research extends the literature discussed above by examining CO_2 market design and operation.

Proponents of CO_2 markets present a view of Climate Change as a *"market failure on the greatest scale the world has seen."* (Stern, 2006: 25). This view conceptualises the market failure as arising from externalities imposed by CO_2 emissions. It follows that the objective of CO_2 markets is therefore to monetise CO_2 emissions and enable businesses to mitigate the risk of Climate Change as part of their profit maximisation objectives (MacKenzie, 2009). The CO_2 market design provides business participants with target CO_2 emissions. Participants then face the choice either to make the required CO_2 reductions in-house, or to buy CO_2 reductions from other market participants who made savings beyond their targets' requirements. The market is designed to push CO_2 savings to the cheapest reduction options available across industry, while still allowing all participants to comply with their reduction targets (Bebbington & Larrinaga-Gonzalez, 2008; Braun, 2009; Kolk et al., 2008; Lohmann, 2005, 2009; Okereke, 2007).

The selection of the empirical research setting was guided by the insight that research on market design and operation is best undertaken through examinations of markets in the making (Araujo, 2007; Araujo et al., 2008). This dissertation presents six case studies, each of which describes business responses during the design and operation of CO_2 markets. The CO_2 markets studied were the Kyoto Protocol, the European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. Collectively, these represented over 98% of the 2009 CO_2 market by value (Kossoy & Ambrosi, 2010). The cases represented contemporary efforts in market design and operation, all of which were less than 5 years old. Such contemporary investigations can expose mundane aspects of market design and operation, which later sit 'below the radar' in established markets (Kjellberg & Helgesson, 2007b; Latour, 1987). Callon supports the claims that CO_2 markets give a good empirical setting for the study of market design and operation: *"Carbon markets are an exceptional field for furthering our understanding of the ... forms of ... economic, political and scientific activities [that constitute the market], their mutual relations and the challenges they are designed to meet"* (Callon, 2009: 546).

CO_2 markets have proven to be significant in terms of their potential to mitigate Climate Change, the value of the transactions made and their reach across the business community. CO_2 markets traded an estimated total of 7.4 billion tonnes of CO_2 in 2009 (Kossoy & Ambrosi, 2010). This volume represented 24% of 2009's estimated global CO_2 emissions of 31.3 billion tonnes (Olivier & Peters, 2010). In addition, the scale of global CO_2 trading has grown rapidly from $25 million in 1998 to an estimated $144 billion in 2009 (Kossoy & Ambrosi, 2010; UNEP/GRID-Arendal., 2005). Finally, there is a direct link between CO_2 markets and the business community, as the majority of CO_2 market participants are businesses. Phase II of the European Emissions Trading Scheme covered around 10,500 sites within the European Union. The sites represented the industries of electricity generation, iron and steel milling, mineral processing, pulp and paper production and general manufacturing (Europa, 2010; Sandoff & Schaad, 2009). The Carbon Reduction Commitment extended the coverage of CO_2 markets within the United Kingdom from the 921 European Emissions Trading Scheme sites to an estimated 5,000 organisations, or 25,000-150,000 sites (DECC, 2007, 2009d). The Carbon Reduction Commitment affected commercial scale organisations such as large retailers, universities, local authorities, landlords, smaller manufacturers and office based organisations with multiple buildings.

The research presented in this dissertation includes the perspective of the regulators and economists who developed the CO_2 market design. However, this market design is also contrasted with descriptions of the actual operation of CO_2 markets developed by each case study. The descriptions of CO_2 markets in operation, or 'in vivo' as Callon refers to them (2009), provide a rich view of the challenges faced by market designers, as well as detailed empirical descriptions of how CO_2 markets are operating in the real world. The research contributes to a growing body of literature which deals with the design and operation of markets. In particular, this PhD study investigates the current design and operation of CO_2 markets and attempts to explain a number of significant failures of CO_2 markets to influence business behaviour (Engels, 2009; Spash, 2010).

The remainder of this chapter gives an introduction to the research presented in this dissertation. Section 1.2 introduces the research objectives and questions. Section 1.3 outlines the structure of the dissertation. Section 1.4 concludes the chapter.

1.2 Research objectives and questions

This research aims to make two contributions to the marketing literature. Firstly, it develops a conceptual framework for the study of CO_2 market design and operation. Secondly, it applies this conceptual framework to an empirical analysis of the design and operation of CO_2 markets.

The scientific, political and business communities widely accept the technical potential to manage CO_2 emissions to a sustainable level. However, there is currently very little uptake of these CO_2 reduction options within the business community. In response to the lack of business action on Climate Change, efforts to reduce CO_2 emissions have focussed upon developing CO_2 markets. The objective of these CO_2 markets is to monetise businesses' CO_2 emissions, thereby providing a financial incentive to reduce them. This research aims to describe CO_2 market design and operation and to explain the discrepancies between the markets as they were designed versus their actual operation. Ultimately, the aim of this research is to explore why CO_2 markets have so far failed to significantly influence businesses' behaviour.

The research questions are introduced here in order to familiarise the reader with the aims of the study. The full discussion of the theoretical underpinnings for the research questions is explored in the literature review, which is presented in chapter 2. Section 2.4.4 discusses the theoretical underpinnings of the research questions which relate to network-level aspects of CO_2 market design and operation. This research adopts a view of markets as networks of actors engaged in exchange, representational and normalising practices (Kjellberg & Helgesson, 2007a). Research question one asked who the actors are that are involved in CO_2 market design and operation. The identification of these actors was essential to the development of rich and complete case studies. Research questions two to four examined actors' exchange, representational and normalising practices and the translations by which they influenced each other as network-level aspects of CO_2 market design and operation. Section 2.5.4 discusses the theoretical underpinnings of the research questions which relate to macro-level aspects of CO_2 markets. Research questions five to seven examined technical, temporal and uncertainty-based considerations as macro-level aspects of CO_2 market design and operation.

Having introduced the research objectives and questions, the next section gives an overview of the structure of the rest of the dissertation.

1.3 Dissertation outline

This dissertation consists of twelve chapters. Chapter one gives an introduction to the research topic and outlines the research objectives and questions, before summarising the structure of the dissertation. Chapter two reviews the literature which is relevant to the research questions. Chapter two develops the research questions and proposes a conceptual framework for the study of market design and operation which is used later in the analysis of the case studies.

Chapter three describes the methods that were applied during the research. It begins with an exploration of the researcher's personal motivations and values and continues with an overview of the epistemological and ontological underpinnings that guided the research design. This discussion is followed by a description of how the research methods were chosen and how data were collected, reported and analysed. Chapter three closes with a section that describes the ethical provisions taken in order to protect research subjects.

Chapter four begins by giving context on the development of Climate Change as a business issue and describes the potential CO_2 reduction pathways that are available to business. Next, a description is given of how CO_2 markets work, as compared to a CO_2 tax or mandated CO_2 reductions. The remainder of chapter four then gives detailed descriptions of the CO_2 markets which were relevant to this research. The CO_2 markets covered are the global Kyoto Protocol, the European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. The United Kingdom's Climate Change Agreements and the practice of CO_2 Offsetting are also introduced as important contextual aspects for the CO_2 markets covered by the case studies.

Chapters five to ten present six empirical cases which describe CO_2 market design and operation. In chapter five, the first case describes efforts to extend the Kyoto Protocol beyond its current expiration date of the end of 2012. Chapter six examines the operation of phase II of the European Emissions Trading Scheme. Chapter seven examines efforts to include aviation in phase III of the European Emissions Trading Scheme. Chapter eight examines consultation responses by the business community to the launch of the United Kingdom's Carbon Reduction Commitment. Chapter nine examines the new accounting and reporting obligations introduced by the Carbon Reduction Commitment. Finally, chapter ten describes interactions resulting from the launch of the Carbon Reduction Commitment.

Chapter eleven analyses the six case studies presented by the research. The chapter confronts the six case studies with the conceptual framework for the study of market design and operation that is proposed at the end of the literature review.

Chapter twelve presents the research conclusions and implications. Firstly, an overview of the results is given, dealing in turn with each research question. Next, the theoretical and managerial implications of the research are given. Finally, the limitations of the research are discussed and suggestions are made for future research.

1.4 Conclusion

This chapter has laid the foundations for the dissertation. The first section gave the background to the research, next the research objectives and questions were presented and finally an outline of the remainder of the dissertation's structure was given. Chapter two now summarises the results of the literature review and presents a conceptual framework for the study of CO_2 market design and operation.

CHAPTER 2:

LITERATURE REVIEW

2 LITERATURE REVIEW

2.1 Introduction

This chapter discusses the literature which has previously dealt with the research questions introduced in chapter one. The first section examines the nature of markets and provides a foundation for the discussion of market design and operation. Next a theoretical basis is developed for the examination of CO_2 markets. Discussions in the remainder of the chapter are split between network-level and macro-level aspects of CO_2 market design and operation. Firstly, network-level aspects of exchanges, representations and norms are examined and corresponding research questions are developed. Secondly, macro-level aspects of technical, temporal and uncertainty-based considerations are examined and corresponding research questions are developed. The last section of the chapter combines this literature to give a conceptual framework for the study of market design and operation that is later used to analyse the case studies.

2.2 The substance of markets

The term 'market' is often used quite loosely within the marketing literature (Andersen & Ritter, 2008). Challenging this ambiguity raises ontological questions about the nature of what is called the 'market' (Araujo et al., 2008). In order to analyse market design and operation, a more detailed description of the substance of markets is required. A starting point in this examination of markets is to argue that markets are institutional arrangements which facilitate the exchange of goods (North, 1990). However, this perspective tells us more about the purpose of a market, rather than describing its substance. This section presents a number of perspectives of the substance of markets, before proposing a starting point for the development of a conceptual framework for the study of market design and operation.

Traditional economic analyses of markets have tended to assume that there is little interaction between buyers and sellers and that exchange will take place with relative ease. As early as the late 1960's, there was an acknowledgement that marketing is less about pushing products onto passive buyers and is more an activity which is undertaken between organisations, persons and ideas (Kotler & Levy, 1969). The network approach of the Industrial Marketing and Purchasing (IMP) Group has further developed the insights given above (IMP, 2010).

The network approach emphasises that business markets are not a faceless topology of atomised and individually insignificant firms (Easton & Araujo, 1994; Lazonick, 1991; Mouzas, 2006b). Instead, the network approach encourages businesses to acknowledge that markets operate through complex relationships between buying and selling organisations, where what is exchanged is often actually created through the interactions taking place (Easton & Håkansson, 1996; Håkansson, 1982; IMP, 2010; Turnbull & Valla, 1986). Although companies are often individually significant actors within markets, they also rely on the resources and capabilities of other actors to perform their operations (Easton & Håkansson, 1996; Gnyawali & Madhavan, 2001; Håkansson & Ford, 2002). These interdependencies result in a view of markets as networks which involve continuing and frequently complex interactions that transcend inter-personal discussion or communication (Håkansson & Waluszewski, 2002, 2007; Ritter, 2000). Buyer-seller exchanges within the market are not simple, flat transactions based upon rational maximisation of utility (Bagozzi, 1975; Biggart & Delbridge, 2004). Instead, interaction within markets is a substantive process that involves the activities and resources of the actors in the network (Håkansson & Johanson, 1992; Håkansson & Snehota, 1995; Håkansson & Ford, 2002; Håkansson et al., 2009).

The view of markets as networks highlights three paradoxes that businesses must take into account (Ford et al., 2003; Ford & Mouzas, 2008). Paradox one, the myth of action, emphasises that relationships constrain the ability to act independently within the market. Each business's actions will be subject to those of others and there is a need to take account of the historical context and complex nature of the network. Paradox two is 'the myth of independence' which refers to the challenge of developing objectives in the network. The second paradox makes the case that businesses should not place too much emphasis upon their individual objectives. Instead, they should acknowledge the need for simultaneous elements of cooperation, conflict, integration and separation within the business network. Finally, the third paradox is that of 'the myth of completeness'. This paradox states that most of the resources and activities that may offer a firm an advantage are located outside of the firm and are not under its control. Paradox three emphasises the need to acknowledge and leverage resources held externally to the business, through interaction in the network.

The literature presented above gives a network perspective of markets that emphasises the importance of interaction during the exchanges that take place in markets. This perspective is taken further by a field of marketing literature that examines ontological concerns relating to the market practices which actually constitute the day to day reality of the market. The market practice literature is compatible with a network view of markets which emphasises connectivity and interdependence. The market practice literature gives an ontological emphasis to the network view of markets, by emphasising the empirical description of market practices. This view presents markets as networks of actors engaged in empirical practices of exchanges, descriptions of the market and attempts to regulate it (Araujo, 2007; Araujo et al., 2008; Kjellberg & Helgesson, 2006, 2007b, 2007a; Mouzas & Ford, 2009; Reverdy, 2010).

The view of markets presented above is aligned with other conceptualisations of markets which are now discussed. Firstly, the view of markets given above is aligned with research on international markets for environmental governance that proposes a 'war of position' based upon 'material', 'discursive' and 'organisational' pillars (Levy & Newell, 2002; Levy & Egan, 2003). The 'material' elements map to exchange practices, 'discursive' elements are related to descriptions of the markets and 'organisational' elements are linked to regulatory or normative efforts. Secondly, the view of markets presented in the previous paragraph also incorporates the concepts of 'regimes' as persistent and connected sets of rules and practices that prescribe behavioural roles, constrain activity and shape expectations (Keohane et al., 1993) and Krasner's clusters of norms, rules, principles and decision-making procedures (1983). Finally, the view of markets adopted in this research also deals with the clues for coordination of behaviour that are embedded in pre-existing norms of interaction, as flagged by the theory of 'focal points' (Janssen, 2006; Schelling, 1960, 1978; Sugden, 1995).

The view of markets as networks of actors engaged in empirical practices of exchanges, descriptions of the market and attempts to regulate it has been shown above to encompass much of the wider literature that emphasises different, but arguably incomplete, perspectives of the substance of markets. This research adopts a view of markets as networks of actors that engage in three categories of market practice of 'exchange', 'representational' and 'normalising' practices (Hagberg & Kjellberg, 2010; Kjellberg & Helgesson, 2006, 2007b, 2007a). Exchange practices relate to the economic exchanges taking place within the market and the supporting activities which surround them. Representational practices are those which aim to depict markets and how they work. Finally, normalising practices are those which aim to introduce normative guidelines for how a market should work.

This section has presented a view of markets as networks of actors engaged in exchange, representational and normalising practices. The following section introduces the objectives and theoretical underpinnings of CO_2 markets.

2.3 CO_2 markets

Any analysis of market design and operation must take into account the objective of the market of interest. The objective of CO_2 markets, is *"to bring [CO_2] emissions within the frame of economic calculation, by giving them a price"* (MacKenzie, 2009: 441) This statement leaves implicit that the ultimate objective behind monetising CO_2 emissions is to influence businesses to reduce their CO_2 emissions and thus mitigate the risk of Climate Change. The mechanisms by which businesses' CO_2 emissions are monetised by CO_2 markets are now discussed.

CO_2 markets provide participants with target CO_2 emissions that are lower than their current CO_2 emissions. This target is then enforced through regulations which present each business with a choice either to make the required CO_2 reductions in-house, or to buy CO_2 reductions from other market participants who saved more CO_2 than was required by their target. Through this market, it is hoped that CO_2 savings will be made at the cheapest reduction options available and then sold between participants, so that each is able to comply with their CO_2 reduction targets. These ideas are neatly summed up by MacKenzie who describes CO_2 markets as "*markets in permits to emit CO_2 gases or in credits earned by not emitting them*" (MacKenzie, 2009: 440). Details behind this description are given in chapter four, where CO_2 markets are described in detail and compared with the alternatives of a CO_2 tax or mandated CO_2 reductions.

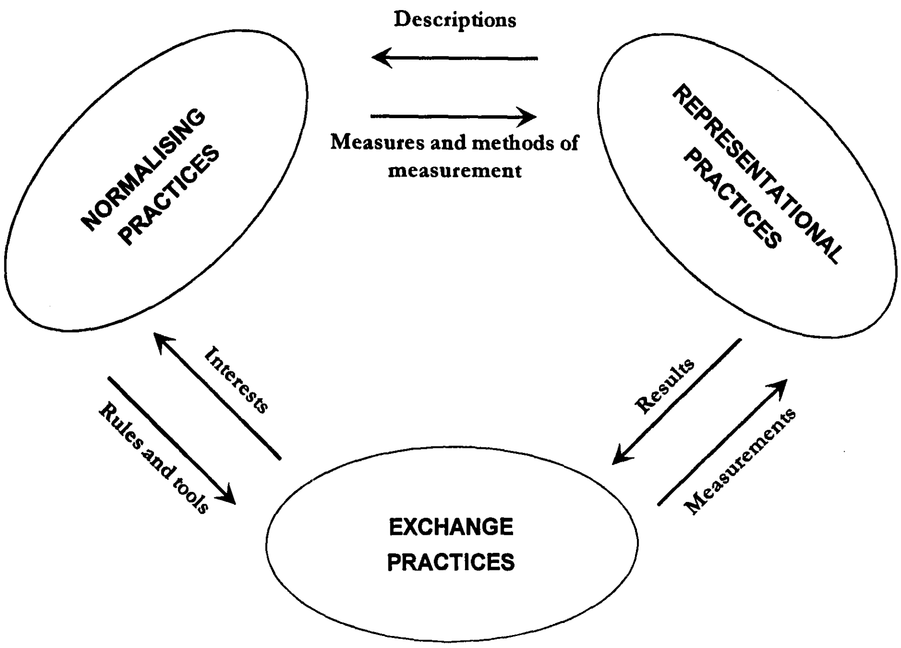
The next section discusses theoretical aspects of market design and operation, starting with network-level aspects of markets.

2.4 Network-level aspects of markets

The following three sections examine network-level aspects of CO_2 market design and operation in more detail. The discussion continues from the introductions presented in sections 2.2 and 2.3. Section 2.2 examined the substance of markets and introduced a view of markets as networks of actors engaged in exchange, representational and normalising practices (Kjellberg & Helgesson, 2007a). Section 2.3 provided an introduction to the objectives and theoretical underpinnings of CO_2 markets. These introductions support the following discussion, which further examines the view of markets as networks of actors engaged in exchange, representational and normalising practices, as illustrated in Figure 1.

Figure 1: Network-level aspects of CO_2 markets

NB: Simplified version of Figure 3 in Kjellberg and Helgesson (2007a: 151)



Sections 2.4.1 to 2.4.3 discuss the implications of market practices and the translations between them for CO_2 market design and operation. Section 2.4.1 examines exchange practices. Exchange practices relate to the economic exchanges taking place within the market and the supporting activities which surround them. Exchange practices influence representational and normalising practices through translations of 'interests' and 'measurements'. Section 2.4.2 examines representational practices. Representational practices are those which aim to depict markets and how they work. Representational practices influence exchange and normalising practices through translations of 'results' and 'descriptions'. Finally,

section 2.4.3 examines normalising practices. Normalising practices are those which aim to introduce normative guidelines for how a market should work. Normalising practices influence exchange and representational practices through translations of 'rules and tools' and 'measures and methods of measurement'. The discussion of these practices and translations is supported by the examination of relevant literature which explores their influence upon CO_2 market design and operation. The discussion starts below by examining exchange practices.

2.4.1 *Exchange in markets*

The purpose of markets is to facilitate the exchange of goods (North, 1990). Exchange practices are at the heart of markets and are the element of market practice that is most often the focus of research. Exchange practices are connected to representational and normalising practices through 'interests' and 'measurements' (Kjellberg & Helgesson, 2006, 2007b, 2007a). Interests drive exchange practices and inform efforts to influence a market's representational and normalising practices. Interests are not specifically defined by Kjellberg and Helgesson, but they are discussed as *"illustrat[ing] how support for and resistance towards various [market] reforms [are] ...influenced ... by the interests that the prevailing exchange practices endow various actors with."* (Kjellberg & Helgesson, 2007a: 148). Later on in the paper *"clashing interests"* are said to be behind *"intense normalising efforts"* in some markets (Kjellberg & Helgesson, 2007a: 153). Although interests are not specifically defined by Kjellberg and Helgesson, their use of the term is consistent with the dictionary definition of interests as *"a stake or involvement in an undertaking"* (Pearsall, 1999: 737). Measurements are defined as descriptions of exchange which feedback into representational practices, influencing how actors see the market. Accordingly, measurements describe how exchanges have altered the market and are *"based on norms concerning what to measure (measures) and how to measure (methods of measurement)"* (Kjellberg & Helgesson, 2007a: 149). Interests and measurements are now discussed.

Interests are important during the design and operation of markets in a number of ways. Firstly, market operation can be hampered by the dominance of established interests. For example, trade associations are often formed and controlled by the incumbents within an industry. These incumbents then use the trade association to voice their self interest, to share knowledge and to campaign against change (Vermeulen et al., 2007). Furthermore, economic interests have historically played a central role in the analysis of markets. For example, previous research concludes that shareholder's economic interests are one of the primary drivers which determines the business response CO_2 markets (Reid & Toffel, 2009). In contrast, the sustainability literature has long argued for greater attention to be paid to environmental and social interests of non business stakeholders (Elkington, 1994; Elkington, 1997; Molisa & Wittneben, 2008). While it is important to acknowledge the other dimensions of markets, a robust treatment of economic interests is essential if adverse economic incentives are to be avoided. Rather than taking the economic system as a given, it has been argued that we are able to design it to achieve the ends which we define as desirable (Barnett, 1986, 2003; Hurwicz, 1973; McMillan, 2003; Roth, 2002, 2007a, 2008). An example of such arguments is that *"environmental accounting helps transform environmental objects into commercial goods and services"* (Lohmann, 2009: 500). This argument illustrates the view that market design efforts must aim to structure incentives so that when participants act in a self-interested manner, desirable outcomes are still possible and economically attractive (Hurwicz, 1973; McKibbin & Wilcoxen, 2002; Myerson, 1979, 1986; Roth, 1982). Research on the United Kingdom's liberalised electricity markets, concludes that economic interests still drive generators to select the cheapest technology available, despite wider environmental interests. These low cost technologies are typically coal or gas fired power stations. Selection of these technologies threatens to prevent the delivery of the United Kingdom's targets for renewable electricity generation and CO_2 reductions. It is suggested that regulators, as market makers, need to reconsider the relationship between the environmental and economic interests at stake in the electricity market (Woodman, 2003). This rebalancing of interests is the objective behind efforts to develop CO_2 markets to monetise CO_2 emissions and align environmental protection interests with business interests in profit maximisation.

The second exchange practice examined is the employment of measurements. Measurements are descriptions of exchange which feedback into representational practices. Measurements, or the lack of them, can impede market design and operation, since measurements form the basis upon which exchanges are undertaken. For example, measurements have offered some potential to overcome the adverse economic incentives faced by the market for renewable electricity. One of the problems faced by the market for renewable electricity is that it is difficult to charge a premium for renewable electricity. The premium for renewable electricity is hard to justify, because it is impossible to match renewable electricity generated to that consumed. All renewable electricity produced is fed into the national grid and mixed with electricity from other sources. At the customer's end, electricity is simply pulled from the grid and it is impossible to measure whether this electricity came from a renewable source or not. This presents problems in how to trace the electricity produced by renewable sources through to the customer who paid for it. Without a mechanism to overcome this challenge and measure the consumption of renewable electricity, it becomes very difficult to charge a premium for renewable electricity. This complication necessitated the development of a market for green electricity certificates called Renewables Obligation Certificates (ROCs) (Rohracher, 2009). Renewables Obligation Certificates are purchased by the customer to prove that they paid for renewable electricity to be supplied to the grid. Even though another consumer may have actually used the renewable electricity, such a system prevents one unit of renewable electricity from being sold a number of times. The United Kingdom's government regulates the generation of Renewables Obligation Certificates to ensure that only one ROC is issued per each unit of renewable electricity produced. Renewables Obligation Certificates also provide a purchaser with proof of their green claims of having paid for the generation of an amount of renewable electricity equivalent to the purchaser's consumption (Rohracher, 2009). Another example of a problem of measurement, is the challenge of measuring and making comparable the Climate Change impact of different activities which produce CO_2 (Kolk et al., 2008; Levin & Espeland, 2002; MacKenzie, 2009). Guidelines have been developed in order to make different CO_2 emitting activities commensurable. These guidelines specify the conversion factors and measurement techniques for the calculation and reporting of CO_2 emissions in an effort to make different CO_2 emitting activities commensurable. These examples illustrate the importance of measurement practices to market design and operation. The next section examines the role of representational practices in markets.

2.4.2 Representations of markets

Representations of markets are not only prerequisites for exchange, they are also significant results of the exchange (Hardie & MacKenzie, 2007). However, representations are not uniform or stable and there are multiple versions of markets, due to different representations developed by different actors (Finch, 2007; Ford et al., 2003; Henneberg et al., 2006; Leek & Mason, 2010; Weick, 1993, 1995). As such, representational efforts must be acknowledged as being negotiated, in flux and actor-specific. This means that representations are influenced by the agendas and biases held by different actors. The considerations presented above mean that representations are a discursive tool, rather than being 'representational' of an external and stable environment (Geiger & Finch, 2010). Theoretically, representations could be linked to concepts such as 'network theories' (Johanson & Mattsson, 1992), 'mental modes' (Hodgkinson & Johnson, 1994; Hodgkinson, 1997). They could also be linked to the theoretical construct of 'network pictures' that circumscribes the subjective interpretations and views of individual business actors (Ford et al., 2003; Geiger & Finch, 2010; Henneberg et al., 2006; Henneberg et al., 2010; Leek & Mason, 2010; Ramos & Ford, in press). In this research, however, representational practices are connected to exchange and normalising practices through 'results' and 'descriptions' (Kjellberg & Helgesson, 2006, 2007b, 2007a). Results drive exchange practices by influencing how market participants view the outcome of their exchanges *'Results [of measurements] act directly upon exchange practice, for example in the shape of costing calculations and evaluations of marketing activities"* (Kjellberg & Helgesson, 2007a: 150). Descriptions of markets drive normalising practices by informing participants' representations of the markets which they are seeking to regulate in some way. Results and descriptions are now discussed.

Results of representational practices drive exchange practices by influencing how participants view their exchanges. Representations *"have a certain normative power"* (Henneberg et al., 2010: 358). For example, the results of different potential representations of being late to collect a child from school have been shown to significantly influence the behaviour of parents (Gneezy & Rustichini, 2000). In this example of representations of late collection of children, it was decided that a fine would be introduced to discourage parents from collecting children late. Surprisingly, this new system did not have the desired affect and the incidence of late collection by parents actually increased. One explanation for this was that, following introduction of the fines, the previous representation of late collection as a 'social taboo' was replaced by fines, which were represented as 'cheap childcare' (Gneezy & Rustichini, 2000). Research also reveals that the way results are presented has an effect upon the ensuing decisions that is independent of the decision variables themselves (Tversky & Kahneman, 1986). For example, it has been shown that positive representations of decisions, regarding gains, prompt risk-averse behaviour. Negative representations however, regarding losses, prompt risk-seeking behaviour (Kahneman & Tversky, 1979). These behavioural affects could be affecting the operation of CO_2 markets, since the majority of actions on Climate Change are negatively framed as responding to a risk.

Descriptions drive normalising practices by informing participants' representations of the markets which they are seeking to regulate in some way. Previous research has examined how descriptions influenced the making and exchange of a second-hand oil field (Finch & Acha, 2008). The research suggests that multiple versions of an object are created through the descriptions developed by different actors, such as a 'spent oil field', or one ready for secondary exploitation, a 'second-hand oilfield'. These descriptions will have implications for attempts to apply calculations ahead of exchanges. Similar insights are given by Simakova & Neyland (2008) when they argue that marketing involves describing 'constituencies' of relevant people and things that could be recipients of a new offering. They argue that offerings will fail if they are without a compelling description articulating the case for the constituency's existence and its need for the new offering. This is again similar to the claim that markets can be understood through a process based explanation of how actors recognise each other and attempt to pre-configure each other for certain desirable outcomes (Andersson et al., 2008). There is a paradox whereby markets rely upon instantaneous disentanglement of context to produce a description of a 'good' which can be the subject of calculated exchange, while simultaneously preserving an entangled description of the historic and current context surrounding the 'product'. The product can be many goods simultaneously and at different points in its life. For example, the product of a car could be described as any number of goods, such as a new car, second-hand car, or a taxi (Araujo, 2007). In a similar manner, the description of CO_2 allowances by companies was a subject of contest at the global level. Under existing accounting rules, CO_2 allowances could either be described as 'intangible assets', or as 'financial instruments'. The choice of description would lead to the application of different international accounting standards which would significantly influence the corporate reporting requirements placed upon companies (Cook, 2009; MacKenzie, 2009). Finally, a further example of the importance of descriptions within markets is German opposition to CO_2 markets that is rooted in the description of CO_2 markets as involving 'selling pollution' (Engels, 2001; Roth, 2007b). This is an example of a market's description impacting upon its operation.

Having examined the importance of representations in markets, the following section explores the influence of market constitutions.

2.4.3 Constitutions of markets

The constitution of markets refers to the *"system of values, norms, rules and other conventions that are shared by actors"* (Mouzas & Ford, 2009: 495). Many markets, such as those for CO_2, aim to bring benefits by simplifying complicated systems and making them accessible to non experts (Tenbrunsel et al., 2000). This process of simplification and standardisation is often embedded in different types of rules which govern the operation of markets (Mouzas, 2006a; Mouzas & Ford, 2009). Specifically, the rules embedded in a number of markets are designed to give a business cost to externalities. Externalities are costs resulting from the actions of businesses, but which businesses are not legally required to pay. For example, CO_2 emissions result in a number of externalities due to the costs imposed by Climate Change. CO_2 markets are attempting to remove these externalities by giving a cost relating to businesses' CO_2 emissions (Bazerman & Hoffman, 1999; Jamieson, 2006). Market constitutions are held within normalising practices that are connected to exchange and representational practices through 'rules and tools' and 'measures and methods of measurement' (Kjellberg & Helgesson, 2006, 2007b, 2007a). Rules and tools are used to perform and influence exchange practices. Measures and methods of measurement influence representational practices. Rules and tools and measures and methods of measurement are discussed below.

Rules and tools can be socially based (Fligstein, 1996; Fligstein & Dauter, 2007; Granovetter, 1985; White, 1981), but can also rely upon non-human actors to support calculative and other activities (Latour, 1992; Morgan, 2008). Examples of these non-human actors include information technology systems, physical arenas, such as trading floors and specialist models, such as the pricing models used in trading (Beunza et al., 2006). During market design and operation, rules and tools are often developed through institutional initiatives which establish new property rights, attenuate previously existing property rights and facilitate the exchange of these rights (Pearce, 2004). These rules and tools are of particular importance to this research, since previous research has found that rules within regulations are significant drivers of the business response to Climate Change (Kolk et al., 2008). Furthermore, market rules are required to deal with technicalities such as how to treat substitute goods. For example, the Kyoto Protocol includes six greenhouse gases: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, but only one price for CO_2 (UNFCCC, 2005). Each of these different gasses has a different global warming potential, so the designers of CO_2 markets have to decide how to develop conversion factors to allow other gases to be expressed in terms of their 'global warming potential' which converts them into equivalent amounts of CO_2 (MacKenzie, 2009). Another example of the influence of rules upon markets is the European Union's treatment of taxes versus environmental regulations. Taxes are regulated by 'unanimity', but emissions trading counts as an environmental matter, managed through 'qualified majority voting' (Christiansen & Wettestad, 2003; MacKenzie, 2007). These rules meant that a CO_2 tax would have been much harder to implement than a CO_2 market. A CO_2 tax required unanimity, while a CO_2 market could be formed through a ballot that reached a majority. Finally, decisions governed by rules of the market emphasise the market itself, rather than the issue which the market is designed to tackle. It is therefore important to recognise that in basing a decision upon a set of market rules, there is a fundamental shift in the decision type, from one based upon absolute effectiveness, towards one based upon effectiveness relative to a reference point, i.e. the legislation (Tenbrunsel et al., 2000).

Measures and methods of measurement influence representational practices. These calculative practices are partly social in nature and do not conform to purely rational considerations (Finch, 2007; MacKenzie, 2004). Furthermore, calculative practices don't simply generate descriptions of the market; they also shape it (Azimont & Araujo, 2007; Callon & Muniesa, 2005). The tools which enable this market shaping to take place are referred to as market devices (Azimont & Araujo, 2010; Callon & Muniesa, 2005; Reverdy, 2010). One example of a market device is the shopping cart. Previous research has shown that the humble shopping cart has a significant influence upon consumer markets (Cochoy, 2008). During the shopping process, the shopping cart becomes a measurement tool, turning price based decisions into a volumetric constraint set by the size of the cart. The cart also embeds some of the rules into the shopping process, for example by converting an individual buying experience into a collective one, with the cart acting as the hub for a 'buying collective' such as a family (Cochoy, 2008). It can be imagined how the size of the cart, the layout of the supermarket and the configuration of packaging could affect market design and operation in this setting. For example, goods must fit in the cart, must be located on an aisle that the cart can fit down and must be identifiable from their packaging. Similarly, measures and methods of measurement are important in CO_2 markets, as they set which CO_2 emissions sources are included, how they are measured and can ultimately influence the actions which the market incentivises. For example, gas has been calculated to be a lower CO_2 form of energy than coal. This has contributed to the United Kingdom's recent emphasis on the development of gas fired power stations and protests at proposed sites for coal fired power stations.

This section brings to a close the discussion of markets as networks of actors engaged in exchange, representational and normalising practices (Kjellberg & Helgesson, 2007a). The following section discusses how this view of the nature of markets influenced the development of the research questions posed.

2.4.4 Network-level implications for research questions

The ultimate objective of this study is to explore why CO_2 markets have so far failed to have a significant influence upon businesses' behaviour. This objective and the study's research questions were introduced in chapter 1. This section now provides a more detailed discussion of the study's research questions which relate to network-level aspects of CO_2 market design and operation. Section 2.5.4 discusses the research questions relating to macro-level aspects of CO_2 market design and operation. The research questions discussed below were developed by considering the concepts presented in the previous sections of this chapter. The four research questions (RQs) are discussed below.

RQ 1: Who are the actors involved in CO_2 market design and operation?

Research question 1 acknowledges that a network perspective of CO_2 market design and operation emphasises the interdependence between CO_2 regulators and CO_2 market participants. The literature review has shown that current theories of CO_2 market design place a disproportionate emphasis upon the desires and objectives of

CO_2 market regulators. This first research question aims to redress the balance by identifying the other network actors who are involved during CO_2 market design and operation. These findings will contribute to a more detailed empirical understanding of the networks which operate CO_2 markets.

Research question 1 will ensure that a complete view of the actors involved in CO_2 market design and operation is developed. Research questions 2 to 4 then aim to ensure that the full range of each actor's network practices are described and analysed. This research adopts a view of markets as networks of actors engaged in exchange, representational and normalising practices (Kjellberg & Helgesson, 2007a). These concepts and their implications for CO_2 markets were discussed in sections 2.4.1 to 2.4.3 and summarised in Figure 1. Research questions 2 to 4 aimed to examine market practices and the translations by which they influenced each other during CO_2 market design and operation.

RQ 2: How do exchange practices affect CO_2 market design and operation and what is their influence upon representational and normalising practices?

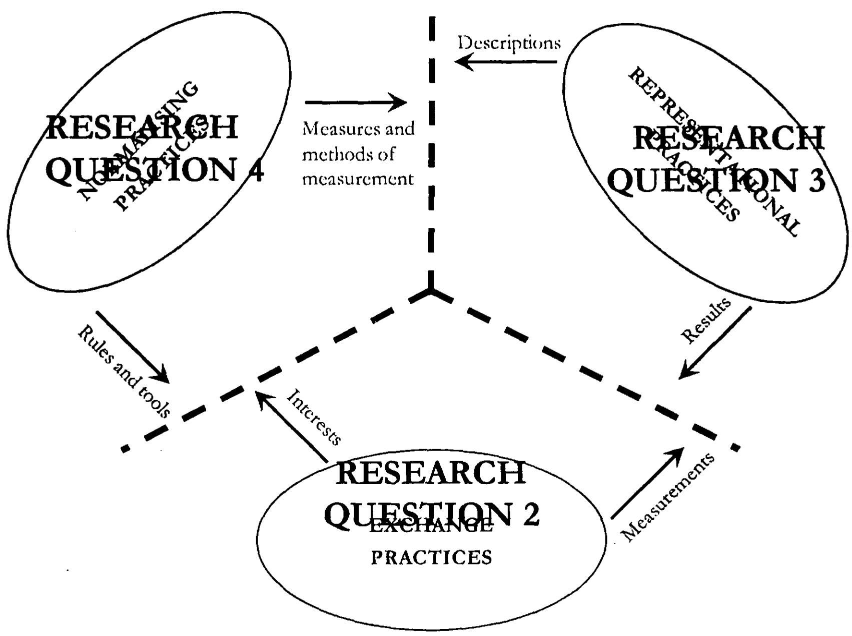
RQ 3: How do representational practices affect CO_2 market design and operation and what is their influence upon exchange and normalising practices?

RQ 4: How do normalising practices affect CO_2 market design and operation and what is their influence upon exchange and representational practices?

As discussed above, these research questions attempt to draw out a complete view of the three types of market practices proposed by Kjellberg and Helgesson (2007a). Research questions 2 to 4 also consider the influence of the three types of market practice upon each other, by examining the translations which link them. Figure 2 summarises the links between Kjellberg and Helgesson's (2007a) model and research questions 2 to 4. Research questions 2 to 4 are discussed below.

Figure 2: Linking research questions 2 to 4 and market practice theory

NB: Annotated version of Figure 1 from page 32



Research question 2 examines the section of Kjellberg and Helgesson's (2007a) model which relates to exchange practices. The first half of the question seeks to understand how exchange practices affect CO_2 market design and operation. The second half of research question 2 looks at how exchange practices influence representational and normalising practices. This part of the question focuses attention upon the two translations of: 'measurements', which link exchange practices to representational practices and 'interests', which link exchange practices to normalising practices.

Research question 3 examines the section of Kjellberg and Helgesson's (2007a) model which relates to representational practices. The first half of the question seeks to understand how representational practices affect CO_2 market design and operation. The second half of research question 3 looks at how representational practices influence exchange and normalising practices. This part of the question focuses attention upon the two translations of: 'results', which link representational practices to exchange practices and 'descriptions', which link representational practices to normalising practices.

Finally, research question 4 examines the section of Kjellberg and Helgesson's (2007a) model which relates to normalising practices. The first half of the question seeks to understand how normalising practices affect CO_2 market design and operation. The second half of research question 4 looks at how normalising practices influence exchange and representational practices. This part of the question focuses attention upon the two translations of: 'rules and tools', which link normalising practices to exchange practices and 'measures and methods of measurement', which link normalising practices to representational practices.

This section has provided a discussion of the theoretical underpinnings for my research questions which relate to network-level aspects of CO_2 markets. The following section examines technical, temporal and uncertainty-based considerations as macro-level aspects of CO_2 market design and operation.

2.5 *Macro-level aspects of markets*

This section summarises the results of a review of the wider business and environmental literature concerning market design and operation and the empirical research setting of CO_2 and other environmental markets. Full results of this review are given in Appendix three. Figure 3 summarises the results of the literature review, giving a conceptual framework for the study of macro-level aspects of market design and operation. The technical, temporal and uncertainty based aspects which impact upon market design and operation are then introduced before being discussed in the following three sections.

This literature review was structured in two parts. Firstly, theoretical keywords of 'market design', 'market operation', 'mechanism design', 'market creation', 'market formation' and 'market barriers' were used to search for material related to market design and operation. The further keywords beyond 'market design' and 'market operation' were added as they were identified in the literature. Secondly, empirical keywords of 'carbon', 'CO_2', 'carbon market', 'Climate Change', 'global warming', 'Kyoto', 'European Emissions Trading Scheme', 'EU ETS', 'Carbon Reduction Commitment', 'CRC', 'Climate Change Agreement' and 'CCA' were used to identify literature that was relevant to the empirical setting. The key words were selected as general phrases relevant to Climate Change, together with the names and abbreviated names of the CO_2 markets and other CO_2 regulation covered by the research. Full results of this review are given in Appendix three and a summary is made below.

The first level of the search was performed through 'Google Scholar' (Google Scholar, 2010) and returned a manageable number of results that were relatively coherent as a group. There were 408 results for 'market design', 169 for 'market operation', 1,550 for 'mechanism design', 61 for 'market creation', 51 for 'market formation' and 90 for 'market barriers'. The terms relating to the empirical setting were not checked within Google, as they were too broad for such a coarse filter. Initial attempts to search these empirical keywords returned unmanageable numbers of results that were not coherent as a group. The results from the Google Scholar search were processed by making a brief review of the titles and abstracts of each paper. Any papers which were relevant to the research were read in full.

Next the search was repeated using the online database, 'Business Source Premier' (Business Source Premier, 2010). To supplement the search through Business Source Premier, all 4* journals and any 3* marketing journals were identified through the Association of Business Schools (ABS) rankings (Association of Business Schools, 2010). Where the Business Source Premier search did not cover these journals, a separate search was undertaken. The search used the Boolean function to identify 'exact matches only' in either the 'article title' or 'abstract' and restricted the results to only those from 'peer reviewed journals'. This time, there were 193 results for 'market design, 73 for 'market operation, 283 for 'mechanism design', 43 for 'market creation', 29 for 'market formation' and 49 for 'market barriers'. 'carbon', 'CO_2' and 'carbon market' returned 8,413 results; 'Climate Change' and 'global warming' gave 3,910 results; 'Kyoto' gave 987 results, 'European Emissions Trading Scheme' and 'EU ETS' gave 61 results, 'Carbon Reduction Commitment' and 'CRC' gave 6 results, 'Climate Change Agreement' and 'CCA' gave 9 results. As a point of reference, a number of searches for more common terms were performed, in order to check that the search settings were not too restrictive. Under the same settings, 'market' returned 40,668 results and 'relationship' returned 23,959. This gave confidence that the search method was structurally correct, meaning that the low numbers of results found were representative of a low level of treatment of market design and operation in the existing marketing literature. The coverage of the search was extended to PhD dissertations through interrogation of a database at Theses.com which carries listings back to the early 1700s. A second database of PhD dissertations was searched at the Industrial Marketing and Purchasing Group's online database (IMP Group, 2010; Theses.com, 2010). Theses.com returned 11 dissertations which warranted investigation, however their abstracts were sufficient to rule them out from being directly relevant to the research. The Industrial Marketing and Purchasing Group's database gave three dissertations which were in environmental fields, but not directly relevant to market design and operation. Finally, a search was made of the policy related energy and Climate Change journals of 'Energy policy', 'Climate policy', 'Climatic change', 'Journal of Cleaner Production' and a 'Wiley interdisciplinary review of Climate Change'. These searches returned another 100 or so results which were reviewed and provided a number of relevant articles.

The results of this literature review were organised by summarising the material in Table 1. Table 1 shows that much of the material could be subsumed within the network-level aspects of market design and operation introduced in section 2.4. The right hand side of Table 1 logged any aspects which did not fit within the exchange, representational and normalising practices identified as network-level aspects of market design and operation. This approach identified macro-level aspects which influenced market design and operation.

Table 1: Identifying macro-level aspects of markets

	Exchange		Representational		Normalising		Macro-level aspects
	Interests	Measurements	Results	Descriptions	Measures and Methods of Measurement	Rules and tools	
1. Off-Street parking policy without parking requirements: A need for market fostering and regulation (Barter, 2010)	✓	✓		✓	✓	✓	· Technical
2. Sources of environmentally destructive behaviour: Individual, organizational and institutional perspectives (Bazerman & Hoffman, 1999)	✓			✓	✓	✓	· Cognitive biases · Resource limitations · Temporal
3. Small firms' interaction with political organizations in the European Union (Bengtson et al., 2009)							· Temporal
4. Barriers to matching new technologies and market opportunities in established firms (Bond & Houston, 2003)	✓	✓			✓	✓	· Technical
5. Carbon market: Business incentives for sustainability (Conejero & Farina, 2003)					✓	✓	· Scarcity of human capital · Technical · Uncertainty
6. Market creation and transnational rule-making: The case of CO_2 emissions (Engels, 2005)	✓	✓	✓	✓	✓	✓	· Technical
7. Megamarketing: The creation of markets as a social process (Humphreys, 2010)	✓	✓	✓	✓			-
8. Getting Counted: Markets, Media and Reality (Kennedy, 2008)				✓			-

	Exchange		Representational		Normalising		Macro-level aspects
	Interests	Measurements	Results	Descriptions	Measures and Methods of Measurement	Rules and tools	
9. Strategic responses to global Climate Change: Conflicting pressures on multinationals in the oil industry (Levy & Kolk, 2002)				✓	✓	✓	· Uncertainty
10. Missing the turn towards a low-emission path? (Meinshausen & Hare, 2008)							· Temporal
11. Innovation Games: A new approach to the competitive challenge (Miller et al., 2008)	✓	✓				✓	· Technical · Uncertainty
12. Communicating Climate Change: history, challenges, process and future directions (Moser, 2010)		✓	✓	✓	✓		· Technical · Temporal
13. Creating Markets for Ecosystem Services (Murtough et al., 2002)							· Uncertainty
14. An exploration of motivations, drivers and barriers to carbon management: The UK FTSE 100 (Okereke, 2007)		✓	✓			✓	· Technical · Uncertainty
15. Environmental market creation: saviour or oversell? (Pearce, 2004)	✓	✓			✓	✓	-
16. Intermediaries and the governance of choice: the case of green electricity labelling (Rohracher, 2009)		✓			✓	✓	
17. Barriers to the implementation of cleaner production in Chinese SMEs: government, industry and expert stakeholders' perspectives (Shi et al., 2008)	✓	✓				✓	· Informational asymmetries · Lax enforcement · Technical
18. Overcoming barriers to the implementation of	✓					✓	· Technical

	Exchange		Representational		Normalising		Macro-level aspects
	Interests	Measurements	Results	Descriptions	Measures and Methods of Measurement	Rules and tools	
alternative fuels for road transport in Europe (Steenberghen & Lopez, 2008)							
19. Economics of migratory birds: Market creation for the protection of migratory birds in the inner Niger delta (Mali) (Sultanian & Van beukering, 2008)	✓	✓	✓	✓	✓	✓	-
20. Market barriers to energy-efficiency investments (Sutherland, 1991)	✓		✓	✓		✓	· Cognitive biases · Uncertainty
21. The sustainable diffusion of renewable energy technologies as an example of an innovation-focused policy (Tsoutsos & Stamboulis, 2005)	✓	✓	✓	✓		✓	· Cognitive biases · Infrastructure limitations · Technical · Temporal
22. Climate Change mitigation: trade-offs between delay and strength of action required (Vaughan et al., 2009)							· Technical · Temporal
23. Economics of electric energy storage for energy arbitrage and regulation in New York (Walawalkar et al., 2007)							· Technical
24. Market barriers to the recycling industry: The effectiveness of a market driven waste management strategy in the UK (Watts et al., 1999)					✓	✓	· Scarcity of human capital

Table 1 identifies a number of macro-level aspects of market design and operation that are discussed in the literature and which fall outside the practice based exchange, representational and normalising practices listed in the left hand columns of the table. These macro-level aspects are listed in Table 2.

Table 2: Macro-level aspects of markets

1.	Cognitive biases
2.	Informational asymmetries
3.	Infrastructure limitations
4.	Lax enforcement
5.	Resource limitations
6.	Scarcity of human capital
7.	Technical aspects
8.	Temporal aspects
9.	Uncertainty-based aspects

These outliers are external to the market being studied and influence all types of market practice. Table 2 lists all of the macro-level aspects of market design and operation identified during the literature review. Inspection reveals that some of the macro-level aspects can be subsumed within others which are more generic. Three macro-level categories are proposed as technical, temporal and uncertainty based aspects of market design and operation. Technical aspects include infrastructure limitations, resource limitations and the scarcity of human capital. Temporal aspects could arguably be subsumed within technical aspects, but have been kept separate as they received considerable attention in the literature. Finally, uncertainty subsumes cognitive biases, informational asymmetries and lax enforcement. These macro-level aspects of market design and operation are shown in Figure 3.

Figure 3: Macro-level aspects of CO_2 markets

MACRO LEVEL ASPECTS	**Technical**	Technological
		Public goods and resource limits
	Temporal	Windows of opportunity
		Lock ins
	Uncertainty	Problem uncertainty
		Cognitive biases

The macro-level aspects of market design and operation are introduced below. Their development is described in more detail in the following three sections.

Firstly, technical aspects of market design and operation are 'technological' aspects and those due to 'public goods and resource limits'. Technological aspects are immutable physical laws, or the limits of today's technical capabilities. Public goods and resource limits relate to environmental constraints upon markets. Secondly, temporal aspects of market design and operation are 'windows of opportunity' and 'lock ins'. Windows of opportunity acknowledge that the design and operation of many markets will be subject to a time limit, after which there is little possibility to solve the problem, or meet the needs, which the market has been designed to tackle. The second temporal aspect of lock ins relates to decisions which have an extended and irreversible impact. Finally, uncertainty based aspects of market design and operation are 'problem uncertainty' and 'cognitive biases'. Problem uncertainty is an important aspect of market design and operation since it introduces uncertainty regarding the best or most expedient way to cope with the problem that the market is designed to tackle. Cognitive biases are frailties embedded in the human learning and decision making process which distort our views of the world and are often subconscious.

The following three sections provide detailed discussions of the three macro-level aspects of market design and operation. The discussion starts by examining technical aspects of market design and operation.

2.5.1 Technical aspects of markets

This section introduces theoretical and empirical examples of technical aspects of market design and operation. Firstly, technological aspects, which are due to immutable physical laws and the limits of today's knowledge and capabilities, are examined. Secondly, public goods and resource limits are analysed.

The first technological aspect of market design and operation is commensuration, which relates to the reconciliation of the physical and exchange technicalities of markets (Engels, 2005). For example, CO_2 market design involves the definition of reporting baselines against which to measure progress. Reporting and monitoring techniques also had to be developed. Finally, these were often built into software and hardware which performed the reporting on an ongoing basis. Furthermore, at a more fundamental level, there are the technological challenges of accurately determining and reflecting the cost of environmental damage caused by CO_2 and other pollutants (Bond & Houston, 2003; Watts et al., 1999). These technological assessments are at the heart of target setting and reporting within CO_2 markets.

Secondly, the objective of these markets is to foster changes in business behaviour. As such, the technological challenges of reducing CO_2 emissions through the development of new technologies, or updates to existing ones, are important aspects of the design and operation of CO_2 markets (Okereke, 2007; Shi et al., 2008). For example, technological aspects relating to infrastructure investment and maintenance are important during the design and operation of renewable electricity markets. These aspects include the complexity caused by challenges of integrating renewables within the existing electricity generation and transmission system; the need for dispersed geographical application of new technologies and electricity distribution network incompatibilities (Teppo, 2006; Tsoutsos & Stamboulis, 2005). A final technological aspect of the market for renewable electricity is that there is a lack of large scale storage options for electricity (Walawalkar et al., 2007). Electricity production is forced to meet demand at an almost real time rate, which is difficult for renewables because they typically rely upon intermittent sources of energy.

A further example of technological aspects of market design and operation comes from an examination of the potential development of markets for parking provision in urban areas. This literature suggests that there is potential for city planning authorities to move away from their typical planning policies which force developers to provide off street parking as a mandatory part of their planning application. Instead an approach is suggested whereby municipalities accept in-lieu payments to support the development of parking at central public sites instead. This parking space market would enable the development of areas where it is not possible to invest directly in onsite parking. This could lead to the development of areas which were previously neglected due to the lack of potential for onsite parking, while still addressing the need for additional parking. An important technological aspect of these developments is that, within urban sites, certain changes of use are less problematic than others. Therefore, the development of a market based response to urban parking provision is hampered by the consideration that parking sites are hard to covert to and from most other uses and are therefore not attractive to developers (Barter, 2010). Another example of a technological aspect of market design and operation deals with new markets for alternative transport fuels. Liquid Petroleum Gas (LPG) has significant potential to reduce automotive CO_2 emissions, but faces the technological challenge that it is heavier than air. This characteristic of Liquid Petroleum Gas introduces cost burdens in the form of gas traps and other safety measures which are required before garages can work on cars powered by Liquid Petroleum Gas (Steenberghen & Lopez, 2008).

Finally, technological aspects can impede communication during market design and operation. For example, technological aspects of CO_2 markets are the invisibility of CO_2; the distant impacts of Climate Change (geographically and temporally); the insulation of modern humans from their environment; the delayed or absent gratification for taking action on Climate Change and the inadequate signals indicating the need to change (Moser, 2010).

The discussion now shifts to public goods and resource limits, which are the second technical aspect of market design and operation. Public goods are examined since they are important technical aspects of CO_2 market design and operation. Resource limits are often the technical reason behind the development of markets, without resource limits there would be no need for the development of markets to protect these resources or to allocate them efficiently.

Before discussing public goods, an important related issue of externalities is examined, since the provision of public goods often also involves dealing with externalities. Certain new markets are formed in order to introduce business costs relating to what were previously 'externalities' (Owen, 2006). Externalities are costs of consumption which do not fall with the actor responsible for their generation (Barrett, 2007; Coase, 1960, 1988; Dales, 1968; Demsetz, 1966). For example, before sulphur dioxide trading was introduced in the United States, companies did not bear a cost relating to their emissions of sulphur dioxide, even though these emissions imposed costs on others, through the formation of acid rain (Webster, 1994). A further example is that the Stern Review estimated the social cost of one tonne of CO_2 emissions to be an externality of $85 (Stern, 2006: xvi).

In discussions of externalities, public goods are often of parallel concern, but it is important to acknowledge that they are not the same as externalities. A public good is any good which is non-excludable and non-rival in its consumption (Cornes & Sandler, 1986; Groves & Ledyard, 1977; Hardin, 1968; Olson, 1965; Peattie & Ratnayaka, 1992). This means that public goods are available for everyone and their consumption by one actor does not prevent others from using them. Public goods are therefore subject to dysfunctional individual incentives which result in what Hardin (1968) terms the 'tragedy of the commons'. When a resource is treated as a 'commons', i.e. free to all, individual incentives for preservation of the resource are insufficient, resulting in damaging behaviour by the collective group of users (Hardin, 1968). The problem is that the incremental benefit to each individual is higher in exploiting the public good, rather than acting to preserve it. At the group level, this ultimately results in degradation of the resource. This is in line with many observations of commons or partial commons in the real world, for example over-fishing, deforestation and overgrazing (Bazerman & Hoffman, 1999). In the case of

CO_2 markets, the scarce natural resource is the earth's atmosphere which is unable to absorb CO_2 at the rate at which it is currently being released (Kjellberg, 2008; Lohmann, 2005).

It is possible to define a number of types of public goods, with each being subject to varying degrees of difficulty in their provision (Barrett, 2007). The first type of public good is a 'single best effort', whereby the public good can be provided by one action and then remains in place. These kinds of public goods are easier to provide, since one actor can provide them and there is no need to uphold them on an ongoing basis. An example of a single best effort is the Global Positioning System that was set up without global funding, but is available globally. Secondly, 'weakest link' public goods are defined as those requiring contributions from all parties. Global disease eradication programmes are efforts to provide 'weakest link' public goods. This is because one single country, the weakest link, can cause failure of the efforts. Finally, 'aggregate effort' public goods sit somewhere between single best effort and weakest link public goods, they can be provided by partial coalitions. Climate Change mitigation is an aggregate public good, it requires all major emitters to contribute to the efforts, but small emitters do not need to be included to make the effort successful. Climate Change mitigation is an example of an effort to provide a good which is both an externality and a public good (Schelling, 1992). Firstly, Climate Change is an externality, since businesses do not typically recognise a cost related to their emissions of CO_2. Of course, this is changing in regions and industries which are covered by CO_2 markets. Secondly, Climate Change is caused by an excess of CO_2 in the atmosphere. The production of CO_2 is a public good, as anyone can emit CO_2 and doing so does not prevent others from also doing so.

Were CO_2 a locally bounded pollutant, it could be managed at the national level, a much easier exercise than the global response required (Vaughan et al., 2009).

This section has discussed the technical aspects of market design and operation. In the following section, the influence of temporal aspects of market design and operation are examined.

2.5.2 Temporal aspects of markets

This section discusses temporal aspects of market design and operation. Temporal aspects of market design and operation are 'windows of opportunity' and 'lock ins'. Windows of opportunity are important since the design and operation of many markets will be subject to a time limit, after which there is little possibility to solve the problem, or meet the needs, which the market has been designed to tackle. The second temporal aspect relates to decisions which have long-term impacts due to the lock ins which they create. Lock ins are decisions which have an extended and irreversible impact. Windows of opportunity and lock ins are now discussed.

Windows of opportunity arise from the consideration that markets are often formed in response to a problem or need that is subject to some form of time constraint. For example products may decay, relevant events may pass, or thresholds may be breached. Windows of opportunity acknowledge that the design and operation of many markets will be subject to a time limit, after which there is little possibility to solve the problem, or meet the needs, which the market has been designed to tackle. Accordingly, an important aspect of CO_2 market design and operation is the time taken for new low CO_2 technologies to be taken up by the energy sector. CO_2 in the atmosphere is measured in terms of the concentration level, which is effectively cumulative, since CO_2 has a long atmospheric lifespan. The Intergovernmental Panel on Climate Change (IPCC), states that *"the projected concentration of CO_2 in the year 2100 ranges from 540 to 970 ppm, compared to about 280 ppm in the pre-industrial era and about 368 ppm in the year 2000… Projections result in an increase in globally averaged surface temperature of 1.4 to 5.8°C over the period 1990 to 2100....the projected rate of warming is very likely to be without precedent during at least the last 10,000 years."* (IPCC, 2001: 1). Taking into account the steep projected increases in CO_2 levels and their time effects, the next 20 to 30 years are critical in mounting a response to Climate Change. If it is assumed that it takes 50 years to transform the energy sector, and if action is delayed until 2020, then an emissions reduction rate of 2.5% per year would lead to an atmospheric concentration of CO_2 at around 540 parts per million. This level is aligned with consensus around safe levels of Climate Change. A further 20 year delay of action would lead to CO_2 concentrations of 730 parts per million and a 40 year delay to concentrations exceeding 1,000 parts per million (Vaughan et al., 2009). These delays are less than the life span of many investments currently being made in facilities such as oil refineries or power stations.

Lock ins can arise from the reluctance of businesses to write off infrastructure before the end of its operating lifetime. For example coal fired power stations have a 40 year life, so there is a lock in for decisions taken today to invest in new coal fired power stations. This example of a 40 year lock in is comparable to the timeframe discussed above for the required reductions in CO_2 emissions targeted by CO_2 markets (Meinshausen & Hare, 2008). Thus lock ins relating to decisions taken today will significantly influence the outcome of efforts to mitigate Climate Change.

Typical contributing factors which underpin these lock ins are the limited capacity of firms and the emergent nature of technical developments as being open ended and path dependent (Bengtson et al., 2009; Conejero & Farina, 2003; Miller & Olleros, 2007; Miller et al., 2008). Furthermore, time delays may be present between taking action and realising the anticipated benefits of that action. One such example is the delay in climate impact of reducing CO_2 emissions. This is because of the long atmospheric lifetime of CO_2 (Moser, 2010).

These examples illustrate that CO_2 markets can only mitigate Climate Change within a window of opportunity of around 20-30 years and that there are lock ins which hinder action inside that timeframe (Teppo, 2006; Tsoutsos & Stamboulis, 2005). The next section examines the influence of uncertainty upon markets.

2.5.3 Uncertainty in markets

This section discusses literature which identifies uncertainty based aspects of market design and operation. Uncertainty based aspects are 'problem uncertainty' and 'cognitive biases'. Problem uncertainty is an important aspect of market design and operation, since it introduces uncertainty regarding the best or most expedient way to cope with the problem that the market is designed to tackle. Cognitive biases are frailties embedded in the human learning and decision making process which distort our views of the world and are often subconscious. Problem uncertainty and cognitive biases are now discussed.

Problem uncertainty exists when the market participant is *"unsure of the best or most expedient way to cope with [their] problem"* (Ford & Mouzas, 2010: 958). For example, problem uncertainty can be due to the emergent nature of innovation (Miller & Olleros, 2007; Miller et al., 2008). Emphasis of the open ended and emergent nature of innovation helps to highlight that uncertainty is an inevitable aspect of market design and operation. Literature also refers to uncertainty regarding the anticipated development or enforcement of the market design (Levy & Kolk, 2002; Okereke, 2007; Shi et al., 2008; Sutherland, 1991). Such regulatory uncertainty can arise from property rights which are ambiguously defined, difficult to verify, expensive to enforce, or poorly linked to the environmental benefit which they are trying to protect (Murtough et al., 2002). Furthermore, inconsistencies in the responses of national authorities are sources of uncertainty of market participants during the operation of CO_2 markets (Conejero & Farina, 2003; Shi et al., 2008). Other markets can also introduce uncertainty, for example the investments in low CO_2 infrastructure which are sought by CO_2 markets can be affected by fuel prices. A rise in fossil fuel prices will incentivise efficiency investments, which will also reduce CO_2 emissions (Sutherland, 1991). Therefore, CO_2 markets are affected by uncertainty regarding price movements in other markets. The examples above show how uncertainty can be an important aspect of the design and operation of CO_2 markets. This problem uncertainty also often drives irrational behaviour in decision making and such cognitive biases are examined in the remainder of this section.

Cognitive biases relate to the human response to uncertainty. Cognitive biases are frailties embedded in the human learning and decision making process which distort our views of the world and are often subconscious. Cognitive biases are important during the design and operation of environmental markets. This is because environmental markets are often designed to help prevent the breaching of subjective thresholds relating to levels of harm. Setting these thresholds requires the definition of both physical and subjective limits. For example, an area will flood if severe weather events exceed the capacity of rivers, but whether this flooding is seen as acceptable or normal is subject to social and cognitive processes. This is relevant to CO_2 market design and operation, since the ultimate purpose of these markets is to avoid such thresholds. For example, the objective of the United Nations' CO_2 market of the Kyoto Protocol, is to *"stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system"* (Meze-Hausken, 2008; UNFCCC, 2005). In other words, the whole CO_2 market is built upon a need to avoid a subjective, uncertain, threshold defined as 'dangerous' Climate Change. It is this kind of uncertainty which makes cognitive biases important aspects of CO_2 market design and operation.

The calculative, social and representational aspects of markets all rely upon processes of cognition and sense making under conditions of uncertainty. In this area there has long been a stream of literature challenging the assumptions of perfect information and the feasibility of strictly rational economic decisions (Bazerman & Hoffman, 1999; Bazerman et al., 2001; Brunsson, 1982; Kahneman et al., 1982; Neale & Bazerman, 1985; Scheytt et al., 2006; Tversky & Kahneman, 1974; Wade-Benzoni, 1999). What follows is an examination of how uncertainty drives biases in cognition and decision making. This is relevant because these biases help to explain the affects of uncertainty during market design and operation.

Particularly relevant to markets targeting environmental protection, are cognitive deficiencies relating to human understanding of our influence on the natural environment. 'Naturalism' is the tendency to weigh damage done by humans to the environment as more serious than that done by nature. For example, naturalism results in a perception that even if Climate Change is real, dangerous and preventable, there is less need to cut emissions if humans did not cause the problem (Baron, 2006). The bias of naturalism is linked to the 'polluter pays' bias which captures observations that actors intuitively feel they should clean up their own waste. This leads to the idea that it is better to undo the harm you have caused than to do more good through a different action unrelated to your original actions; this is the 'undoing bias' (Baron, 2006). With Climate Change, there is a debate over whether to mitigate or adapt. The undoing bias would suggest that people would be keener to mitigate (undo) the problem, rather than adapt to the changes it brings about. Schelling argues that money spent upon mitigation would be better spent upon investment to develop local economies in the developing world, i.e. people should overcome their undoing bias (Schelling, 1992).

Timing also has an important affect upon cognitive biases. There is evidence of cognitive biases which are triggered by the inter-temporal aspects of problem solving. These biases relate to decision making regarding future benefits. Research has shown that decisions regarding future gains lead actors to discount the future more than would be justified on a purely rational basis. This leads to excessive discounting of future benefits which become disproportionately undervalued when compared to benefits available in the present day (Bazerman & Hoffman, 1999; Weber, 2006). Thus actions to mitigate Climate Change are often perceived as unattractive because they incur immediate costs in order to create future benefits which are excessively discounted before being taken into account. The full extension of excessive discounting leads to inter-generational discounting, where decision makers end up burdening future generations (Bazerman & Hoffman, 1999). This is important, since it demonstrates that temporal aspects relating to the market can lead to systematic biases in decision making processes.

Actors' engagement with markets often involves an assessment of the risk of action versus inaction. A special issue in the journal 'Climatic Change' called 'Thinking about global warming' has dealt with this issue at length (Baron, 2006; Oppenheimer & Todorov, 2006; Sunstein, 2006; Thompson, 2006). Research suggests there are two mechanisms by which actors recognise risk. The first is 'risk as feeling' and requires real world experience as input. Risk as feeling is intuitive, automatic and fast (Loewenstein et al., 2001). Risk as feeling uses 'system 1' thought, which is often used when actors approach information overload, or in situations of uncertainty (Bazerman & Malhotra, 2006). Risk recognition also occurs through 'system 2' thought (Weber, 2006), which could be called 'risk as thinking'. 'System 2' thought is conscious, reasoned and based upon analysis. Some of the slow uptake of and resistance to CO_2 markets can be explained by acknowledging that Climate Change is an example where 'risk as feeling' does not flag a significant problem, but 'risk as thinking' does. That Climate Change does not trigger a 'system 1' / 'risk as feeling', type of response could be explained by the 'availability heuristic' which suggests that people weigh risks by the ease with which examples of resulting harm can be visualised or recalled (Kahneman et al., 1982; Sunstein, 2006; Tversky & Kahneman, 1973). There is a large body of research suggesting that the relative lack of concern about Climate Change is due to a lack of availability of examples of harm resulting from Climate Change and the difficulty of visualising the complex, non-tangible, scientific and indirect chains of cause and effect at play. In other words, the lack of availability of examples of harm resulting from Climate Change can at least partly be explained by the somewhat unique nature of CO_2 as a pollutant. CO_2 is invisible, odourless and has no direct health impacts; it does not create harm that is immediately apparent. These empirical findings are consistent across the United States (Boykoff, 2008; Jamieson, 1991, 2006; Kellstedt et al., 2008); the European Union (Dunlap & Saad, 2001; Hersch & Viscusi, 2006; Poortinga & Pidgeon, 2003); and the developed world as a whole (Leiserowitz, 2006; Lorenzoni & Pidgeon, 2006; Oreskes, 2004). Although 'system 1' thought tends to dominate actors' risk perceptions, it is argued that important and complicated decisions are best made using 'system 2' thought (Weber, 2006). Furthermore, previous research reveals that the way problems are presented has an effect upon the resulting decision which is independent of the decision variables themselves (Tversky & Kahneman, 1986). It has been shown that positive framing of decisions, regarding gains, prompts risk averse behaviour; while negative framing of decisions, regarding losses, prompts risk-seeking behaviour (Kahneman & Tversky, 1979).

The next two paragraphs examine cognitive biases which lead to distorted views of others. These cognitive biases are home team betting, parochialism, egoism and egocentrism. They are important during market design and operation, since they affect the interactions between different parties.

There are a number of biases leading actors to make self-serving choices at either the personal or group level. This section discusses a number of these biases and how they are relevant to CO_2 markets. 'Home team betting' is where people tend to predict the outcome they would like to see. These predictions are not rational, they are influenced by tendencies to pay more attention to and remember evidence pointing to the desired outcome, at the expense of other contradictory material (Viscusi & Zeckhauser, 2006). Linked to this is 'parochialism', where group members will favour their group at the expense of outsiders and possibly themselves (Baron, 2006; Schwartz-Shea & Simmons, 1991). Parochialism can lead groups to under spend on solutions when they feel that they will not benefit from this investment. It can also lead to distortions in judgements of fairness. For example, during CO_2 market design and operation, developing nations see reductions in emissions by the big polluters (i.e. the developed world) as fairest, while developed nations favour equal reductions for all (Baron, 2006). The principle rationale given by the United States' for not ratifying the Kyoto protocol was that India and China were not required to cut their CO_2 emissions (Viscusi & Zeckhauser, 2006).

Finally, achieving agreement in conflicts and disputes relies upon consensus at two levels (Farber & Bazerman, 1987; Markovits, 2004). Firstly, an agreement must overcome the inherent 'egoism' of actors who seek to serve their self interest, weighing personal benefits resulting from coordination, against the costs to the group resulting from defection from the agreement. Overcoming egoism depends upon an actor being concerned for the interests of others. An example of egoism during market operation is the problem faced during the allocation of CO_2 permits for phase I of the European Emissions Trading Scheme. National governments allocated generous numbers of permits to their national industries and thus collectively contributed to the over allocation of permits, leading to a price crash at the end of phase I of the European Emissions Trading Scheme. In this case, short-term nationalistic concerns overrode longer-term environmental concerns at the heart of CO_2 markets (Hopwood, 2009). The second hurdle is 'egocentrism', where actors often have different views upon what the common interest is. Egocentrism is a bias which is particularly rampant in situations of uncertainty over causes or affects (Bazerman, 2006). Thus agreement must be based upon recognition of the value of others' perceptions of the nature of the common interest, as well as its importance relative to personal interests. Egocentrism can be observed in the development of the CO_2 market of the European Emissions Trading Scheme. During the allocation of CO_2 permits to each country, some argued for allocations to be by emissions per capita, while others called for the metric to take into account per capita income (Bailey, 2010). These contrasting calls for allocations by 'emissions per capita' versus 'income per capita' represented egocentrism, since actors could not agree upon a shared definition of the common interest.

Bazerman emphasises that rather than caused by a desire to manipulate situations, cognitive biases are inherent in processes of decision-making and become increasingly common in situations of uncertainty.

2.5.4 Macro-level implications for research questions

The ultimate objective of this study is to explore why CO_2 markets have so far failed to have a significant influence upon businesses' behaviour. This objective and the study's research questions were introduced in chapter 1. Section 2.4.4 discussed the research questions relating to network-level aspects of CO_2 market design and operation. This section provides a more detailed discussion of the study's research questions which relate to macro-level aspects of CO_2 market design and operation.

The research questions discussed below were developed by considering the concepts presented in sections 2.5.1 to 2.5.3. The three research questions (RQs) are listed below and then discussed.

RQ 5: How are technical considerations affecting CO_2 market design and operation?

RQ 6: How are temporal considerations affecting CO_2 market design and operation?

RQ 7: How are uncertainty-based considerations affecting CO_2 market design and operation?

The literature review of macro-level aspects of CO_2 market design and operation did not identify a theory which could encompass all of the different concepts which were discussed. Instead, a conceptual framework for the study of macro-level aspects of CO_2 market design and operation was proposed, as illustrated in Figure 3 and discussed in sections 2.5.1 to 2.5.3. The links between the conceptual framework and the macro-level research questions are now discussed.

Firstly, research question 5 aims to identify how technical considerations are affecting CO_2 market design and operation. Research question 5 is intended to focus attention upon the 'technological' aspects of CO_2 market design and operation and 'public goods and resource limits' which were discussed in section 2.5.1. Secondly, research question 6 aims to identify how temporal considerations are affecting CO_2 market design and operation. Research question 6 is intended to focus attention upon the 'windows of opportunity' and 'lock ins' which were discussed in section 2.5.2. Finally, research question 7 aims to identify how uncertainty-based considerations are affecting CO_2 market design and operation. Research question 7 is intended to focus attention upon the 'problem uncertainties' and 'cognitive biases' which were discussed in section 2.5.3.

This section has provided a discussion of the theoretical underpinnings for the research questions which relate to macro-level aspects of CO_2 market design and operation. The following section reviews the conceptual framework which was developed during this literature review.

2.6 A conceptual framework for the study of CO_2 markets

This chapter has developed a conceptual framework for the study of CO_2 market design and operation. The conceptual framework presents network-level and macro-level aspects of CO_2 markets, which are now discussed.

Network-level aspects of CO_2 market design and operation were discussed in section 2.4. Firstly, exchange practices relate to the economic exchanges taking place within the market and the supporting activities which surround them. Exchange practices are connected to representational and normalising practices through 'interests' and 'measurements'. Secondly, representational practices are those which aim to depict markets and how they work. Representational practices are connected to exchange and normalising practices through 'results' and 'descriptions'. Finally, normalising practices are those which aim to introduce normative guidelines for how a market should work. Normalising practices are connected to exchange and representational practices through 'rules and tools' and 'measures and methods of measurement'.

Macro-level aspects of CO_2 market design and operation were then discussed in section 2.5. Firstly, technical aspects of market design and operation were captured by 'technological' aspects and those due to 'public goods and resource limits'. Technological aspects are immutable physical laws, or the limits of today's knowledge and capabilities. Public goods and resource limits relate to environmental constraints upon markets. Secondly, temporal aspects of market design and operation are 'windows of opportunity' and 'lock ins'. Windows of opportunity are important aspects since the design and operation of many markets will be subject to a window of opportunity, after which there is little possibility to solve the problem, or meet the needs, which the market has been designed to tackle. The second temporal aspect relates to decisions which have long-term impacts due to the lock ins which they create. Lock ins are decisions which have an extended and irreversible impact. Finally, uncertainty based aspects of market design and operation are 'problem uncertainty' and 'cognitive biases'. Problem uncertainty is an important aspect of market design and operation since it introduces uncertainty regarding the best or most expedient way to cope with the problem that the market is designed to tackle. Cognitive biases are frailties embedded in the human learning and decision making process which distort our views of the world and are often subconscious.

Figure 4: Conceptual framework for the study of CO_2 markets

NETWORK LEVEL ASPECTS	**Exchange**	Interests
		Measurements
	Representational	Results
		Descriptions
	Normalising	Rules and tools
		Measures and methods of measurement
MACRO LEVEL ASPECTS	**Technical**	Technological
		Public goods and resource limits
	Temporal	Windows of opportunity
		Lock ins
	Uncertainty	Problem uncertainty
		Cognitive biases

This conceptual framework is used later to analyse the market and macro-level aspects of CO_2 market design and operation which were described in the six empirical case studies.

2.7 Conclusion

This chapter started by examining the nature of markets, providing the foundation for a discussion of market design and operation. Next, a theoretical basis was provided for the examination of CO_2 markets. The remainder of the chapter then examined network-level and macro-level aspects of market design and operation. The last section of the chapter provided a conceptual framework for the study of market design and operation that will be used later to analyse the case studies. Chapter three now describes the development of the research methods that were applied during the research.

CHAPTER 3:

METHODOLOGY

3 METHODOLOGY

3.1 Introduction

This chapter opens with descriptions of how axiological, epistemological and ontological stances were taken into account during the design and deployment of the research methods. The first section discusses the influence of an axiological stance which is driven by a desire to understand the environmental challenges faced by businesses. The next two sections give a treatment of a critical realist epistemology and how it fits with an ontological stance that prioritises a network-level view of the world. The second half of this chapter details the reasons for selecting a case study research method and explains how data were collected, reported and analysed. The chapter closes by explaining how ethical issues were managed during the research.

3.2 Axiology

The researcher is a British male in his late twenties; he grew up in a rural village of around 2,000 people. During his childhood he spent a lot of time outdoors and developed a strong connection with the natural world that is still important to him today. At school he studied physical sciences and mathematics, leading him to read mechanical engineering at university. Linking back to his interest in the environment, he chose to focus his studies upon the development of renewable power. His final year dissertation was on wind and biomass power; assessing the United Kingdom's target of producing 10% of electricity from renewables by 2010. At the time, the researcher concluded that the renewables target was not on track. In fact, the latest figures show that in 2008 only 5.5% of the United Kingdom's electricity came from renewable sources (DECC, 2009b). This was the researcher's first experience of the challenges associated with developing regulation to incentivise the business response to environmental challenges.

While at university, the researcher worked for a manufacturing company, completing a number of summer placements. These placements were in an engineering environment, developing energy efficiency projects on the shop floor. These projects demonstrated that the business and management elements of the projects were more challenging than their technical aspects. This led the researcher to change the focus of his studies. He completed his bachelor's degree in Mechanical Engineering. However, he chose to study an MSc in management instead of continuing his engineering studies to Master's level. The MSc in Management represented an intellectual wrangle for the researcher, challenging many of his positivistic assumptions about problem solving and the nature of the world. While studying management, he continued to work on issues related to the environment, making his dissertation on the development of the 5 year strategy of a leading sustainable energy consultancy. Later he went on to work for this company and then a second sustainable energy consultancy in the same field. Following employment at these two consultancies, he worked for a major energy company in their headquarters, where he helped to develop projects for their renewables division and Climate Change policies for the core operations of their business. During the last 2 years of his PhD research, the researcher returned to the consultancy environment, supporting companies in their responses to the development of CO_2 markets.

Although there is an established and accepted technical potential for managing CO_2 emissions to a sustainable level, the researcher has repeatedly observed that the business world is failing to tackle Climate Change on any meaningful scale. A point of particular interest is the development of a number of CO_2 markets, because CO_2 markets have gained some traction in the business world. Thus the researcher chose to examine the design and operation of CO_2 markets.

The researcher's values are underpinned by a belief that environmental protection represents an important challenge for society. His research is driven by a desire to understand these environmental challenges. During his training in mechanical engineering, he originally developed positivistic beliefs about the potential types of solution to environmental challenges. However, the experiences described in the previous paragraph have led him to relax his positivistic views of the world and instead his research approach is now consistent with a critical realist epistemology. Epistemological issues are discussed in the following section.

3.3 Epistemology: Critical realism

Epistemological stances relate to *"assumptions about how we can come to know the world"* (Easton, 2002: 108). Historically, positivism has dominated marketing research, with claims that theory must be based upon *"a classified and systemised body of knowledge... organised around one or more central theories and a number of general principles... usually expressed in quantitative terms... [and consisting of] knowledge which permits the prediction and, under some circumstances, the control of events."* (Buzzell, 1963: 33). This view of theory stems from approaches originally taken in physical sciences. While certain elements of markets obey positivistic rules, positivism struggles to deal with the human aspects of social sciences. Marketing researchers have attempted to capture social elements of markets through the epistemological stances of relativism and realism. Relativism, sometimes referred to as constructivism, stresses that "*no meaningful interpretation of [the] world can be made that does not involve some form of human processing*" (Peter, 1992: 74). Relativism therefore stresses that even if there is an external reality, it will be impossible to do anything other than construct an interpretation of it through theory (Muncy & Fisk, 1987). Realism differs from the relativist perspective, in that it advocates attempts to develop knowledge of an external reality, while acknowledging that our knowledge will always be fallible and open to challenge and revision (Hunt, 1990). The rest of this section provides a discussion of the epistemological stance of critical realism, which guided the selection of research methods.

Critical realism is a theory of knowledge that stresses the 'embeddedness' of actions within a stratified social reality (Hedstrom & Swedberg, 1998; Pawson & Tilley, 1997). Eight 'signposts' have been developed to summarise the key aspects of a critical realist mode of enquiry, these signposts are discussed below (Sayer, 1992). Critical Realism acknowledges that reality is not entirely socially constructed and that the world exists independently of our knowledge of it. It follows that knowledge of this independent reality is fallible and theory laden. As we develop knowledge, it will progress incrementally, upon the existing theory base. However the development of knowledge will also be subject to discontinuous developments and /or revisions. Critical realism recognises that the world is differentiated and stratified and that events or regularities are underpinned by a specific context and set of objects which are both physically and socially constituted. The social aspects of objects are concept dependent and as such, we must seek to understand their meaning in order to explain their affects. Finally, critical realism acknowledges that research is a social process and that the design of this process will influence the knowledge obtained. It is acknowledged that it is impossible to be a passive observer. It follows that, in order to explain and understand social phenomena, it is necessary to evaluate them critically (Sayer, 1992).

These insights from critical realism guide researchers in social science to explore the mechanisms acting and the contexts in which they sit, seeking generative explanations of causation, as illustrated below (Easton, 2010; Sayer, 1992).

Figure 5: Summary of critical realist causal explanation

(Easton, 2010; Sayer, 1992)

ENTITIES...

Constituted of:
- Structures

Linked by up to two types of relation:
- Necessary
- Contingent

Demonstrating:
- Powers
- Liabilities
- Emergence

...which activate...

... MECHANISM(s)...

...leading to ...

... EFFECT(s) / EVENT(s)

A critical realist epistemology emphasises the importance of generative modes of causation and also the critical role of the researcher in attempting to understand the external world. The following explanation of causation draws upon Easton's review of critical realism in case study research (Easton, 2010). The first building block of a causal explanation is to describe the relevant entities. Entities will be made up of multi-layered structures, the representation of which will influence the findings of the research. Furthermore, these levels of structure are not simply additive, their combination leads to the 'emergence' of new aggregate characteristics which are greater than the sum of their parts. For a set of entities to be coherent, they must be linked by necessary relations. For example a 'seller' cannot exist without a 'buyer'. Full description of the entities is likely to also draw upon their contingent relations. For example, the 'buyer' and 'seller' may use the same electronic data interface system. This contingent relationship would help explain the exchange between 'buyer' and 'seller', but is not a necessary relation for definition of the two entities. Finally, each entity will be subject to powers and liabilities. For example, amongst other things, the seller has the power to set the asking price of their goods and is subject to the liabilities of being undercut in price, or running out of stock. The combination of these entities can trigger certain mechanisms, leading to effects / events.

The critical realist mode of explanation is in contrast with the positivistic approach of seeking to identify regularities and taking their identification to be the objective of research (Easton, 2000, 2010; Sayer, 1992). Positivists concentrate upon the empirical domain, while critical realists would recommend we try to probe back through another two domains in Bhaskar's model (Bhaskar, 1978).

Table 3: The domains of the 'real', 'actual' and 'empirical'

Based upon Tsoukas (1989), as adapted from Bhaskar (1978: 13)

	Domain of ***real***	Domain of ***actual***	Domain of ***empirical***
Mechanisms	x		
Events	x	x	
Experiences	x	x	x

In stepping from the domain of the 'empirical' to that of the 'actual', the researcher must acknowledge that his / her experience of the event is shaped by his / her interpretation, giving an experience that is unique to him / her and the context he / she sits within. The second leap, from the 'actual' to the 'real', requires recognition that events are a product of mechanisms that may or may not combine to produce the event observed.

It could be said that positivists are 'correlationists', striving to create a black box model of regularities; while relativists could be seen as 'scholars of meaning' and critical realists could be seen as 'explanationists'. In this way, critical realism does not reject the existence of an external reality, but primarily seeks to explain, rather than quantify it. Furthermore, critical realist explanations do not reject the importance of meaning; meaning can be part of the generative modes of causation which are sought. As such, critical realism is best suited to the research objective to describe and explain market design and operation. The following sections discuss the suitability of critical realism to a network-level ontology and a case study research method.

3.4 Ontology: Network approach

Ontological concerns relate to *"assumptions about how the world is"* (Easton, 2002: 108). An ontological stance of a network approach is closely linked to the epistemology of critical realism which underpins the research. Critical realism emphasises both 'context' and 'mechanism' in seeking to explain observations (Pawson & Tilley, 1997). This is aligned with a view of the world as a network consisting of interconnected and interdependent elements. The term network is used as a metaphor to capture this connectivity. The network draws in the 'context' in which organisations need to respond to CO_2 markets and as such it facilitates the development of the generative forms of explanation explored in the previous section (Easton & Araujo, 1994; Lazonick, 1991; Mouzas, 2006b).

Furthermore, the advantage of a network ontology is that it emphasises the interconnectivity among actors, moving beyond analysis of dyadic relationships and on to a higher aggregation level. The literature review provides a discussion of the network perspective of business marketing. This literature emphasises that research on markets should not take exchange as given. Instead exchange should be viewed as created within a network of interaction between organisations that are interdependent, embedded within time and subject to the constraints and opportunities imposed by their position within the industrial network (Easton & Håkansson, 1996; Ford et al., 2003; Ford & Mouzas, 2008; Håkansson, 1982; IMP, 2010; Turnbull & Valla, 1986). The literature review explores a theory of markets that extends the network perspective by emphasising market practices as constituting the reality of business markets and marketing (Araujo, 2007; Araujo et al., 2008; Kjellberg & Helgesson, 2006, 2007b, 2007a). This view presents markets as networks of actors engaged in empirical practices of exchanges, descriptions of the market and attempts to regulate it (Kjellberg & Helgesson, 2006, 2007b, 2007a).

Assuming that the world is a network of interconnected organisations led to the development of cases which emphasised empirical observation. Each case aimed to describe interaction between different actors, taking account of interdependencies, time and the rules of the game which conditioned exchanges (Mouzas & Ford, 2009). This empirical focus encouraged by a network-level ontology was well suited to the development of rich case studies and to the inclusion of wider context which was important to critical realist explanations. Accordingly, the study of CO_2 market design and operation was an exercise in examining inter-organisational dynamics and the affect of contextual aspects that were both social and resulting from the natural world. In summary, the ontological stance adopted guided the researcher to seek explanations which were situated outside or between, rather than within, organisations.

Having examined epistemological issues, the discussion now switches to the justification of the selection of a case study research method.

3.5 Research method: Case study research

3.5.1 Research method selection

This section starts by providing a justification for the use of a case study research method. Next follows a detailed description of the rationale for the data collection methods. The third section explains how the cases were selected and reported. Finally, the chapter closes with a discussion of how the cases were analysed.

Selection of the research method required consideration of the research objectives and questions, as well as the epistemological and ontological orientations behind the research. Firstly, in terms of the type research questions posed, the objective was to describe and explain the design and operation of CO_2 markets. Secondly, the epistemological stance was that of a critical realist perspective. Finally, the research design coupled the epistemological stance of critical realism with a network ontology that drew in the wider network context and mechanisms which were important for critical realist modes of inquiry.

A case study research method was well suited to the research objectives and epistemological and ontological stances. Yin defines a case study as *"an empirical enquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomena and context are not clearly evident"* (Yin, 2003: 13). This is aligned with Easton's definition of case study research as *"a research method that involves investigating one or a small number of social entities or situations about which data are collected using multiple sources [to] develop a holistic description through an iterative research process"* (Easton, 2010: 2). These definitions highlight that the case study research method seeks valid explanatory knowledge suitable for the generative forms of explanation required by critical realism (Easton & Araujo, 1997; Easton, 2000; Remenyi et al., 2002; Tsoukas, 1989; Yin, 2003). Furthermore, case studies draw in the wider context that is important in developing critical realist types of explanation (Halinen & Törnroos, 2005; Knox-Hayes, 2009; Perry, 1998). The research design also had to acknowledge that the researcher had little control within the empirical domain of the CO_2 markets. This was due to the researcher's position, his influence relative to the scale of the efforts underway and the high number of degrees of freedom in the situation. Furthermore, ethical considerations dictated that while data were collected through participant observation, the researcher was only to fulfil the role of his employment and not to manipulate the situation for the purpose of his research. As such, the case study methodology suited the ambition to describe and explain empirical examples of the design and operation of CO_2 markets. The researcher did not require, or have, the same type of controlled environment that would be suitable for positivistic natural experiments which are typically more linear and less context dependent. Finally, the contemporary nature of the research made it suited to the case study methodology. Easton (2000) gives the example that a case study can be preferable to a history, since a case study's contemporary nature allows for further data to be collected as explanations evolve.

Having introduced the case study research method and justified its selection, the methods of data collection employed are now discussed.

3.5.2 Data collection

Use of a case study method does not predetermine the methods of data collection to be used. This section explains the choice of data collection methods and outlines how data were collected through participant observation supplemented by access to other sources of data.

Participant observation involves the researcher in *"gather[ing] data by participating in the daily life of the group or organisation he [/ she] studies"* (Becker, 1958: 652). The use of participant observation fits with the objective of describing and explaining empirical examples of the design and operation of CO_2 markets. Participant observation is most commonly used when attempting to build understanding of an organisation or problem, rather than to investigate positivistic types of relationships between variables. Participant observation tends to generate large quantities of detailed description and is well suited to being reported through the development of case studies. However, participant observation has been interpreted in different ways by a number of different researchers. Becker's definition above is informed by a relatively positivistic view of participant observation that views it more as a full blown research method, rather than as a means of data collection. Becker advocates four steps to a participant observation research project. These start with the selection and definition of problems, concepts and indices. Next, the frequency and distribution of phenomena is tabulated. Following this tabulation, social system models are constructed. Finally, the results are analysed and presented. These recommendations suggest a positivistic epistemology is behind Becker's approach to participant observation, which is further suggested through his call for the use of 'quasi-statistical' support for findings, reaching conclusions that are 'essentially quantitative'.

The use of participant observation in this research is better aligned with treatment of participant observation as a method of data collection (Vinten, 1994; Yin, 2003). This definition of participant observation sees the researcher in *"a special mode of observation [which involves] assum[ing] a variety of roles within a case study situation and may actually [involve] participat[ion] in the events being studied.* (Yin, 2003: 93)". Furthermore, the use of participant observation by this research can be classified as 'participant as observer' in a continuum through from 'complete participant', 'participant as observer', 'observer as participant' to 'complete observer' (Belk, 1990; Gold, 1958). This specific type of participant observation involves complete submersion of the researcher in the role they are undertaking. This mode of participant observation also reveals the researcher's function as a researcher to their peers in the participant role. This avoids some of the ethical challenges associated with the complete observer role, where research is carried out covertly. Acting in the 'participant as observer' role also buys some affordances for the researcher, in that they can dedicate effort to their research without jeopardising relationships. The 'observer as participant' and 'complete participant' modes of participant observation give the opportunity to make more structured observations and to avoid the need for such committing participation in terms of time and the development of required expertise. However, since the participant observation role formed the researcher's formal employment, it was not necessary to minimise commitments in terms of dedicating time or developing expertise. The 'participant as observer' role also gave access to data that would have been difficult to access in other ways (Azimont & Araujo, 2010). The research subjects were very busy. While the researcher was paid to help them in their responses to CO_2 markets, they had time to meet him frequently and had significant incentives to engage him and share meaningful insider data. The relationship was as beneficial for them as it was for the researcher. However, had the researcher focussed upon being purely an observer, he would have been granted only a limited number of arm's length interviews and would not have been invited to audits by the regulator, or been privy to the sensitive insider information which was shared routinely as part of his employment.

Participant observation was one of three potential modes of data collection which were considered. The second option for data collection was to interview representatives from companies active in CO_2 markets, rather than actually participate in the design and operation of these markets. This option was ruled out for a number of reasons. The primary consideration was that such a request would result in interviews being granted with the communications team within organisations. Because of the need to assess the credibility of participants, the option of interviewing communication team members was a problem. Assessments of credibility can be made in a number of ways (Becker, 1958). Firstly, by considering whether the participant in question had reasons to lie or conceal certain data.

Secondly, it was necessary to consider whether vanity or convenience led the participant to distort presentations of their role in the events being studied. Finally, it was also important to ask whether the participant was actually party to the actual events being studied. These considerations flagged first that communications teams had an interest in presenting a favourable impression of the business which they represented. The second concern was that the communications teams were not actually party to the events being studied. Hence participant observation was seen as being more attractive than interviewing the communications teams from businesses.

The third option for data collection was to perform an analysis of publicly available data. One such source of data are the reports of the Carbon Disclosure Project (Carbon Disclosure Project, 2009). The Carbon Disclosure Project collects and publishes CO_2 emissions data from the top 500 global businesses. Research has previously used the Carbon Disclosure Project to study CO_2 markets, see for example the work of Kolk, Levy and Pinkse (2008). However, given that the researcher already had direct access to allow participant observation, it was decided that participant observation as a fully fledged member of the group would give the richest data (Becker, 1958; Pâlsson, 2007; Vidich & Shapiro, 1955). Sources such as the Carbon Disclosure Project would be used to supplement, rather than replace, data from participant observation.

In further justifying the selection of participant observation as the primary method of data collection, it is useful to acknowledge that participant observation is most appropriate in situations which meet four conditions (Jorgensen, 1989). Firstly, the research concerned human meanings and interactions, as viewed from the insider's perspective. Secondly, the phenomenon of market design and operation was observable within the everyday setting of the researcher's employment. Thirdly, the research settings were sufficiently bounded in time and space to allow the generation of a coherent case study. Finally, as discussed earlier in this chapter, the research objective and questions were appropriate for investigation using a case study method.

Within the participant observation role, it is essential to consider whether volunteered or directed statements are most suitable for the research being undertaken (Becker, 1958). Volunteered statements made directly in the 'public' research setting are likely to be more accurate in situations where the participant is freely expressing themselves and isn't party to significant controls such as group norms, confidentiality concerns or personal promotion within a group. However, directed statements, those made in response to questioning, can be more useful where the types of responses given would be less likely to be made in public or undirected settings. With regards to the specific setting of research on CO_2 market design and operation, the researcher was part of the team which aimed to generate the business response to CO_2 markets. The researcher held longstanding professional relationships with the research participants. Furthermore, all work was bounded by confidentiality agreements and there was the time available to undertake extensive periods of participant observation. All of these considerations meant that volunteered public statements within the teams were most likely to be transparent. The primary concern for the participants was that we prepare their response to the CO_2 markets. The research was not kept secret, but was not discussed on a day to day basis.

Another consideration was that in order to undertake successful participant observation, the researcher must be able to speak the language of the group which they are researching (Vinten, 1994). The researcher has a degree in Mechanical Engineering, having specialised in renewable energy. He has also studied an MSc in Management, where he made placements with the director of a leading sustainable energy consultancy. The two languages which were relevant to the research setting were what could be called 'MBA-speak' and a mix of 'Engineer-Environmentalist speak'. For example, the researcher was able to discuss the potential fungibility of RGGI credits with EUAs post Kyoto; or the need to ensure additionality during the assessment of the potential NPV of a CER offset project within the CDM. The understanding of the difference between energy and power, the conversion of energy consumption into CO_2 equivalent and the ability to understand the technical aspects of CO_2 markets was also important. The researcher's academic training and professional experience allowed him to converse with different stakeholders in terms with which they were familiar and which reinforced his 'insider status'. This helped him to build trust and to foster the open exchange of data and experiences.

Another consideration is that there is a risk that the presence of the researcher during participant observation may change the phenomenon which they are studying (Vinten, 1994). This risk was minimised, since the researcher's role was one that was common within business and therefore did not create a new role that would distort the situation. The researcher also refrained from manipulating events in order to further his research agenda. Finally, although the research was not covert, it was not discussed on a day to day basis. These considerations helped to minimise the impact of the research upon the research setting.

Finally, data collection did not rely solely upon participant observation. Additional alternative sources of data were used to support the development of the cases. Yin (2003) sees participant observation as being one of six sources of evidence for data collection. The other five being documentation, archival records, interviews, direct observation and physical artefacts. Examples of the types of supplementary data accessed are given in Table 4. Appendix four also gives an example of the exact types of data accessed, by listing the data accessed during the development of case study six.

The participant observation role enabled access to a wide range of documentation. Much of this documentation was available publicly, but not widely accessed. For example, the Environment Agency's consultation documentation for the launch of the Carbon Reduction Commitment was available publicly. However, without being directly involved in the consultation process, the documentation would have been very difficult to access, since it was not widely circulated or reported on outside of the industry. The development of the case studies drew upon 180 reports, the majority being regulatory guidance specifying the details behind the design of each CO_2 market. The research also made use of a number of sources of documentation that were not publicly available. Emails, proposals, strategy documents, audit reports and trading statements all informed the development of the case studies. These were accessed through the participant observation role and held in case study libraries. Furthermore, a large amount of email documentation was drawn upon during the development of the case studies. The participant observation roles lasted from October 2006 until June 2010. Over this three and a half year period, the researcher sent and received around 5,000 emails in total.

Table 4: Types of data sources used to supplement participant observation

NB: Table format based upon the six sources of data proposed by Yin (2003)

DATA SOURCE	EXAMPLE	NUMBER
1. Documentation	– Regulatory guidance.	180 reports
	– Emails and other written correspondence.	5,000 emails 15 letters
	– Proposals and strategy documents.	15 proposals 12 strategy documents
	– Audit reports and trading statements.	8 audit reports 50 trading statements
	– Government and industry training events and mailing lists.	10 training events 140 emails from 3 mailing lists
2. Archival records	– European Emissions Trading Scheme compliance records.	Archived records back to scheme's start in 2005
3. Interviews	– Semi-structured interviews building specific aspects of cases not accessed through participant observation.	15, primarily during development of case 2
	– Semi-structured interviews to review any confidentiality or accuracy issues in case study drafts.	18, across all cases
4. Direct observation	– Not applicable. All observation was through participant observation, rather than direct observation.	-
5. Participant observation	– Employment by CO_2 market participants.	Employment by 5 CO_2 market participants. Oct 2006 to Jun 2010, see Table 5 for details.
6. Physical artefacts	– Online regulatory compliance accounts.	2 EU ETS accounts 2 CRC accounts
	– Business intranet based CO_2 management and reporting systems.	3 proprietary systems 2 in-house systems
	– Spreadsheet CO_2 calculation tools.	15 excel based sheets

Certain regulatory communications were sent out as letters, such as the announcement of the commencement of the Carbon Reduction Commitment. 15 such letters were drawn upon during the development of the case studies. 15 proposals by CO_2 market service providers and 12 strategy documents were also accessed through the participant observation role. Furthermore, 10 industry or government training events were attended and 3 email lists provided 140 email updates during the development of the case studies.

Archival records were of less importance to the case studies, because of the contemporary nature of the research subject. The only CO_2 market that had any significant trading history at the start of the research was the European Emissions Trading Scheme. For this CO_2 market, access was granted to archival records of the case participants, giving historical data on compliance and trading back to the start of phase I of the European Emissions Trading Scheme in January 2005.

Although not the primary mode of data collection, semi-structured interviews were used in two ways. Firstly, data were collected in 15 instances through semi-structured interviews where the participant observer role didn't allow access to the data of interest. One example of such an occasion was when the researcher wished to make a prolonged visit to Manufacturer Alpha's production site during his development of case study two. In this instance he set up a number of semi-structured interviews with the relevant site staff and visited the site for a number of days. Secondly, 18 semi-structured interviews were used to check the case studies in two ways. The researcher gave each case study to staff in the case organisation to be checked for accuracy and for any breaches of confidentiality. This review of each case study was carried out through a semi-structured interview. Where necessary, the case studies were revised in light of the feedback received.

The methods of participant observation which were employed have been already been discussed at length. Data were collected between October 2006 and June 2010 through employment by five CO_2 market participants. Specifically, data were collected and recorded using a research diary to log observations and insights while undertaking the participant observation role. At certain times the researcher also used his company email to record observations. This was because the standard mode of working in the office was at a laptop, meaning that taking research notes electronically was less intrusive than writing a hard copy diary. As an example, appendix four gives details of the interactions which took place the during participant observation which developed study six. Case study six dealt with a manufacturer's response to the first phase of the Carbon Reduction Commitment. During the data collection the researcher managed a Carbon Reduction Commitment steering team within Manufacturer Beta. This steering team met seven times between January 2009 and June 2010. The steering team consisted of the Head of Environment in the Corporate Sustainability team, Heads of Sustainable Development at the business unit level, a member of the Corporate Legal Team, the UK Company Secretariat, the manager of the UK real estate database, the UK's central Energy Procurement Manager, a trading specialist from the Corporate Treasury team and finally, the Carbon Consultancy Project Director and Data Analyst. A further 39 separate meetings were held outside of the 7 steering team meetings. Many of these meetings involved one or more member of the steering team; however they also included an associate in the Corporate Sustainability team, an associate within the Corporate Legal team, the Head of Property within the Corporate Legal team, the Group Property Director, the UK Finance Director and the UK Managing Director. Furthermore, weekly project meetings were held with the Carbon Consultancy Project Director and Data Analyst. External to Manufacturer Beta, the researcher also met with the bureau provider (bill checking service) key account manager six times and attended an Environment Agency training session and two industry training sessions. Further details of all participant observation roles are given in Table 5 in the next section.

Physical artefacts were the final sources of data flagged by Yin (2003). A number of internal and external CO_2 reporting systems were accessed during the development of the case studies. These systems had to be updated in light of developments in the design and operation of CO_2 markets. The development of these systems was one of the major streams of business effort in response to the CO_2 markets, as discussed in cases four and five. Through the participant observer role, the researcher was involved in the development and use of these systems. Firstly, the researcher had direct access to a number of regulatory compliance accounts. These were two European Emissions Trading Scheme accounts and two Carbon Reduction Commitment Accounts. Secondly, access was granted to business intranet based CO_2 management and reporting systems. Three of these were proprietary software systems that were either considered or actually subscribed to, two further systems were extensions of internal Health, Safety and Environment reporting systems. Finally, 15 spreadsheet based CO_2 calculation and reporting tools were accessed during participant roles. For example, during the development of case study six, a site survey questionnaire was used to ascertain how many sites were covered by the Carbon Reduction Commitment and what energy supplies were present at each site. A template for collecting half hourly meter data was used to collect registration data. These two sources of data were then combined into a Carbon Reduction Commitment registration template. Where these systems had different types of user account, the researcher was granted administrator level access rights.

This section has explained the choice of data collection methods and outlined how data were collected through participant observation supplemented by access to other sources of data. The next section discusses how data were reported.

3.5.3 Data reporting

This section starts by reviewing the justifications for the selection of a case study research method as a means of capturing and reporting the empirical data. Then a justification of the selection of an empirical domain of the design and operation of CO_2 markets is given. Next the content of each of the six cases is summarised and an explanation of how and why each was selected is given. Finally, the steps taken during the drafting and reporting of the cases are described and justified.

A case study research method is well suited to the research objectives of describing and explaining empirical examples of the design and operation of CO_2 markets. This is because the case study research method fits with the epistemological stance of critical realism by providing rich descriptions which can support the development of generative explanations of causality which are important for critical realist modes of inquiry. Furthermore, case studies fit with the network ontology since they include the wider network context that influences business decisions. A full justification for the selection of a case study research method is given in section 3.5.1. Following the selection of a case study research method, it was important to choose an empirical domain for the research that would be suitable for the study of market design and operation. This selection of the empirical domain of the research was the first step in choosing the case studies. The choice of empirical domain was guided by the insight that research on market design and operation is best undertaken through examinations of markets in the making. This is because such contemporary investigations can expose mundane aspects of markets as they are formed which will later sit 'below the radar' in established markets (Kjellberg & Helgesson, 2007b; Latour, 1987). CO_2 markets represent one example of such efforts. None of the developments covered in the six case studies are more than 5 years old and a number of them are yet to take place, so they represent contemporary efforts in market design and operation. Callon supports the argument that CO_2 markets give a good empirical setting for the study of market design and operation: *"Carbon markets are an exceptional field for furthering our understanding of the ... forms of ... economic, political and scientific activities [that constitute the market], their mutual relations and the challenges they are designed to meet"* (Callon, 2009: 546). The remainder of this section is dedicated to a summary of the content of the six case studies and an explanation of how and why they were selected.

Having selected a case study research method and an empirical setting for the research, the next challenge was to decide how many cases to use and whether to focus upon a single unit of analysis or to use an embedded design. As discussed previously, the objective was to make an empirical study of CO_2 market design and operation. The case studies cover contemporary global, regional and national CO_2 markets. All of these markets were either in their first trial period or close to being launched. These CO_2 markets were: the Global Kyoto Protocol, the Regional European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. Two important contextual developments were also examined, due to their influence upon these CO_2 markets. These were firstly, the United Kingdom's energy tax relief regime, the Climate Change Agreements. Climate Change

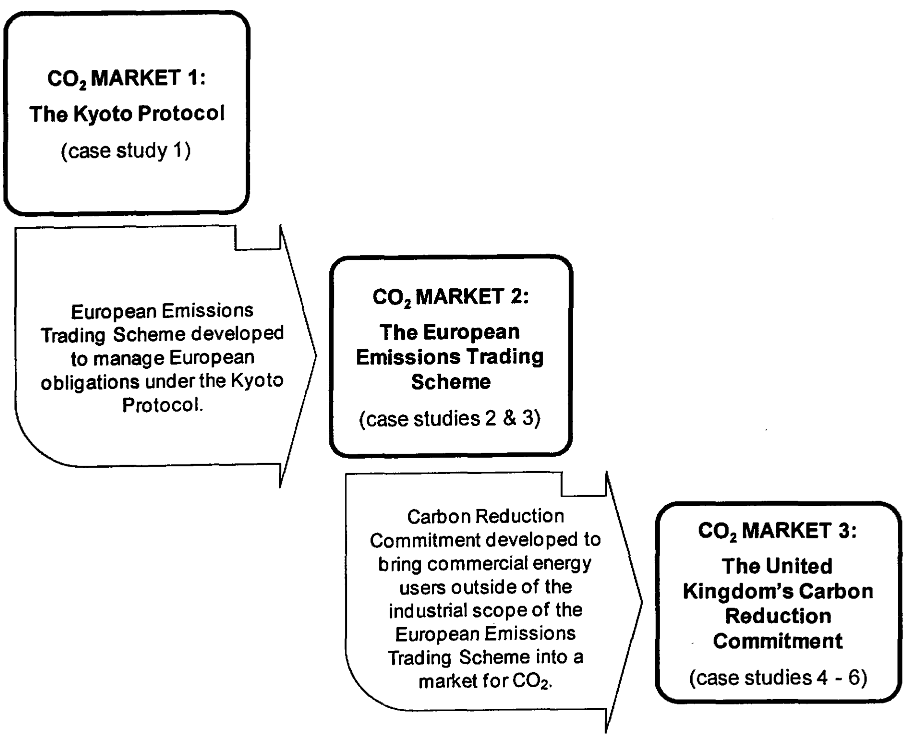
Agreements offer a discount on the United Kingdom's Climate Change Levy. Secondly, details are also given on the quasi CO_2 market practices involved in CO_2 offsetting. These considerations gave a multiple case design with six cases; each linked by the overall context of the design and operation of CO_2 markets. Each case is summarised in Table 5 and introduced in more detail later on in this section.

The next section examines the scope of the research with regards to CO_2 markets. The research gives six case studies describing business responses during the design and operation of the global Kyoto Protocol, the European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. Collectively, these represented over 98% of the 2009 CO_2 market by value (Kossoy & Ambrosi, 2010). In terms of temporal scope, the research started in October 2006 and continued until June 2010. Furthermore, through the participant observer role the researcher was granted access to case data back to 2005. These timeframes fitted with the timeframe of the European Emissions Trading Scheme which ran a practice phase (phase I) from 2005 to 2007. The European Emissions Trading Scheme then entered the first compliance period, which runs from 2008 through to 2012 (phase II). Phase II of the European Emissions Trading Scheme mirrors the Kyoto Protocol's commitment period and is the European Union's mechanism for delivering the Kyoto Protocol's CO_2 reduction targets. The Kyoto protocol is yet to be extended beyond the end of 2012, but the European Union has already setup phase III of the European Emissions Trading Scheme to run for 5 more years, until the end of 2018. The final CO_2 market which was examined was the United Kingdom's Carbon Reduction Commitment. This CO_2 market was launched in April 2010, following a consultation period which closed in October 2009. The

Carbon Reduction Commitment targets the next tier down of energy users, commercial companies which are not covered by the European Emissions Trading Scheme which is more industrial in its focus. Thus the research covers the important temporal scope of the past, present and future phases of CO_2 markets.

The links between each of the three CO_2 markets examined is now illustrated, leading into an explanation of the order of presentation of the case studies. Figure 6 illustrates the links between the different CO_2 markets and Table 5 summarises the content of each case study.

Figure 6: Links between CO_2 markets and cases



The first CO_2 market examined was the Kyoto Protocol which is international in scope. The link between the Kyoto Protocol and the European Emissions Trading

Scheme is that the Kyoto Protocol has been ratified by the European Union. Phase II of the European Emissions Trading Scheme was developed to match the compliance timeframe of the Kyoto Protocol. The Kyoto Protocol is set to expire in 2012 and case study one gives a treatment of attempts to extend the Kyoto Protocol into a second phase. Case study one also provides important context for the European Emissions Trading Scheme. Case study two details Manufacturer Alpha's response to phase II of the European Emissions Trading Scheme. Case study three gives an energy supplier's response to the proposed inclusion of aviation in phase III of the European Emissions Trading Scheme. Case studies two and three give important contextual information for cases four, five and six which examine the United Kingdom's Carbon Reduction Commitment. The Carbon Reduction Commitment extends the coverage of CO_2 markets within United Kingdom beyond the industrial facilities targeted by the European Emissions Trading Scheme and into commercial organisations which represent the next tier down of energy users.

The purpose of the case studies is to support an analysis of CO_2 market design and operation. Each case study is an empirical description of efforts during the design and operation of a CO_2 market. The contents of each case study are summarised in Table 5 and in the following discussion.

Table 5: Data reporting by case studies

Market	Case	Timeframe	Participant Role	Subject	Network actors
CO_2 MARKET 1: The Kyoto Protocol	**Case 1: Extending the global CO_2 market of the Kyoto Protocol**	Oct 2006 - Dec 2008	Policy analyst	United Nations' negotiations to extend the Kyoto Protocol beyond 2012. Covers annual Conference of the Parties (COP) negotiations: – COP 12- Nairobi, 2006. – COP 13- Bali, 2007. – COP 14- Poznan, 2008.	– The G8 – United Nations Framework Convention on Climate Change – Brazil – China – European Union – India – United States – HSBC Bank – BASF – Tesco – Stop Climate Chaos (Coalition including Friends of the Earth, Greenpeace & Oxfam) – World Business Council for Sustainable Development
CO_2 MARKET 2: European Emissions Trading Scheme	**Case 2: A manufacturer's response to phase II of the CO_2 market of the European Emissions Trading Scheme**	Jan 2009 - June 2009	Carbon consultant	Implementation of phase II of the European Emissions Trading Scheme, covering: – Carbon Trust energy efficiency audit. – Climate Change Levy and Climate Change Agreement management. – European Emissions Trading Scheme management.	– Carbon Consultant – Carbon Trust – Department of Energy and Climate Change – Environment Agency – Independent verifier 1 – Independent verifier 2 – Manufacturer Alpha – Technical consultant – Trade Association
	Case 3: An energy supplier's response to aviation's inclusion in phase III of the CO_2 market of the European Emissions Trading Scheme	April 2008 - Dec 2008	Efficiency and Climate Change analyst	Extension of phase III of the European Emissions Trading Scheme to include the Aviation Industry, covering: – Interactions during proposal of phase III changes. – Development of corresponding new business offering and route to market for aviation fuel.	– Aviation Fuel Users – Consumers – EUTA (Niche European Trade Association) – European Union – 'NRG' (Multinational energy company)

		Timeframe	Participant Role	Subject	Network actors
CO_2 MARKET 3: The United Kingdom's Carbon Reduction Commitment	**Case 4: Manufacturer and trade association responses to the consultation on the United Kingdom's CO_2 market, the Carbon Reduction Commitment**	Jan 2009 - Oct 2009	Carbon Consultant	Consultation process ahead of the launch of the Carbon Reduction Commitment, covering: – Manufacturer Beta and Confederation of British Industry consultation responses. – Consultation outcomes.	– Carbon Consultant – Confederation of British Industry – Environment Agency – Manufacturer Beta
	Case 5: Accounting and reporting obligations within phase I of the United Kingdom's CO_2 market, the Carbon Reduction Commitment	Jan 2009 – June 2010	Carbon Consultant	Review of accounting and reporting obligations introduced by the Carbon Reduction Commitment., covering the following obligations: – Scheme registration – Auction participation – Annual and Footprint report submission – League table publication	– Bureau Provider – Carbon Consultant – Retailer Gamma – Energy Suppliers – Environment Agency
	Case 6: A manufacturer's response to the launch of phase I of the United Kingdom's CO_2 market, the Carbon Reduction Commitment	Jan 2009 – June 2010	Carbon Consultant	Business Implications of launch of Carbon Reduction Commitment, including: – Interactions during launch of Carbon Reduction Commitment. – Implications for energy suppliers and bureau (bill checking) services. – Development of a CO_2 reporting system.	– Bureau Provider – Carbon Consultant – Energy Suppliers – Environment Agency – Manufacturer Beta

Case study one examined efforts to extend the global CO_2 market of the Kyoto Protocol beyond its current end in 2012. Data were collected between October 2006 and December 2008 through participant observation as a policy analyst. This work was first carried out at a leading sustainable energy consultancy in the United Kingdom. Data collection continued through participant observation as an Energy Efficiency and Climate Change Analyst at a large multinational energy company. This case study described the processes whereby changes to the Kyoto Protocol were made through structured annual negotiations. These were called the 'Conference of the Parties' (COP) negotiations. The case describes the results of three of these negotiations: COP 12 which was held in Nairobi in December 2006, COP 13 which was held in Bali in December 2007 and COP 14 which was held in Poznan in December 2008. Data access was granted through participant observation of business efforts to track anticipated developments in the Kyoto Protocol. The case describes the stances of International Governance Bodies, Governments, Businesses and Non-Governmental Organisations with regards to the extension of the Kyoto Protocol. The case described the responses of international governance bodies such as the United Nations Framework Convention on Climate Change, The G8 group of countries and the European Union. The case also described national policy responses from Brazil, China, India and the United States. Businesses' interactions with the extension of the Kyoto Protocol were examined through the responses of HSBC Bank, BASF and Tesco Plc. Finally, the case examined Non-Governmental Organisations' stances through a Climate Change coalition called Stop Climate Chaos and an organisation called the World Business Council for Sustainable Development.

The second case study described phase II of the CO_2 market of the European Emissions Trading Scheme. The link between cases one and two was that the European Emissions Trading Scheme could be viewed as a 'child' of the Kyoto Protocol. Phase II of the European Emissions Trading Scheme was designed to deliver European obligations under the Kyoto Protocol's commitment period of 2008-2012. Data were collected between January and June 2009 through participant observation as a Carbon Consultant supporting Manufacturer Alpha. The case described the interactions of Manufacturer Alpha during their participation in phase II of the European Emissions Trading Scheme. These interactions included an audit from the Carbon Trust that was designed to flag CO_2 reduction opportunities. The case study also drew upon interactions with independent verifiers, the Department of Energy and Climate Change and the Environment Agency. These concerned management of Manufacturer Alpha's participation in the United Kingdom's Climate Change Agreements and the European Emissions Trading Scheme. Finally, the case examined the influence of Manufacturer Alpha's capital appraisal process and operational key performance indicators upon engagement with the European Emissions Trading Scheme.

Case study three described efforts to extend the European Emissions Trading Scheme to cover the aviation industry in its third phase which was due to start in 2013. The case study details the response of a large multinational energy company, NRG, to these changes in the European Emissions Trading Scheme. Data were collected through participant observation as an Energy Efficiency and Climate Change analyst at NRG. The temporal scope of the case study was from April to December 2008. The case study described the interactions between different parts of NRG and a European Trade Association 'EUTA' that was active in a niche of the aviation industry. These interactions took place during the development of an offering that bundled aviation fuel with CO_2 permits equivalent to those which would be emitted during the burning of the fuel. The case also described the influence of NRG's relationships with regulators of other anticipated CO_2 markets upon the extension of the European Emissions Trading Scheme. Finally, consumers' views of CO_2 offsetting were examined, since they significantly influenced the response of NRG to their inclusion within phase III of the European Emissions Trading Scheme.

Case studies four, five and six described the launch of another CO_2 market, the United Kingdom's Carbon Reduction Commitment. If the European Emissions Trading Scheme is a 'child' of the Kyoto Protocol, then the Carbon Reduction Commitment could be its 'grandchild'. The Carbon Reduction Commitment targets the next tier down of energy users. These represent commercial companies which are not covered by the European Emissions Trading Scheme which is more focussed upon industrial scale operations.

Case study four described a manufacturer's and trade association's responses to the launch of the United Kingdom's CO_2 market, the Carbon Reduction Commitment. Data were collected between January and October 2009 through participant observation as a Carbon Consultant supporting Manufacturer Beta. Firstly, Manufacturer Beta's submission to the Environment Agency's consultation process was described. Secondly, the public response of the Confederation of British Industry was also described. These responses were then compared with the outcome of the consultation process and the final structure of the Carbon Reduction Commitment was given.

Case study five described the new accounting and reporting obligations introduced by the Carbon Reduction Commitment. Data were collected between January 2009 and June 2010 through participant observation as a Carbon Consultant hired by Retailer Gamma. Interactions involved Retailer Gamma and the Environment Agency, as well as Retailer Gamma's Energy Suppliers and their Bureau Provider who checked the accuracy of Retailer Gamma's energy bills. Firstly, the case described the process of registration with the Environment Agency for participation in the Carbon Reduction Commitment. Next the case described the implications of participation in the Environment Agency's annual CO_2 auction. Thirdly, the process of preparing and submitting the Footprint and Annual Reports was described. Finally, the case examined the league table publication and the recycling payments generated by the Carbon Reduction Commitment.

Case study six detailed the response of Manufacturer Beta and its energy supply and reporting network to the launch of the Carbon Reduction Commitment. Data were collected between January 2009 and June 2010 through participant observation as a Carbon Consultant hired by Manufacturer Beta. The case described the influence of the Carbon Reduction Commitment upon Manufacturer Beta's relationships with their Energy Suppliers, bill checking service provider and their Carbon Consultant, who prepared their accounts for the different CO_2 markets in which Manufacturer Beta participated. The case study ends with a description of Manufacturer Beta's final choice between the Carbon Reduction Commitment service offerings put to them by their Energy Suppliers, Bureau Provider and other third parties.

The drafting of the cases is possibly one of the tougher challenges in case study research. Each case must be individually crafted to tell the empirical story, while still preserving commonality in certain aspects and structures to allow cross case comparisons to be made (Tsoukas, 1989; Yin, 2003). The cases are presented in an order which preserves the historical sequence of the design and operation of CO_2 markets. This helps to preserve the temporal narrative for analysis later on. Furthermore, the cases follow a somewhat standardised form, in that they each start by introducing the business network and then progress to introduce each organisation. Once the network has been described, the case episodes are discussed in detail. This discussion is kept rich and detailed in two ways. Firstly, contextual material describing the structure of the CO_2 markets is given in section 4.7, allowing each case to focus upon the network interactions taking place. Secondly, rich cases were developed by supplementing case narration with graphics, tables and figures to illustrate the phenomena being studied (Borghini et al., 2010). The final consideration was that cases were drafted and redrafted on an ongoing basis. This was because case studies are well suited to further development as explanations evolve and necessitate further data or elaboration of certain aspects of the case (Easton, 2000). The cases were continuously presented and improved through presentation as competitive papers at the annual conferences of the Industrial and Marketing Purchasing Group in 2007, 2008, 2009 and 2010 (Veal & Mouzas, 2007, 2008a; 2009, 2010a) as well as a 2008 IMP journal seminar (Veal & Mouzas, 2008b). Furthermore, reviewers' comments during the development of two papers containing the case studies gave useful feedback to improve the quality of the cases. Cases one and three were published in the Journal of Business and Industrial Marketing and Industrial Marketing Management respectively (Veal & Mouzas, 2010b; Veal & Mouzas, 2011).

This section has reviewed the justifications for the selection of a case study research method. It then justified the selection of the empirical domain of the design and operation of CO_2 markets. Next, the content of each of the six cases was summarised and an explanation given of how and why each was selected. Finally, the steps taken during the drafting and reporting the cases were described and justified. The next section describes how the cases were analysed.

3.5.4 Data analysis

Data analysis involves the researcher making sense of their empirical observations by confronting them with theory (Easton, 2000; Ragin & Becker, 1992; Yin, 2003). More specifically, data analysis is a process of "*examining, categorising, tabulating, testing, or otherwise recombining evidence to draw empirically based conclusions*" (Yin, 2003: 126). This section explains how data analysis was conducted during the present research.

The use of a conceptual framework allowed the researcher to adopt a theoretical orientation that guided data analysis efforts towards data which was theoretically relevant (McKinney, 1950; Ragin & Becker, 1992; Yin, 2003). The conceptual framework for the study of CO_2 market design and operation that was employed by this research is given in Figure 4 on page 73. The development of the conceptual framework allowed the researcher to make a matrix of categories and place empirical evidence within the resulting array (Miles & Huberman, 1994). Emphasis was placed upon the explanatory power of the conceptual framework, rather than upon traditional issues of classification, such as categories being mutually exclusive, jointly exhaustive and at the same level of generality (Bowker & Star, 1999; Marradi, 1990; Nowotny, 1971). The primary objective in developing the conceptual framework was not to create a set of labels; instead it was to assist in developing explanations during data analysis. During explanation building, the conceptual framework was used to analyse data by helping to structure and build explanations and is therefore consistent with what Elman would call an 'explanatory typology' (Elman, 2009; Yin, 2003). Explanatory typologies are *"multidimensional conceptual classifications based on explicitly stated theory"* (Elman, 2009: 121). The use of such an 'explanatory typology' and how it differs from 'descriptive' or 'classificatory' typologies, is presented in Table 6.

Table 6: Three sorts of typology and their uses

Abridged version of Table 6.1 from Elman (2009: 123)

	Descriptive typology	**Classificatory typology**	**Explanatory typology**
Analytic moves	Defines 'types' to use as descriptive characterisations.	Assigns cases to types.	Places data in relevant cells to determine data's links with theory.
Questions answered	What constitutes this type?	What is this a case of?	How can theory explain my observations?

As illustrated above, the conceptual framework employed by this research is less concerned with identifying types and instead focuses upon providing a means of identifying and analysing the theoretical aspects of CO_2 market design and operation identified in the data (Elman, 2009; Miles & Huberman, 1994; Yin, 2003).

During the earliest stages of data analysis, a research diary was used to record observations and insights while undertaking the participant observation role (Yin, 2003). This early stage of data analysis was facilitated by careful selection of the research setting, allowing participant observation through the researcher's employment. This was in response to the consideration that data analysis during case based research should draw upon prior expert knowledge in the field of the case study (Yin, 2003).

Early stage data analysis involved the interplay between observations logged in the research diary and preliminary versions of the conceptual framework, allowing iterative changes to the cases and the conceptual framework. To supplement the research diary, a case study database was employed that enabled the handling of rich data from multiple sources of evidence. The case study database contained a wide range of empirical data from the six sources listed in Table 4 and was kept distinct from the case reports. Initially, the case database was arranged so that material was split into six sections which corresponded to each of the six cases. As the cases matured and became more stable in their structure, the case database was then further divided on the basis of the data's fit with the conceptual framework. The conceptual framework was then used to re-present and summarise the empirical material from the research diary, case database and case reports, as presented in chapter 11 and section 12.2. In this way, the conceptual framework developed explanations which were based upon a mix of within-case and cross-case analysis (Bennett & Elman, 2006; George & Bennett, 2005; Numagami, 1998). The conceptual framework also allowed the researcher to triangulate different sources of data to build explanations about CO_2 market design and operation (Miles & Huberman, 1994).

Much like the development of the case reports, data analysis was an iterative process that was influenced by peer review. During the write-up of the dissertation in 2010, early versions of the data analysis were presented as part of three conference papers and one lecture to the Institute for Sustainable Energy and Environment at the University of Bath (Veal & Mouzas, 2010a, 2010d, 2010c). However, although data analysis was an iterative process, there had to be some measure of when to stop. Data analysis was halted when it was found that further efforts yielded no incremental knowledge in relation to the study's research questions (Yin, 2003).

This section has given an account of the data analysis methods employed by the present research. The final section of this chapter now discusses how ethical issues were managed during this research.

3.6 Research ethics

This section details the efforts taken in order to ensure appropriate ethical practises were followed at all stages of the research. The ethics guidelines of the Economic and Social Research Council were followed, as laid down in their 'Research Ethics Framework' (Economic and Social Research Council, 2009). This framework was chosen, as the 36 page guideline is comprehensive and well tested. Although the framework was used to structure the ethical precautions taken, it was cross-checked with other treatments of ethics, such as Patton's five part ethics framework (Patton,

1990) and other similar works (Homan, 1991; Oliver, 2003; Wiles et al., 2006). These frameworks confirmed the comprehensive nature of the ESCRC's guidelines.

The ESRC defines research ethics as *"referring to the moral principles guiding research, from its inception through to completion and publication of results and beyond"* (Economic and Social Research Council, 2009: 7). The ESRC gives a checklist of issues which would normally be considered to involve more than a minimal level of risk. While much of the checklist wasn't relevant to the research, for example guidance relating to research on children, or involving deception, there were two issues which were flagged as constituting a potentially significant risk. These were the issues regarding treatment of 'sensitive topics' and 'confidential information'. Climate Change policy and responses within a company are a sensitive and sometimes confidential topic. They involve financial data such as operating costs, energy costs and strategic plans for future action. The level of sensitivity of secondary data was also examined with reference to the ESRC's three-level scale of sensitivity. Most of the data was found to fall into the first category of lowest sensitivity. However, some was found to potentially be in the highest category, due to the potential to use or combine the data in other circumstances or situations to infer confidential or sensitive information.

These checks highlighted the need for a rigorous treatment of ethics in the research. The following section uses the ESRC's six high-level considerations for research ethics to highlight precautions taken during the research (Economic and Social Research Council, 2009: 23-26).

Firstly, the ESRC stipulated that research must be designed and carried out to ensure integrity and quality. This chapter aims to meet this need, by carefully laying out the objectives and methods of the research. Furthermore, periodic review meetings with the PhD supervisor and annual progress review meetings with a review panel aimed to deliver high quality research of value to the academic and business communities.

Secondly, the ESRC stressed that the research purpose, methods, participation requirements and risks and intended possible uses of the research must all be made explicit from the outset. These issues are dealt with in detail in the 'sample research agreement' given in Appendix one and the 'sample statement of informed consent' in Appendix two.

The research agreement was signed by a medium to high-level Operations or Communications Manager on behalf of the company as a whole. This research agreement laid out the details of data collection, the expected research participants, document sharing protocol, data ownership and research timeframe. The research agreement also gave a detailed treatment of issues of anonymity, confidentiality and commercial and security sensitive information. This satisfied the third criterion of the ESRC, that confidentiality and anonymity must be preserved.

The statement of informed consent was signed by all research participants. It introduced the research and its objectives, the proposed audience of the research, how data would be shared within the respondent's company, detailed what research participation involved, gave reassurances of confidentiality and anonymity, stressed that participation was voluntary and could be terminated at any time and gave full contact details of the researcher, encouraging the participant to contact them with any questions they may have had. This met the fourth ESRC criterion that research participants must participate voluntarily, without any coercion.

The fifth criterion was that harm to research parties must be avoided. In the sense of physical harm, there was little risk. However, the researcher took care that all site visits included a health and safety briefing and that suitable personal protective equipment was worn. For example during plant visits, ear defenders and safety boots were necessary. Potential harm through accidentally releasing confidential data was avoided through the research agreement, with the failsafe that any publications resulting from the research were first given to the case company, ahead of publication, so that they could check them for any sensitive information.

The ESRC's final criterion was that partiality and conflicts of interest must be made explicit during the research process. This was not a significant concern for the research, but two issues were dealt with. Firstly, as a consultant, the researcher was party to sensitive information that was not suitable for publication. The conflict was managed through careful choice of case studies and the details laid out in the research agreement. The company names, and to some extent their industry, were also anonymised to help overcome this challenge. The second challenge in this area was the conflict between the researcher's interests as a consultant and employee, versus those related to his research role. In a few rare circumstances, it was not clear whether the researcher was working, or making a case study for the research. If a visit were classed as being for research purposes, there was a risk of giving away too much 'free consultancy' and thus disadvantaging the consultancy employing the researcher. However, it was also important to make sure that adequate time was set aside for research purposes. This conflict in interests was managed by discussing it with the researcher's manager and agreeing with him what he was comfortable with in terms of research access and time spent. During the research it was also less of an issue than imagined at the outset, because much of the data collection for the research was contextual information for the work as a consultant. So long as the correct research agreements were in place, the employment and research efforts were often complementary. This arrangement was facilitated by setting up the research agreement with the researcher's employer and the case companies in good time before the start of the research.

3.7 Conclusion

This chapter has explored how the researcher's values have influenced his views on the nature of the world, how he understands and theorises about it to develop knowledge and the uses that he eventually aims to put that knowledge to. The chapter started by tackling axiological issues relating to how the researcher's values influenced the research. Next a treatment of the researcher's critical realist epistemology was given, exploring how it fitted with an ontological stance that prioritised a network-level view of the world. The second half of this chapter then detailed reasons for selecting a case study research method and explained how data were collected, reported and analysed. The chapter closed by explaining how ethical issues were managed during the research.

Chapter four now examines wider sustainability issues and the energy supply industry. Chapter four then gives a history of the evolution of Climate Change as a business issue and introduces the logic which underpins the CO_2 markets. The remainder of the chapter is then dedicated to a detailed introduction to each of the CO_2 markets, ahead of their discussion in the six case studies which follow chapter four.

CHAPTER 4:

CONTEXT AND INDUSTRY DEFINITION

4 CONTEXT AND INDUSTRY DEFINITION

4.1 Introduction

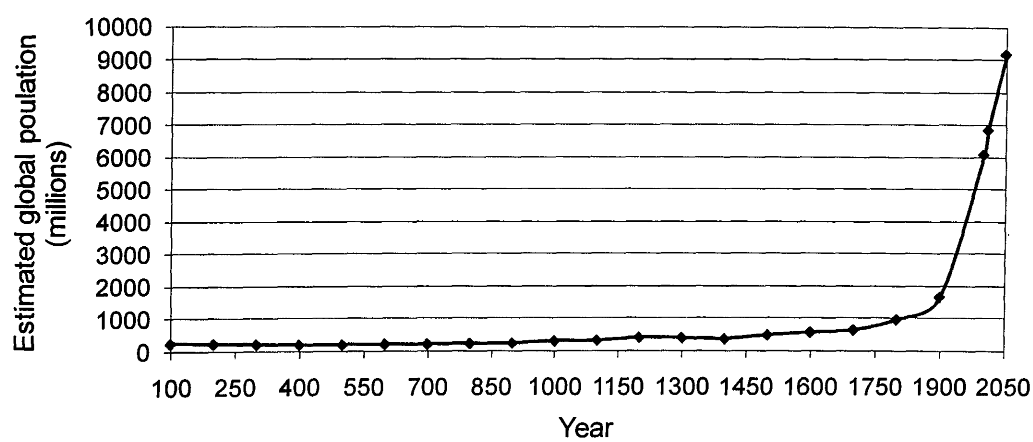
This chapter gives the contextual aspects relevant to CO_2 market design and operation. The chapter starts by examining how these markets have been influenced by trends in wider sustainability issues and in the energy supply industry. Next, the chapter gives a history of the evolution of Climate Change as a business issue. Subsequently, the logic which underpins the CO_2 markets is introduced. This introduction compares CO_2 markets with the alternatives of a CO_2 tax, or mandated CO_2 reduction targets. Subsequently, the chapter outlines the structure of the three CO_2 markets examined by this research. These CO_2 markets were the global Kyoto Protocol, the regional European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. The chapter also introduces the practice of 'offsetting' and the United Kingdom's 'Climate Change Agreements' in order to support the analysis of these CO_2 markets. These final sections give the context required for the development of the case studies which each describe specific episodes during the design and operation of CO_2 markets.

4.2 The relevance of sustainability

This section introduces trends in sustainability as wider context to the development of CO_2 markets. The business community is currently facing calls to acknowledge the sustainability impacts of their operations. However, these calls are not always coherent, because 'sustainability' is still a contested term, the meaning of which is not standardised between different organisations. The most commonly quoted definition of sustainability is the Brundtland definition, which defines sustainability as meeting the needs of the present generation without compromising the ability of future generations to meet their own needs (Brundtland, 1983). This is a high-level definition which does not refer to how the stated objective should be achieved. The Brundtland definition's reference to the protection of the needs of future generations is much easier to grasp, given the summary of global population trends shown in Figure 7. Estimates of global population by the United Nations show that until around 1800AD, the global population was roughly constant at less than 1 billion people (United Nations, 2004, 2008). In the 200 years following 1800AD, the global population has grown to its current level of around 6 billion. The United Nation's current mid-level projection is a global population of 9 billion people by 2050. This rapid increase in the global population has placed unprecedented demands upon the natural systems of the planet, changing the relationship between nature and society.

Figure 7: Global population trends

Based upon data from United Nations (United Nations, 2004, 2008)



Operational sustainability metrics generally encompass the three dimensions of 'people', 'profit' and 'planet' (Elkington, 1994; Elkington, 1997). One example of such a metric is the guidance for managing sustainable development within British Standard 8900, which defines sustainable development as *"..an enduring, balanced approach to economic activity, environmental responsibility and social progress"* (BSI, 2006: 1). In line with these three core dimensions, the Global Reporting Initiative (GRI) collects and reports data on business sustainability performance (GRI, 2010a). The GRI gives dimensions of sustainability which split 'economic', 'environmental' and 'social' performance down into two further levels of detail, as illustrated in Table 7. The economic dimension of sustainability includes the traditional business metrics of economic and market performance, but also pulls in indirect economic impacts on third parties. The environmental dimensions of sustainability largely relate to protection of natural resources, such as materials, water and biodiversity. The environmental dimensions also pull in relationships within the supply chain and the lifecycle impacts of goods. Finally, social dimensions of sustainability relate to labour practices, human rights, society and product responsibility.

Table 7: Setting the scope of sustainability

1) ECONOMIC	**Economic**	1. Economic Performance 2. Market Presence	3. Indirect Economic Impacts
2) ENVIRONMENTAL	**Environmental**	1. Materials 2. Energy 3. Water 4. Biodiversity 5. Emissions, effluents, a waste	6. Suppliers 7. Products & services 8. Compliance 9. Transport 10. Overall
3) SOCIAL	**Labour Practices & Decent Work**	1. Employment 2. Labour/Manageme nt Relations 3. Occupational Health & Safety	4. Training & Education 5. Diversity & opportunity
	Human Rights	1. Investment & Procurement Practices 2. Non-discrimination 3. Freedom of Association & Collective Bargaining 4. Child Labour	5. Prevention of Forced & Compulsory Labour 6. Complaints & Grievance Practices 7. Security Practices 8. Indigenous Rights
	Society	1. Community 2. Corruption 3. Public Policy	4. Anti-Competitive Behaviour 5. Compliance
	Product Responsibility	1. Customer Health & Safety 2. Products & Services Labelling	3. Marketing Communications 4. Customer Privacy 5. Compliance

The dimensions of sustainability given above are acknowledged by the majority of businesses, but not yet integrated into business decision making. Businesses approach sustainability as a risk management issue, consequently it has become standard practice to produce 'Corporate Responsibility Reports'. Examples of such reports are IBM's report (IBM, 2009), GlaxoSmithKline's report (GSK, 2009) and the Global Reporting Initiative's summary reports which cover the returns of 493 companies (GRI, 2010b). These reports highlight some changes in business practices. However in the vast majority of cases they present pilot projects and incremental changes which leave the core of the businesses unchanged. In other words, while businesses recognise the need to respond to the challenge of sustainability, they have yet to make any fundamental changes in business practice. This is the context within which business responses to CO_2 markets sit. The following section examines another trend which is pressuring businesses to reduce CO_2 emissions, this time due to trends in the energy supply industry.

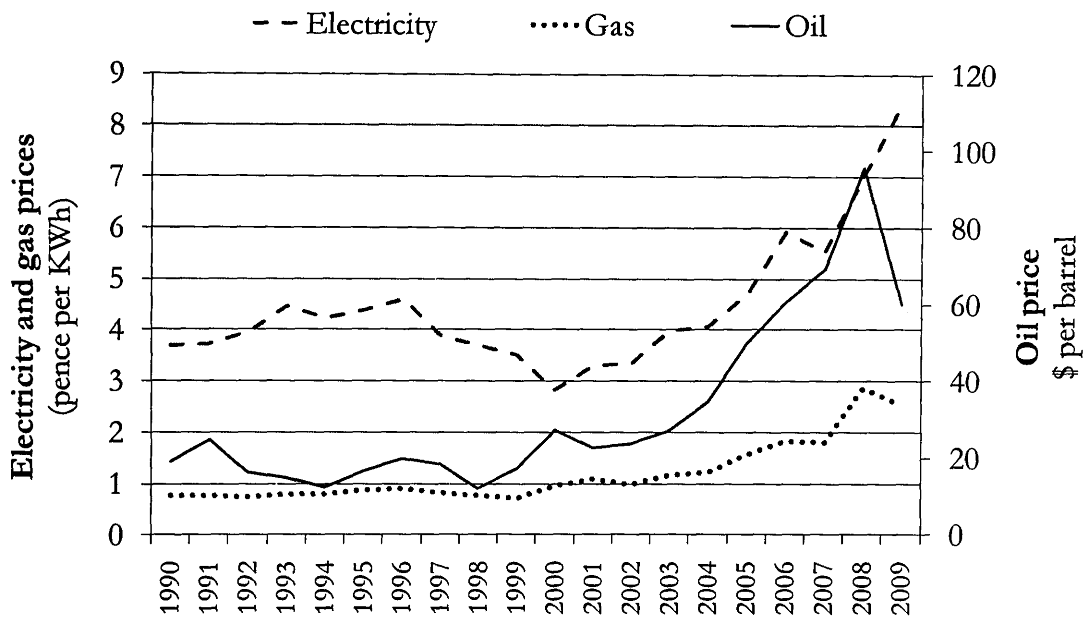
4.3 The relevance of the energy supply industry

Many CO_2 markets define their target participants through a threshold of minimum energy consumption, thus targeting large scale industrial users of energy. At the same time, industrial energy costs have risen sharply over the past 20 years. Both of these considerations necessitate an examination of the energy supply industry, as context to the study of CO_2 market design and operation. Electricity, gas and oil are the fuels most frequently used for business operations, hence these are chosen as the focus for the discussion. Reference to Figure 8 shows the price of electricity, gas and oil since 1990.

Figure 8: Industrial energy prices since 1990

Industrial electricity and gas prices: Median for EU 15 & G7 countries (DECC, 2010)

Global oil price: Country prices, weighted by estimated export volume (EIA, 2010)

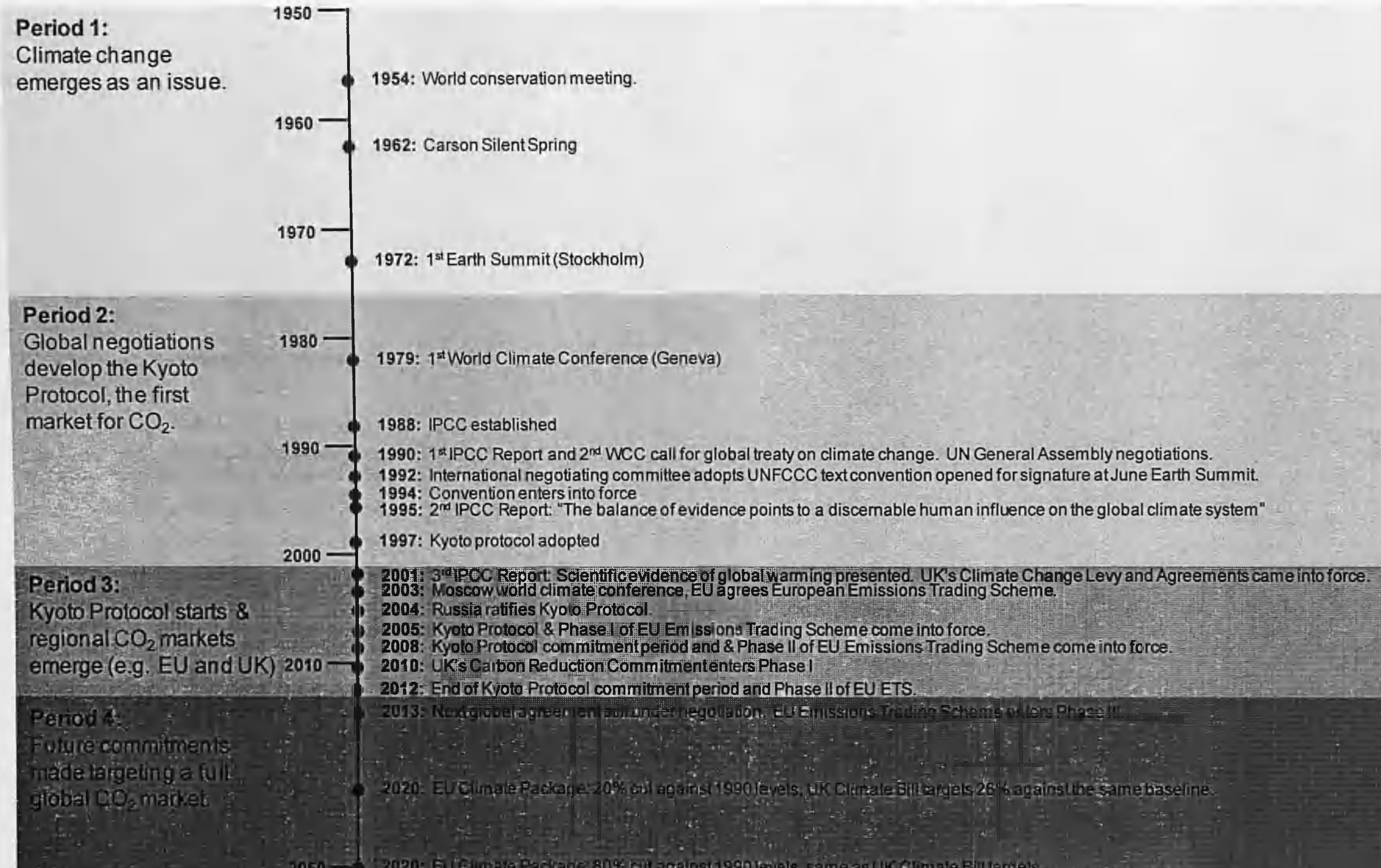


Industrial energy costs are important contextual aspects of CO_2 market design and operation. Significant amounts of managerial attention and effort have been directed at managing rising energy costs in the past ten years. While the drive to reduce energy costs is often aligned with efforts to reduce CO_2 emissions, there are dynamics whereby energy management can be seen to compete with CO_2 for managerial attention. These trends in the energy supply industry are related to the next section, which gives a history of the evolution of Climate Change as a business issue.

4.4 The evolution of Climate Change as a business issue

Climate Change is an issue which can be traced back to the 1950s. For two examples of Climate Change timelines, see Depledge and Lamb (2003) or Grubb (2005). The challenge when examining CO_2 market design and operation is that Climate Change has only become a mainstream business concern since around 2000. Most of the history of Climate Change negotiations is a political story, where business involvement in the debate often focussed upon efforts to discredit Climate Change science. One example of such efforts was Exxon's sponsorship of the 'Competitive Enterprise Institute' (CEI, 2010). The CEI famously denied Climate Change existed and then subsequently denied human causality. Exxon was a prominent sponsor of their work, but cut the funding in 2007 (Littlemore, 2007). The first case study explains how the CEO of Exxon opened the 2007 CERA Energy Conference by acknowledging the realities of Climate Change. There are now very few businesses which publicly deny that Climate Change is happening or that human influence is the major cause of the changes. Businesses are now entering a new phase where they acknowledge the need for action to reduce CO_2 emissions and to engage with CO_2 markets. Figure 9 gives a periodisation of Climate Change from the point of view of the business community. Periodisation can be useful in helping to divide a continuous time sequence into manageable and individually significant segments. Attempts to avoid making arbitrary subdivisions were undertaken by using intrinsic criteria to identify meaningful periods. This is because extrinsic factors are less likely to be linked to the processes and events of interest (Besserman, 1996). Harrison gives an example of the use of periodisation in her thesis examining the banning of CFCs (Harrison, 1998).

Figure 9: A periodisation of Climate Change as an issue



In period one, Climate Change first emerges as an issue. During period two, global negotiations develop the Kyoto Protocol as the first proposed CO_2 market. Period three relates to the emerging global, regional and national CO_2 markets and is dealt with in the case studies. Period three ends in 2012, when the global CO_2 market of the Kyoto Protocol comes to an end. Finally, period four starts in 2013 and relates to future commitments targeting a full global CO_2 market. This periodisation gives a wider context for the scope of the case studies, as illustrated in Figure 11.

The research draws upon data collected between 2006 and 2010, encompassing the compliance period of the Kyoto Protocol, phases I and II of the European Emissions Trading Scheme and the qualification period and first phase of the Carbon Reduction Commitment. The research also deals with negotiations over the extension of the Kyoto Protocol post 2012 and phase III of the European Emissions Trading Scheme.

The case studies do not deal specifically with the development of scientific consensus regarding Climate Change's causes which has emerged over the past two decades. Instead, the political and technical conclusions of these debates are outlined in this chapter. The leading authority on Climate Change, the Intergovernmental Panel on Climate Change (IPCC), released the following statement in 2001: *"The Earth's climate system has demonstrably changed since the pre-industrial era. Human activities have increased the atmospheric concentrations of greenhouse gases and aerosols. An increasing body of observations gives a collective picture of a warming world and other changes in the climate system."* (IPCC, 2001: 4). This opinion is now widely accepted and even previous sceptics have stopped questioning the science of global warming. Exxon is famous for its past rejection of

Climate Change. Yet in his opening speech at the 2007 CERA Energy Conference, the CEO of Exxon broke this stance saying: *"So, we know our climate is changing, the average temperature of the earth is rising and greenhouse gas emissions are increasing…despite the uncertainties, it is prudent to develop and implement sensible strategies that address these risks…"* (Tillerson, 2007). This research focuses upon CO_2 market design and operation. The researcher takes the consensus that Climate Change is real and man-made as a 'given'. However, should a reader wish to further examine this discussion, there are a large number of detailed technical treatments of Climate Change. The following sources are recommended starting points (Damro et al., 2008; IPCC, 2001; Stern, 2006; UNEP/GRID-Arendal, 2005; UNFCCC, 2005; World Business Council for Sustainable Development, 2005).

When responding to Climate Change, the choice at the highest level is between mitigation (prevention) and adaptation (responding). The two approaches are both valid. Mitigation is necessary to stabilise atmospheric CO_2 levels, while adaptation will be required to cope with changes that have already occurred and that we are locked into. A further refinement of the research scope is that the research focuses upon Climate Change mitigation. The justification for this is twofold. Firstly, many of the most 'knotty' problems of tackling Climate Change are embedded in the challenge of mitigation, due to the global aspects of CO_2 management. In contrast, adaptation efforts, such as building defences against rising sea levels, can be tackled locally and present less of a challenge because the benefits are tangible and locally contained. These ideas are linked to 'problems of the common' and 'public goods' which are given full treatment in section 2.5.1 in the literature review. Secondly, the empirical subject of the research is CO_2 market design and operation. CO_2 markets target emission reductions through giving businesses a means to 'monetise' their CO_2 emissions. The development of CO_2 markets represents an attempt to foster mitigation, rather than adaptation, meaning that mitigation is also the most empirically relevant challenge to CO_2 markets. Examples of such mitigation options are given in the following section.

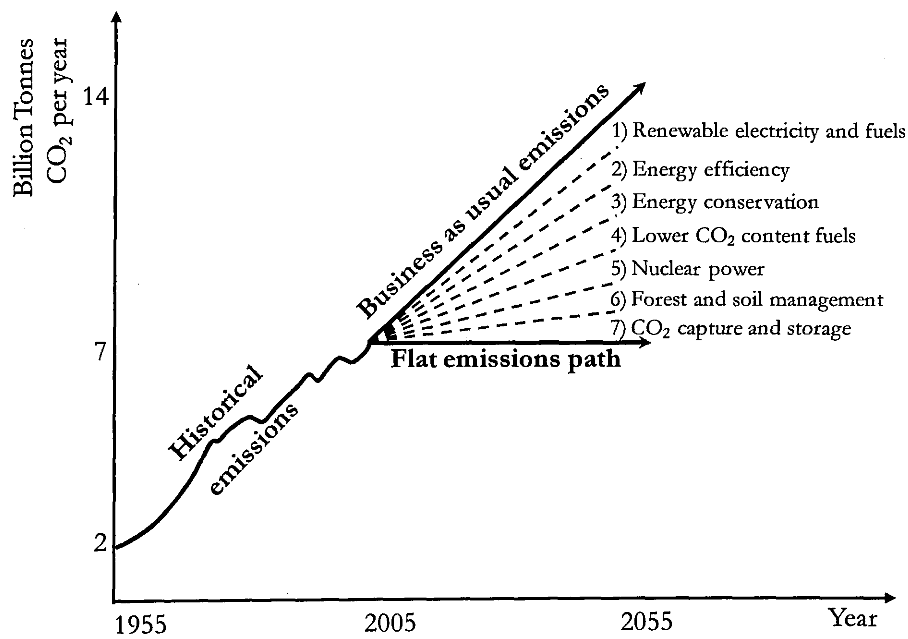
4.5 CO_2 reduction pathways: The end game for CO_2 markets

So far this chapter has examined trends in sustainability and the energy supply industry, leading into a presentation of the history of Climate Change as a business issue. It has also been clarified that the scope of this research is Climate Change mitigation, rather than adaptation. This is because mitigation is the primary objective of CO_2 markets. As further context for CO_2 market design and operation, an introduction is now given to the commonly accepted actions that could mitigate Climate Change, by stabilising CO_2 concentrations at acceptable levels. These are the actions which CO_2 markets aim to incentivise.

A wide number of reports detail the range of possible responses to mitigate Climate Change (Pacala & Socolow, 2004; PricewaterhouseCoopers, 2006; Stern, 2006; World Business Council for Sustainable Development, 2005). These reports recommend a portfolio of similar actions to reduce CO_2 emission rates to acceptable levels. Pacala and Socolow's (2004) recommendations for action are illustrative of the types of responses called for, they are outlined in Figure 10. Pacala and Socolow call for action on seven fronts in order to flatten the projected business as usual CO_2 emissions. The seven 'wedges' identified are: the development of renewable electricity and fuels, increased energy efficiency, increased energy conservation, switching to lower CO_2 content fuels, deployment of extra nuclear power, forest and soil management and CO_2 capture and storage. CO_2 markets will need to span all of these fields, since none of the seven wedges offers abatement potential significant enough to mitigate Climate Change on its own.

Figure 10: Seven wedges to flatten business as usual growth in CO_2 emissions

Adapted from Pacala and Socolow (2004)



Further to the development of these CO_2 reduction options, there is also agreement that action now will be cheaper than the resulting costs of inaction. In other words, it will be cheaper to manage CO_2 emissions now, rather than to let them develop unchecked. One of the influential reports in this area is the Stern Review which was released by the British Government in 2006. The Stern Review concluded that the costs of mitigating Climate Change would be around 1% of GDP and that these would be small relative to the costs and risks that will be avoided (Stern, 2006). The following section compares CO_2 markets with their alternatives of a CO_2 tax or mandated CO_2 reductions.

4.6 A comparison of CO_2 markets with the alternatives of a CO_2 tax or mandated CO_2 reduction targets

CO_2 markets are the most common mechanism used by regulators to encourage businesses to engage with Climate Change mitigation. By giving a price to CO_2 emissions and a corresponding market for CO_2 emission reductions, businesses can reduce their CO_2 emissions as part of their financial planning. During CO_2 market design and operation, the objective is *"to bring [CO_2] emissions within the frame of economic calculation, by giving them a price"* (MacKenzie, 2009: 441). This section introduces CO_2 markets and illustrates the logic that regulators present in order to explain their preference of a market based response, as opposed to the alternatives of a CO_2 tax or mandated CO_2 reduction targets.

At the highest level, the guiding principle used for the design of CO_2 regulation is to minimise the costs of reducing CO_2 emissions, thus achieving compliance at the minimum cost to the economy and society as a whole (DEFRA, 2007). To this end, two key design criteria are: the avoidance of unnecessary regulatory burdens and achieving flexibility that allows business as much freedom as possible in modes of compliance (DEFRA, 2007). Table 8 illustrates the main three potential mechanisms for regulation of CO_2: namely a tax, mandate, or CO_2 markets.

Table 8: CO_2 markets compared with the alternatives of a tax or mandate

Regulatory options	**Factory A:** Cost of reducing CO_2 emissions through changes to plant = £50/tonne	**Factory B:** Cost of reducing CO_2 emissions through changes to plant = £10/tonne	**Cost borne by industry**	**Tonnes CO_2 saved**
1) Tax: Fixed cost of £XX/tonne CO_2 emitted.	Factory A makes CO_2 reductions based upon individual economics and priorities.	Factory B makes CO_2 reductions based upon individual economics and priorities.	**> min possible** Industry costs are not pushed to cheapest reduction options	**cannot be predicted** since not fixed by regulation
2) Mandate: Fixed reduction of CO_2 mandated across industry. E.g. 20 tonnes split evenly between factories A and B.	10 tonnes CO_2 saved in-house at a cost of £500	10 tonnes CO_2 saved in-house at a cost of £100	**> min possible** (£600)	**fixed by regulation** (20 tonnes)
3) CO_2 market: Emission reduction target set for whole industry (e.g. 20 tonnes). Market decides best mode of compliance.	High cost of CO_2 reductions at Factory A means compliance comes through buying 10 tonnes CO_2 from the carbon market (in this case bought from Factory B).	Low cost of abatement justifies 20 tonnes CO_2 saved in-house at a cost of £200. 10 tonnes used for compliance. 10 tonnes sold to carbon market (bought by Factory A).	**min possible** (£200)	**fixed by regulation** (20 tonnes)

As illustrated above, a straight tax on CO_2 faces the criticism that at the outset it is not possible to predict the level of CO_2 savings to be generated. A tax also fails to introduce any flexibility for compliance, neglecting the different costs of CO_2 abatement faced by different businesses. The second option for CO_2 regulation, a mandate, equally shares a CO_2 reduction target across each site. This does set a predictable reduction in CO_2 emissions; however the total cost across industry is not minimised, since there is no flexibility to trade emission reductions across sites. Finally, a CO_2 market, enabling CO_2 emissions trading, is a system which sets an industry wide CO_2 reduction target and provides a market for CO_2 savings. CO_2 savings achieved beyond the emissions cap at one site can be sold into the market as emissions permits, to be purchased by sites with a CO_2 reduction cost higher than the market price. In the example shown in Table 8, Factory B makes all the CO_2

reductions required and sells the excess to Factory A. Theoretically, within the emissions trading design, the scale of emission cuts is predictable at the outset and the cost of compliance is minimised, because emission reductions are pushed to the sites with the cheapest CO_2 abatement options.

The next section discusses the mechanisms by which businesses' CO_2 emissions are monetised by CO_2 markets. CO_2 markets provide participants with target CO_2 emissions that are lower than their current CO_2 emissions, as illustrated in Figure 13. This target is enforced through regulations which present the business with a choice of either making the required CO_2 reductions in-house, or buying CO_2 reductions from other market participants who have saved more CO_2 than was required to meet their target. Through this market, it is hoped that CO_2 savings will be made at the cheapest reduction options available across industry and then sold between participants, so that each is still able to comply with their CO_2 reduction targets. In line with the discussions above, this research adopts a definition of CO_2 markets as "*markets in permits to emit CO_2 gases or in credits earned by not emitting them*" (MacKenzie, 2009: 440).

For further reading on the alternatives to a CO_2 market, see Haug et al. (In press), Levin and Espeland (2002), McKibbin and Wilcoxen (2002), Sanden and Azar (2005), or Wittneben (2009) who all compare CO_2 markets with their alternatives of a CO_2 tax or mandated CO_2 reductions. Dealing specifically with the technicalities of introducing a price for CO_2 emissions, thirteen options are presented by Aldy, Barrett and Stavins (2003) and then compared along their environmental outcomes, dynamic efficiencies, cost-effectiveness, distributional equity, flexibility and the levels of incentive introduced for participation and compliance. Furthermore, Kolk and Pinkse (2004) provide a classification of business Climate Change strategies, setting out of six types of response and contrasting them with a market based response.

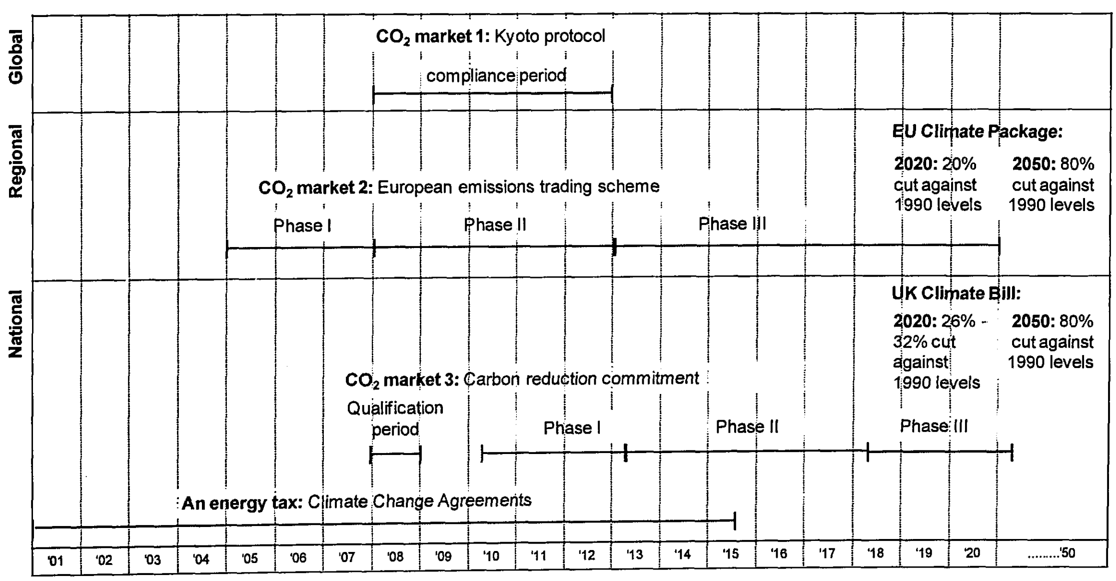
Having introduced how CO_2 markets work, the following section describes the global Climate Change network and introduces each CO_2 market.

4.7 *Introducing the CO_2 markets*

4.7.1 *An overview of CO_2 markets*

The businesses described in each case study faced a number of CO_2 markets, as illustrated in Figure 11. The following sections describe each CO_2 market in what is broadly a chronological order of developments.

Figure 11: A timeline of CO_2 markets

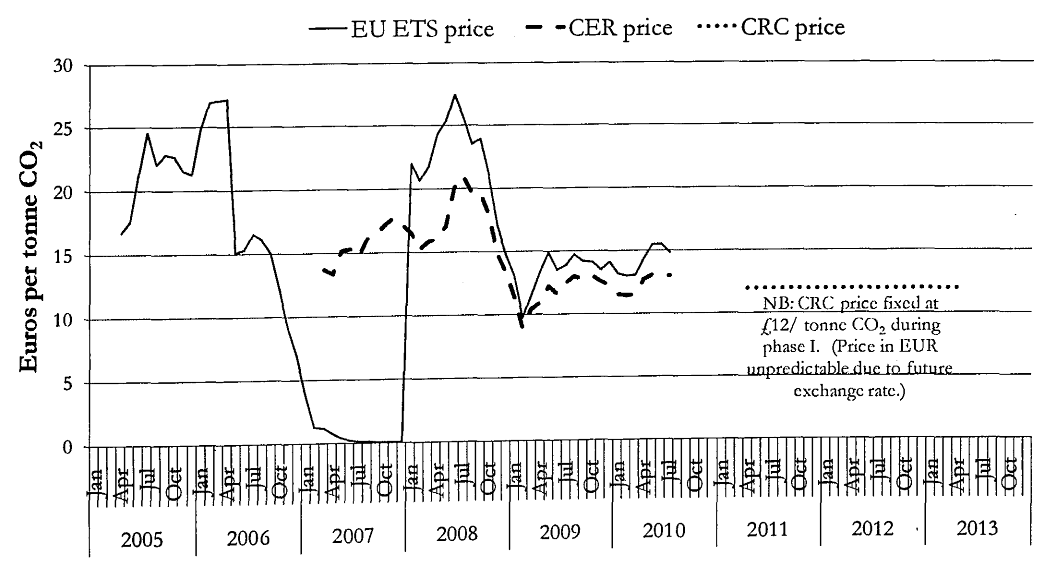


The first section introduces the CO_2 market of the Kyoto Protocol. Next the quasi CO_2 market for 'CO_2 offsets' is examined, as it was important context for the examination of the extension of the European Emissions Trading Scheme. The third section introduces the CO_2 market of the European Emissions Trading Scheme. In the fourth section, the United Kingdom's 'Climate Change Agreements' are introduced as context to the United Kingdom's Carbon Reduction Commitment. The chapter closes with an introduction to the United Kingdom's CO_2 market, the Carbon Reduction Commitment.

Since CO_2 markets are designed to introduce financial incentives for business change, it is important to examine their trading history. Figure 12 summarises the trading history of the CO_2 markets covered by the case studies developed by the research.

Figure 12: Prices in CO_2 markets

EU EUTS price from ECX (2010), CER price provided by trade association on anonymous basis, CRC price from DECC (2009c)



The CER price refers to the price of Certified Emission Reduction Units, which are linked to CO_2 reduction projects approved as part of the United Nation's Kyoto Protocol. These projects allow mitigation efforts to take place in developing countries, with the CO_2 credits generated being sold back towards compliance with Kyoto Targets, or used to meet up to 8% of the target set under the European Emissions Trading Scheme. CERs are traded to match the compliance period of the Kyoto Protocol of 2008-2012. There was some trading of credits in 2007, as these were sold ahead of their delivery from 2008 onwards. The EU ETS price is the price of CO_2 credits within the European Emissions Trading Scheme. These credits were first traded during phase I of the European Emissions Trading Scheme, which spanned 2005 to 2007. Credits from phase I of the European Emissions Trading Scheme were not allowed to be taken across into phase II of the European Emissions Trading Scheme. Once industry realised that too many credits had been allocated in phase I, the price of the credits crashed, as actors tried to sell their surplus credits before they expired at the end of December 2007. The over allocation during phase I explains the European Emissions Trading Scheme's price crash in December 2007. The price crash was followed by a sudden recovery, when new credits were issued for phase II in January 2008. Finally, the price of Carbon Reduction Commitment credits has been given, but is not realised until the scheme starts in April 2011. The Carbon Reduction Commitment scheme credits will be priced in pounds, since the scheme is specific to the United Kingdom. For the duration of phase I of the Carbon Reduction Commitment, the price of credits will be set at £12 per tonne. In following years, once the reporting mechanisms have been set up, the price will be set by the market during an auction which will be held each April.

The remainder of this chapter is dedicated to introducing each of the CO_2 markets in more detail.

4.7.2 CO_2 market 1: The Kyoto Protocol

The only global CO_2 market is that of the Kyoto Protocol. The Kyoto Protocol sets an emission reduction target for 37 industrialised countries, plus the European Union's member states and is enacted at the national level through signatory governments (UNFCCC, 2005). The reduction target *"adds up to a total cut in greenhouse-gas emissions of at least 5% from 1990 levels in the commitment period 2008-2012"* (UNFCCC, 2005). This is held within the United Nations Framework Convention on Climate Change (UNFCCC) that is an earlier treaty which sets out the principles of collaboration and refers targets and legal issues back to the Kyoto Protocol (UNFCCC, 2006a). The Kyoto Protocol is guided by scientific research from a wide body of scientists, who collaborate through the Intergovernmental Panel on Climate Change (IPCC). The Intergovernmental Panel on Climate Change mediates research from climate scientists representing 194 countries. There are three working groups within the Intergovernmental Panel on Climate Change, namely Working Group I which deals with *"The Physical Science Basis of Climate Change"*, Working Group II with *"Climate Change Impacts, Adaptation and Vulnerability"* and Working Group III with *"Mitigation of Climate Change"* (IPCC, 2007). The findings of the Intergovernmental Panel on Climate Change steer the reduction targets adopted and thus influence the function of the CO_2 markets, by impacting upon government allocations of CO_2 credits and target setting. It took decades and multiple stages of negotiations to create the Kyoto Protocol, as illustrated in Figure 9. The negotiations over the future of the Kyoto Protocol are discussed in the first case study which examined the ongoing negotiations that aims to extend the Kyoto Protocol beyond its scheduled end in 2012. The Kyoto Protocol forms the basis for the European Emissions Trading Scheme. The following section introduces the practice of offsetting, because it was contextually important during negotiations to extend the European Emissions Trading Scheme.

4.7.3 Offsetting: A quasi CO_2 market (context for extension of the European Emissions Trading Scheme)

'Offsetting' is the process whereby individuals or businesses, not covered by a legally binding CO_2 market, purchase and destroy CO_2 permits. By destroying one CO_2 permit, businesses claim to have offset one tonne of CO_2. The claim to have offset a tonne of CO_2 follows from the consideration that the destroyed permit is no longer available for another business to use for CO_2 market compliance. The reduced supply of permits should theoretically force another business seeking to comply with the CO_2 market to save an extra tonne of CO_2 in-house, or to buy another permit from the CO_2 market, which in turn would force another business to save a tonne of CO_2. Offsetting can thus be defined as the purchase and destruction of CO_2 permits outside of a legally binding CO_2 market. Offsetting is important when examining CO_2 markets, as a number of businesses are considering offsetting as part of their response to Climate Change. The practise of offsetting is often confused with emissions trading within formal CO_2 markets, although the two are distinct and significantly different. Offsetting is deemed to be environmentally dubious, for reasons outlined below and explored in more detail in case study three.

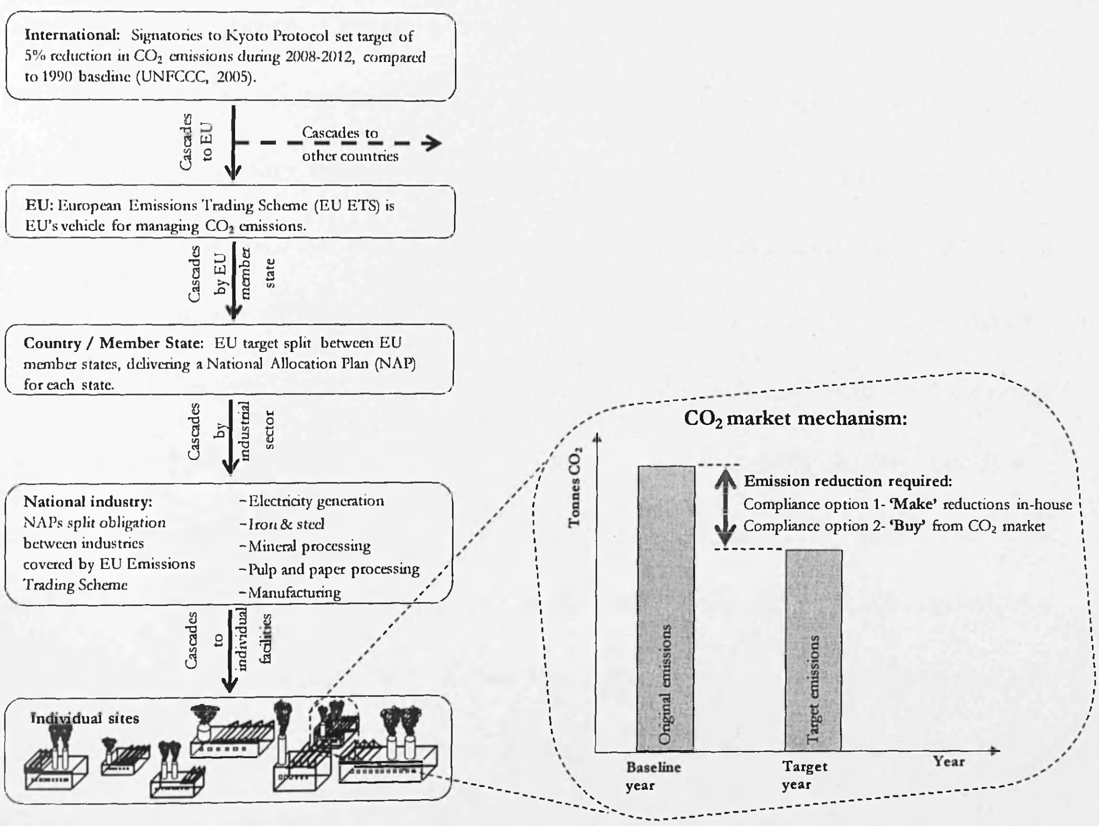
Offsetting brings a number of complications not faced by those covered by a legally binding CO_2 market, such as the European Emissions Trading Scheme. Firstly, there is no legal requirement for the strict verification processes used within the legally binding CO_2 markets. Secondly, as offsetters are not able to sell any CO_2 reductions made in-house back into the CO_2 market, the capital efficiency of emissions trading does not apply to offsetting. Offsetters are routinely only able to choose the 'buy' option given in Figure 13. Reductions in-house, the 'make' option, do not enable offsetters to monetise their CO_2 savings, since they do not have access to sell into the CO_2 market. Given its lack of verification, plus the fact that offsetting can short-circuit the market mechanism at the heart of the capital efficiency of emissions trading, offsetting is often met with scepticism and accusations of 'green-wash'. Offsetting often faces criticisms that it is a cheap way of tabling green claims, without taking any action to 'make' emissions savings by reducing CO_2 emissions in-house. It is important to understand the dynamics of offsetting, because in case study three, issues with offsetting significantly influenced the business response to the inclusion of aviation within the European Emissions Trading Scheme.

4.7.4 CO_2 market 2: The European Emissions Trading Scheme

The European Emissions Trading Scheme is the primary initiative within the European Union which aims to deliver European obligations under the Kyoto Protocol. The European Emissions Trading Scheme covers around 10,500 sites across the European Union (Europa, 2010). Phase II of the European Emissions Trading Scheme is set to mirror the timing of the Kyoto Protocol's compliance period from 2008 – 2012 (Braun, 2009; Delay & Grubb, 2008). Phase I of the scheme was a three year preparatory period, designed to prepare Europe ahead of the Kyoto Protocol going live in 2008. The European Emissions Trading Scheme covers approximately 45% of the total CO_2 emissions of the European Union and targets an 8% reduction in emissions by the end of 2012 (Sandoff & Schaad, 2009). The scheme targets large industrial users of energy, such as manufacturing sites, power generation sites and large buildings with high heating demands. The qualification threshold for the European Emissions Trading Scheme is that any site with aggregated combustion facilities of more than 20MW will be included (DTI, 2004). 20MW is a measure of the power of installed equipment. To give an idea of scale, the aggregated power of a medium sized hospital's boilers would be around 20MW. Each site within an organisation that breaks this threshold must participate in the scheme, meaning that large businesses are likely to have multiple sites included within the European Emissions Trading Scheme. The emission reduction target set by the European Emissions Trading Scheme cascades first to member states, then to industry sectors and finally to individual sites. In phases I and II, the CO_2 market developed by the European Emissions Trading Scheme included the electricity, iron and steel, mineral processing, pulp and paper and manufacturing industries, as illustrated in Figure 13.

Under the scheme, each individual site is allocated an allowance of CO_2 permits. If their allowances are less than their actual CO_2 emissions, then sites must decide whether to 'make' the CO_2 reductions in-house or 'buy' the savings required from the CO_2 market. This structure of the European Emissions Trading Scheme runs until the end of 2012 and is the subject of case two which examines a manufacturer's response to the European Emissions Trading Scheme. After 2012 there is uncertainty over whether there will be another global CO_2 regime and if so, what form it will take. The European Union is active in these debates and has already put forward a plan to extend the European Emissions Trading Scheme beyond 2012. Phase III of the European Emissions Trading scheme will be expanded in scope to include aviation, petrochemicals, ammonia and aluminium production, as well as Carbon Capture and Storage demonstration facilities (Europa, 2008).

Figure 13: Cascade of the Kyoto protocol to individual sites within the European Emissions Trading Scheme



The European Union has also made changes to the scheme's qualification criteria in order to exclude some smaller sites where it feels that the administrative burden outweighs the potential CO_2 savings. The threshold for inclusion in the scheme in phase III has been revised upwards from 20MW to 35MW of installed combustion plant. A further threshold will allow some sites to be excluded if their CO_2 emissions in the three years leading to 2013 were each less than 25,000 tonnes (Europa, 2008). These developments are dealt with in case study three, which examines an energy supplier's response to aviation's future inclusion within the European Emissions Trading Scheme.

4.7.5 An energy tax: The United Kingdom's Climate Change Agreements (context for the Carbon Reduction Commitment)

The United Kingdom's Climate Change Levy was introduced in 2001 and targets industrial, commercial, agricultural and public sector uses of electricity, natural gas, oil and coal for lighting, heating and power. The Climate Change Levy is a tax which is charged at a flat rate per unit of energy used and is designed to be revenue neutral to the government (HMRC, 2010). The payments are recycled back to industry through a cut in employers' national insurance contributions and support for energy efficiency and low carbon technologies. The levy is not a CO_2 market, but it is a means by which companies recognise a cost relating to their CO_2 emissions. The levy is an important contextual aspect for the United Kingdom's CO_2 market, the Carbon Reduction Commitment. Businesses within the United Kingdom that are covered by the European Emissions Trading Scheme are often also subject to Climate Change Agreements. Climate Change Agreements arise from applications for partial exemption from the Climate Change Levy.

At the time of introduction of the Climate Change Levy, industry argued that companies should not be penalised if they were energy intensive and/or exposed to international competition. The argument was that, for such industries, the national tax would put them at a disadvantage to international competitors. In response to these pressures, the government set up Climate Change Agreements, whereby energy intensive industries could apply for up to an 80% discount on the Climate Change

Levy. The government specified that, to be eligible for the discount, energy intensive industries must sign up to sector-level and site-level targets for challenging energy efficiency or CO_2 reductions. The sector-level target is administered through the relevant trade association and is recognised through a certificated scheme called a 'Climate Change Agreement'. The Department of Energy and Climate Change reported in 2009 that 36 out of 52 sectors met their reduction targets and that 8,973 sites within the United Kingdom had applied for and were managing an ongoing Climate Change Agreement (DECC, 2009a).

4.7.6 CO_2 market 3: The United Kingdom's Carbon Reduction Commitment

The Carbon Reduction Commitment is a CO_2 market within the United Kingdom. It is administered by the Environment Agency and started in April 2010. The Environment Agency developed the Carbon Reduction Commitment in order to bring the next tier of energy users, those not covered by the European Emissions Trading Scheme or the United Kingdom's Climate Change Agreements, into a national CO_2 market. It is anticipated that the Carbon Reduction Commitment will save approximately 4.4 million tonnes of CO_2 per year by 2020 (DECC, 2009d). This saving represents approximately 3% of the projected 2020 UK total CO_2 emissions of 146.2 million tonnes CO_2 (DEFRA, 2006).

Participation in the Carbon Reduction Commitment is determined by electricity consumption during the qualification year of 2008. Electricity usage was chosen to measure the threshold for qualification, since large industrial companies targeted by the European emissions trading scheme and Climate Change Agreements tend to use primary forms of energy such as coal, oil and gas; while medium scale energy users in the commercial sectors tend to use electricity to run their operations. An organisation must participate in the Carbon Reduction Commitment if their 2008 electricity consumption through an industrial class of electricity meter breaks a threshold of 6000MWh. This threshold represents an annual electricity expenditure of approximately £500,000. The Carbon Reduction Commitment targets the highest United Kingdom parent company, meaning that a company with multiple sites in the United Kingdom would need to compare their total electricity consumption across all sites to the qualification threshold.

The Carbon Reduction Commitment will extend the number of sites within the United Kingdom covered by a CO_2 market from 921 European Emissions Trading Scheme sites to an estimated 5,000 organisations, or 25,000-150,000 sites (DECC, 2007, 2009d). The Carbon Reduction Commitment will affect organisations such as large retailers, universities, local authorities, landlords, smaller manufacturers and office based organisations with multiple buildings. These organisations will be legally required to participate in the CO_2 market of the Carbon Reduction Commitment as of April 2010. As well as a CO_2 market, the Environment Agency has introduced a number of novel mechanisms within the Carbon Reduction Commitment's structures, as summarised in Table 9 and explained in more detail below.

Table 9: Key elements of the Carbon Reduction Commitment as per the draft order released for consultation mid 2009

(DECC, 2009c, 2009d; Environment Agency, 2009)

Key mechanism	Details
1. A market price for CO_2 emissions.	Priced at £12/tonne CO_2 for the first phase. Set by Environment Agency auctions after 2013.
2. Public league table on emission reduction performance.	Published annually for all 5,000 participants.
3. Recycling payments (rebates) given on purchased CO_2 allowances with penalties or bonuses set by league table performance.	Rebate starts at ± 10% of expenditure in the Environment Agency auction, rising to ± 50% by 2015.

The first feature of the Carbon Reduction Commitment, a market price for CO_2 emissions, is common to other CO_2 markets. However, from there on, no previous CO_2 market has included the other features of the Carbon Reduction Commitment. Firstly, there will be a public league table which ranks each participant's year on year cuts in absolute CO_2 emissions. The public league table introduces a significant reputational driver for CO_2 reductions. Secondly, a further financial driver for emissions reductions is introduced, since there will be bonuses for league table leaders and penalties for laggards. These bonuses and penalties will be administered through a rebate called a 'recycling payment' made by the Environment Agency. In the first year of the scheme, the rebate will be ± 10% of expenditure in the Environment Agency's April CO_2 permit auction, rising to ± 50% by 2015.

The timing of the Carbon Reduction Commitment is now discussed. Figure 11 illustrates how the Carbon Reduction Commitment is split into phases and runs to a United Kingdom tax year of April to March. Phase I is a three year preparatory phase, running through from April 2010 until March 2013. Phase I starts with a single year that does not include an auction of CO_2 permits. In this year the only obligation is to report CO_2 emissions. This is because one year's worth of data will be required to make year on year comparisons and to support participants' preparation of their forecast emissions for the coming year. For the remainder of phase I, the price of CO_2 permits will be fixed at £12/tonne and there will be no limit on how many an organisation can purchase. After this three year practice phase, each phase runs for five years and the price of CO_2 permits will be set during an Environment Agency auction to be held each April. A secondary market for inter-organisational trading of CO_2 allowances is also likely to develop.

At the beginning of each phase, companies must submit a footprint report which represents 100% of their emissions within the United Kingdom. This is used to calculate any exemptions, for example carving out Climate Change Agreement and European Emissions Trading Scheme CO_2 emissions. The footprint report is then used as an 'energy map' of the company over the coming phase. During each phase, participants must collect their emissions data for included emissions sources and submit them in the form of an annual report. The Carbon Reduction Commitment is based upon self reporting, whereby companies are expected to complete their annual submissions and submit them online to the Environment Agency registry. These are not checked upon submission, instead a participant can expect to be audited at random by the Environment Agency at a frequency of approximately once per phase.

It is inevitable that companies already covered by the European Emissions Trading Scheme and /or the United Kingdom's Climate Change Agreements will overlap with the coverage of the Carbon Reduction Commitment. However, CO_2 credits from each market will not be interchangeable. There will be some minimal potential to convert permits from the European Emissions Trading Scheme into Carbon Reduction Commitment Permits, although even this will be governed by a minimum price for the permits created. This minimum price is to avoid creating adverse incentives due to potential price differences between the schemes. The Environment Agency has acknowledged these overlaps and gives two rules to help avoid any double counting of CO_2 emissions. Firstly, any company which has more than 25% of its emissions covered by a Climate Change Agreement will be exempt from the Carbon Reduction Commitment. This follows the logic that if companies have significant coverage by Climate Change Agreements, then they are likely to be large enough to be industrial type companies, which are not the target of the Carbon Reduction Commitment. They will also already be following best practice in energy management as part of the maintenance of their Climate Change Agreement. Secondly, any qualifying processes covered by the European Emissions Trading Scheme will be exempted from coverage by the Carbon Reduction Commitment. Together, these provisions mean that although one site may be covered by a number of CO_2 markets, no one emissions source will be 'double counted' by being in more than one CO_2 market. As an example, a large boiler at a site may be covered by the European Emissions Trading Scheme, while electricity use in a number of offices and production areas may be covered by the Carbon Reduction Commitment.

4.8 Summary

This chapter has given the contextual information required to support the case studies developed by this research. The chapter started with an examination of trends in wider sustainability issues and in the energy supply industry. Next the chapter gave a history of the evolution of Climate Change as a business issue. The discussion then moved on to introduce the logic which underpinned these CO_2 markets. CO_2 markets were compared to their alternatives of a CO_2 tax or mandated CO_2 reduction targets. Finally, the chapter closed by outlining the structures of each CO_2 market. These three CO_2 markets were the global Kyoto Protocol, the regional European Emissions Trading Scheme and the United Kingdom's national Carbon Reduction Commitment. The chapter also introduced the practice of 'offsetting' and the United Kingdom's 'Climate Change Agreements', since they gave important context to the CO_2 markets covered by the research.

Chapters five to ten which follow give six case studies that describe CO_2 market design and operation.

CHAPTER 5:

EMPIRICAL FINDINGS (CASE 1)

5 CASE 1: EXTENDING THE GLOBAL CO_2 MARKET OF THE KYOTO PROTOCOL

5.1 Introduction

The Kyoto Protocol developed the first and only global CO_2 market. This first case examines efforts to extend the Kyoto Protocol beyond its expiration date of the end of 2012. Data were collected through participant observation between October 2006 and December 2008. Participant observation was first undertaken as a Policy Analyst at a leading sustainable energy consultancy in the United Kingdom and then completed as an Energy Efficiency and Climate Change Analyst at a large multinational energy company.

This case describes the processes whereby changes to the Kyoto Protocol were negotiated through annual negotiations. These negotiations were structured by the United Nations Framework Convention on Climate Change. The negotiations took place at what was called the 'Conference of the Parties' (COP). The case describes the results of three of these Conferences of the Parties: COPs 12, 13 and 14. The second half of the case examines the stances of international governance bodies, governments, businesses and Non-Governmental Organisations with regards to the extension of the Kyoto Protocol. This case drew upon the responses of international governance bodies such as the United Nations Framework Convention on Climate Change, The G8 group of countries and the European Union. The case also draws upon national policy responses from Brazil, China, India and the United States. Businesses' interactions with the extension of the Kyoto Protocol were examined through HSBC Bank's, BASF's and Tesco Plc's responses. Finally, the case describes

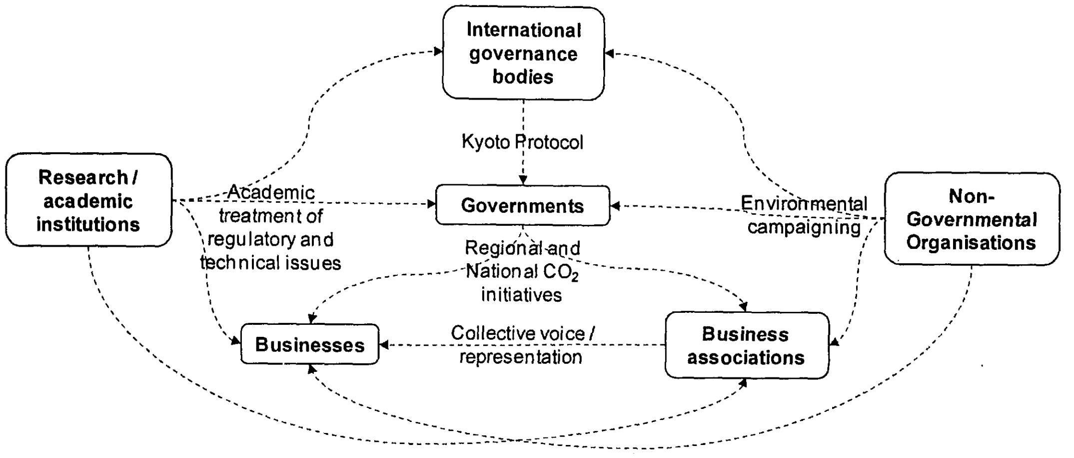
Non-Governmental Organisations' stances through a Climate Change coalition called 'Stop Climate Chaos' and an organisation called the World Business Council for Sustainable Development.

This case was designed to give a macro-level illustration of the responses of key actor groups to the challenge of forming CO_2 markets. This examination of the Kyoto Protocol was also important because it gave the framework for the European Emissions Trading Scheme, which was set up to deliver European commitments under the Kyoto Protocol.

5.2 The business network during phase I of the Kyoto Protocol

Phase I of the Kyoto Protocol which runs from 2008 to 2012, was the first and only global CO_2 market. As such the Kyoto Protocol was at the centre of global negotiations regarding coordination in response to Climate Change. These considerations made the Kyoto Protocol the logical starting point in examining CO_2 market design and operation. The global network of the Kyoto Protocol is illustrated in Figure 14. This network consisted of governments, international governance bodies, businesses, Non-Governmental Organisations and research organisations (GlobeScan, 2006). The interactions of each of these actors are discussed in the next section of this case.

Figure 14: The network during phase I of the Kyoto Protocol



Developments in the Kyoto Protocol were important to multinational businesses and their engagement with CO_2 markets. These businesses were seeking forward visibility on what would happen to the Kyoto Protocol when the first phase expired at the end of 2012. Uncertainty regarding the future of the Kyoto Protocol post 2012 was identified in Cambridge Energy Research Associates' CO_2 market analysis as one of the major risks with regard to the future profitability of businesses' CO_2 mitigation projects (CERA, 2007).

Negotiations regarding the structure and objectives of the Kyoto Protocol were ongoing and took place each year at the Conference of the Parties (COP). COP 12 was held in Nairobi in 2006, COP 13 in Bali in 2007 and COP 14 in Poznan in 2008. The Kyoto Protocol was set to run until the end of 2012 and negotiations to extend it started at COP 12 in 2006. However, progress on extending the Kyoto Protocol was stalled and by the end of COP 14 in November 2008, no agreement had been reached.

There were a number of discussions at each Conference of the Parties. This case focuses upon the part of the discussion which looked to extend the Kyoto Protocol beyond 2012. As will be illustrated in the case, the COP negotiations were generally met with disappointment. The British Broadcasting Corporation (BBC) summed up progress as having agreed *"a tentative date for beginning negotiations and no timeframe for concluding them" (BBC News, 2006).* The decision was thus deferred to COP 13 and COP 14 in 2006, 2007 and 2008 respectively. There were successive failures to agree upon an extension to the Kyoto Protocol at each of these COP meetings. This case now gives representative examples of recommendations for action post 2012, as put forward by each group of CO_2 market actors identified in Figure 14.

5.3 Interactions to extend the Kyoto Protocol beyond 2012

5.3.1 International governance bodies

The most influential international governance body with regards to Climate Change was the United Nations Framework Convention on Climate Change (UNFCCC). This was a United Nations administered treaty that set out the framework which underpinned the Kyoto Protocol (UNFCCC, 2006a). The objective of the United Nations Framework Convention on Climate Change, was to *"stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system"* (UNFCCC, 2005). The United Nations Framework Convention's published mandate public for COP 12 was illustrative of their approach to tackling Climate Change. The mandate for the discussion was published as *"The Conference of the Parties, at its eleventh session by its decision 1/CP.11, resolved to engage in a dialogue, without prejudice to any future negotiations, commitments, process, framework or mandate under the Convention, to exchange experiences and analyse strategic approaches for long-term cooperative action* *to address Climate Change that includes, inter alia, the following areas: advancing development goals in a sustainable way; addressing action on adaptation; realizing the full potential of technology, realizing the full potential of market-based opportunities"* (UNFCCC, 2006b). As detailed in the quote above, the United Nations Framework Convention saw Climate Change as part of sustainable development and requiring action on adaptation, not just mitigation. They also regarded technology and the market based opportunities offered by CO_2 trading as being essential. Looking to the United Nations as a whole, the UN Secretary General, Ban Ki Moon, had been vocal about the threats of Climate Change. He stated *"the danger posed by war to all of humanity and to our planet, is at least matched by the climate crisis and global warming."* (Bone, 2007). The G8, consisting of Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States, was another international organisation that showed interest in issues of Climate Change. Both the United Kingdom and Germany were strong advocates of extending the Kyoto Protocol beyond 2012 during their presidencies of the G8 council (Mulholland, 2007).

5.3.2 Governments

This section deals with the interests, attitudes and recommendations of different governments with regard to Climate Change and the extension of the Kyoto Protocol. The case first examines the governments represented by the European Union, next follows an examination of the United States and finally the case gives a discussion of the responses of the governments of the developing world.

The European Union was a progressive region on Climate Change. It set up the CO_2 market of the European Emissions Trading Scheme to manage its commitments under the Kyoto Protocol and has set ambitious targets for CO_2 emission reductions. In January 2007 the new energy and Climate Change package set *"a series of ambitious targets on greenhouse gas emissions and renewable energy and aims to create a true internal market for energy and strengthen effective regulation. The Commission believes that when an international agreement is reached on the post-2012 framework this should lead to a 30% cut in emissions from developed countries by 2020. To further underline its commitment the Commission proposes that the European Union commits now to cut greenhouse gas emissions by at least 20% by 2020, in particular through energy measures"* (Europa, 2007). The European Union was looking to lead on the issue of Climate Change and was prepared to accept different standards for developed and developing countries. As stated above, the European Union's target was for *developed* countries, implying developing countries would have less stringent targets than those adopted by Europe.

Within the United States, the Bush administration took a protectionist stance, choosing not to ratify the Kyoto Protocol. The principle rationales for the United States' stance were: the poor design of the controls, the overall expense of the Kyoto Protocol and concerns about international competitiveness given that China and India were not required to cut emissions (Viscusi & Zeckhauser, 2006). However there had been increased action on Climate Change in the United States. Global Insight's Global Climate Change Service (2007) stated that recent developments in the United States were mounting pressure on the government to take a decisive stance on actions to address CO_2 emissions. These were occurring at federal, regional, state and local levels of government. At the federal level there was a court case suing the Environmental Protection Agency to recognise CO_2 as a pollutant under the Clean Air Act of 1970. There was also the Lieberman–McCain Climate

Stewardship Act which looked to establish CO_2 emissions limits for *"electricity generation, transportation, industrial and commercial sectors, representing about 85% of total GHG emissions."* (Global Insights, 2007). California was a leader in the United States; it had financial penalties for CO_2 intensive transport fuel, progressive emission standards for cars sold in the state and a number of other linked measures. California was also looking to link its proposed CO_2 market to the European Emissions Trading Scheme and was pushing hard for Federal action. Thus the picture from the United States was one of recent progressive action against a past history of procrastination and protectionism. The movement was growing from the state level upwards. As a thermometer to American interest in the issue, Al Gore's documentary about Climate Change, 'An Inconvenient Truth', won two Oscars at the 2007 ceremony. One link between parties in the United States who valued Climate Change action on pure environmental terms and traditionally sceptical groups was the issue of energy security. President Bush started to link the two issues, stating *"I want to make sure that the goal I set by reducing gasoline usage by 20 percent over a 10-year period is a realistic goal. I know it's a necessary goal: it's necessary for national security purposes; it's necessary for economic security purposes; and it's necessary in order to be good stewards of the environment."* (Whitehouse.gov, 2007). This portrayal linked Climate Change, energy security and economic security, removing some of the previous emphasis of Climate Change as a purely environmental issue.

In the developing world, governments were nervous of action on Climate Change in case it created obstacles to economic growth. This desire to protect economic growth tended to lead to intensity based targets, which aimed for energy efficiency, instead of targets for absolute reductions in CO_2 emissions. As an example, Russia only joined the Kyoto Protocol once it became clear that the decline in Russian industry meant it would easily meet targets to cut against a baseline of 1990 emissions. In China there were targets to *"reduce the amount of energy [used] to generate each dollar of national income by 20 percent between 2006 and the end of the decade"* (Planet Arc, 2007b). However China had not set any targets for absolute reductions in CO_2 emissions. India had regulation in place to encourage renewable electricity generation, but had not yet set any targets for CO_2 reductions or announced an ambition to develop or join a CO_2 market. Some developing world governments looked to the developed world for support on Climate Change, with opinions such as that of President Lula of Brazil being commonly encountered: *"The wealthy countries are very smart, approving protocols, holding big speeches on the need to avoid deforestation, but they already deforested everything,"* (Planet Arc, 2007a). In the negotiations on extending the Kyoto Protocol, Brazil put forward the Brazilian Historical Responsibility proposal. This called for *"Annex I [developed] countries with the longest histories of industrialisation and hence greatest cumulative contributions to global warming since 1840, to be allocated the most stringent emissions targets. Non-Annex I [developing] countries would not be assigned targets in the first instance but would be drawn into the process in subsequent commitment periods when their share of historical emissions crossed a threshold."* (Nordhaus, 2006; The Australia Institute, 2004). Developing countries took a protectionist stance, seeing the extension of the Kyoto Protocol as potentially threatening their economic development.

5.3.3 Businesses

In his open letter to the United Nations Global Compact, Jürgen Hambrecht, the Chairman of the chemical company BASF said *'We have to ensure that we deploy the most cost-efficient technologies first and get maximum climate protection at a minimum price and – most* *importantly – without distorting competitiveness."(BASF, 2007).* This statement was aligned with Tesco's statement on their website that *"Tesco supports the UK Government's commitments to the Kyoto Protocol on Climate Change. Tesco is committed to reducing its energy consumption and emissions of greenhouse gases responsible for Climate Change. We welcome the Government's initiatives to develop the renewable energy industry and are actively looking at the possibility of using energy from these sources"* (Tesco, 2007). These quotes were representative of the business community. Businesses were making efforts to be seen as aware of Climate Change and to be seen to support CO_2 markets. However, they commonly looked to governments to take the lead, as they argued the need for regulation to force their hand before they could justify action to their shareholders. Further evidence of this stance comes from a report signed by the CEOs of global companies in a World Business Council for Sustainable Development report. The report was titled 'CEO Climate Policy Recommendations to G8 Leaders' and was signed by 150 companies including Alcoa, British Airways, British Petroleum, EDF, EON, Lafarge, Petrobras, Renault, RioTinto and Vattenfall. The report called for *"the [CO_2] market to ...facilitate the linkage of explicit or implicit carbon values established at various national and regional levels, with the ultimate aim of establishing a deep and liquid international market for carbon that takes into account international competitive pressures."* (World Business Council for Sustainable Development, 2008: 7). The report also highlighted the need for *"information metrics and methodologies such as common carbon accounting standards... data calculation tools and disclosure processes... to create a level playing field for all."* (World Business Council for Sustainable Development, 2008: 19). Finally, emphasis was placed upon the need for regulation to enable business action: *"Business cannot fully capitalize on these new opportunities in an international policy vacuum: strong* *leadership from all governments, particularly those of the major economies, is essential."* (World Business Council for Sustainable Development, 2008: 9).

However, aside from the calls for a level playing field and the need for regulation to lead, businesses were starting to interact on the basis of revised assumptions with regards to CO_2 markets. For example, insurance companies were taking seriously the potential that coal fired power stations would be hit hard by future CO_2 markets. Furthermore, some companies were introducing screening values for the price of CO_2 at the project appraisal stage, in preparation for anticipated CO_2 markets. The objective of these screening values was to ensure that projects which passed investment hurdles would remain viable once a CO_2 market was in place. The screening values used by individual businesses cannot be disclosed due to confidentiality reasons. However, there was a useful reference point which was the United Kingdom's *"shadow price of carbon... for... policy and investment appraisals across government in the UK"* (Department for Environment Food and Rural Affairs, 2007: 7) This policy set the shadow price for CO_2 at £25/tCO2 in 2007 (Department for Environment Food and Rural Affairs, 2007). The shadow price was effectively a predicted CO_2 price which was designed to be built into UK government investment decisions, in order to help build the business case for lower CO_2 investments. Although the screening values adopted by businesses were not the same, they were informed by similar analyses and they were broadly aligned with such values.

One final distinction worth acknowledging was the difference between the responses to Climate Change by energy intensive industries, such as manufacturing, versus the responses from less energy intensive businesses, such as banks and other service companies. The distinction was that companies which did not use a lot of energy were less constrained in their response to Climate Change. For example, HSBC Bank achieved 'Carbon Neutral' status in 2007 (HSBC Bank, 2007).

The overall trend was that companies were taking limited actions to recognise the price of CO_2, while publicly advocating for a scheme that would set a transparent long-term price for CO_2.

5.3.4 *Non-Governmental Organisations*

There were a great many Non-Governmental Organisations campaigning on the issue of Climate Change. To capture a representative point of view, the Non-Governmental Organisation examined was a coalition of around 50 individual organisations including ActionAid, Christian Aid, Friends of the Earth, Greenpeace, Oxfam, WWF-UK and a large number of smaller and regional groups (Stop Climate Chaos, 2006). Stop Climate Chaos had pulled together the positions of their 50 or so members and come up with a manifesto which was summarised in the following statement (Stopclimatechaos.org, 2007). *'It is clear that there must be a global target for halting human-induced Climate Change, that the UK must gain proper control over its emissions and that the poorest countries of the world - who will be hit first and worst by Climate Change - must be fully supported. Consequently we call on the Government to do the following:*

1. *Negotiate internationally for global warming to peak at no more than 2 deg. C – there is an international consensus that this is the threshold for dangerous Climate Change. This will mean global greenhouse gas emissions must peak by 2015 and then decline irreversibly thereafter.*
2. *Institute a Carbon Budget to enable the UK to deliver an immediate and sustained decline in UK greenhouse gas emissions by an average of at least 3% p.a.*

3. *Give all necessary support to developing countries to help them adapt to Climate Change and gain access to sufficient low/zero carbon technology to grow sustainably; support programmes to help biodiversity adapt to Climate Change.*

We will strive in the UK to generate public support for personal and political action pursuant to the above objectives. We will also help mobilise international civil society for concerted global action on Climate Change that is fair and equitable to all." This stance was common to most Non-Governmental Organisations, in that they advocated strong action on global regulation of CO_2. Stop Climate Chaos called for *"global emissions [to] peak by 2015 and then irreversibly decline"* (Stopclimatechaos.org, 2007). This was a strong call for action, especially when taking account that in 2008 there was currently only a semi global CO_2 market, which would expire in 2012 and that reference to the Intergovernmental Panel on Climate Change estimates showed projected emissions in all scenarios rising sharply well past 2015 (IPCC, 2001). There was also a call for industrialised countries to support clean development in the developing countries. This was due to the industrialised countries' responsibility for the majority of manmade CO_2 emissions to date and the lack of the necessary resources to develop a low-carbon economy in the developing world. Stop Climate Chaos called for adaptation strategies to be integrated within existing national and international development and poverty reduction activities and to be undertaken in such a way as to empower poor communities and strengthen disaster risk-reduction capabilities for the future.

5.4 Summary

This case examined efforts to extend the Kyoto Protocol beyond its expiration date of the end of 2012. The case first examined the processes whereby changes to the Kyoto Protocol were made through structured annual negotiations. These were held annually by the United Nations Framework Convention on Climate Change. The case described the results of three of these 'Conference of the Parties' (COP) negotiations from 2006, 2007 and 2008. The second half of the case examined the stances of International Governance Bodies, Governments, Businesses and Non-Governmental Organisations with regards to the extension of the Kyoto Protocol. This case drew upon the responses of international governance bodies such as the United Nations Framework Convention on Climate Change, the G8 group of countries and the European Union. The case also drew upon national policy responses from Brazil, China, India and the United States. Businesses' interactions with the extension of the Kyoto Protocol were examined through HSBC Bank, BASF and Tesco Plc. Finally, the case examined Non-Governmental Organisations' stances through a Climate Change coalition called 'Stop Climate Chaos' and an organisation called the World Business Council for Sustainable Development.

This case was designed to give a macro-level illustration of the responses of key actor groups to the challenge of forming a CO_2 market. It also gave a framework for the European Emissions Trading Scheme which was set up to deliver European commitments under the Kyoto Protocol. The European Emissions Trading Scheme was examined in the second and third cases. Case two examines phase II of the European Emissions Trading Scheme. Case three then drew the discussion on to an examination of the extension of phase III of the European Emissions Trading Scheme to cover the aviation industry.

CHAPTER 6:

EMPIRICAL FINDINGS (CASE 2)

6 CASE 2: A MANUFACTURER'S RESPONSE TO PHASE II OF THE CO_2 MARKET OF THE EUROPEAN EMISSIONS TRADING SCHEME

6.1 Introduction

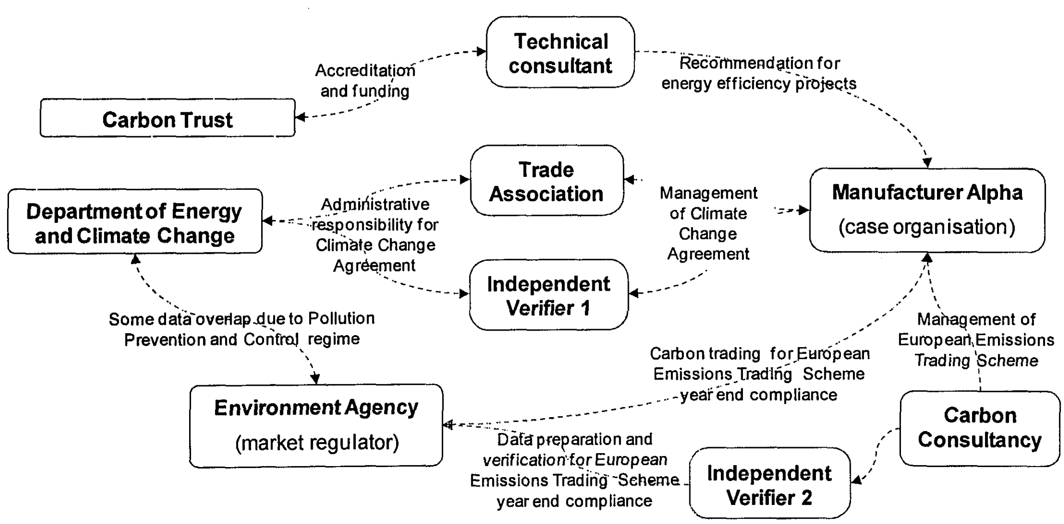
This second case examines phase II of the CO_2 market of the European Emissions Trading Scheme. The previous case examined efforts to extend the global CO_2 market of the Kyoto Protocol beyond its expiration date of the end of 2012. The link between cases one and two was that the European Emissions Trading Scheme could be viewed as a 'child' of the Kyoto Protocol. Phase II of the European Emissions Trading Scheme was designed to deliver European obligations under the Kyoto Protocol's commitment period of 2008-2012.

The case examines the interactions of Manufacturer Alpha during phase II of the European Emissions Trading Scheme. Data were collected between January and June 2009 through participant observation as a Carbon Consultant supporting Manufacturer Alpha. The case starts with an introduction to Manufacturer Alpha and their industrial network. Next, details are given of an audit from the Carbon Trust that was designed to flag CO_2 reduction opportunities at Manufacturer Alpha. The case then describes interactions with independent verifiers, the Department of Energy and Climate Change and the Environment Agency. These interactions concerned management of Manufacturer Alpha's participation in the United Kingdom's Climate Change Agreements and the CO_2 market of phase II of the European Emissions Trading Scheme. Finally, the case examines the influence of Manufacturer Alpha's capital appraisal process and operational key performance indicators upon engagement with the European Emissions Trading Scheme. These discussions lead into case three which deals with how businesses responded to the announcement of future developments within phase III of the European Emissions Trading Scheme.

6.2 A business network in phase II of the European Emissions Trading Scheme

This case examined a number of incentives and regulations which aimed to encourage energy efficiency improvements and CO_2 emission reductions by Manufacturer Alpha. Manufacturer Alpha specialised in the production of dairy nutrition goods. The case does not give further details of Manufacturer Alpha's product, since these details are not an important part of the case and some of the processes involved are subject to commercial confidentiality. Instead, it was the energy characteristics of the manufacturing process which made the case representative of an energy intense manufacturer responding to CO_2 markets. The manufacturing process relied heavily upon pumping to move the product around the site. To give an idea of the process, raw material entering at one end typically took 3 to 4 days to emerge at the other end as a finished product. Pumps were required at all stages to keep the product moving. Heating and cooling requirements were also large draws on energy, as the product required pasteurisation (heating) and preservation (cooling) at a number of stages in the process. Finally, steam drove large evaporators which converted the treated liquid to a powder at the end of the process. Another reason that energy use was so intense was that the production process was continuous. All stages of production fed into each other and hence all parts of the site had to run simultaneously. Extra storage could be introduced between productions stages, but as the product was perishable, this would require extra energy for refrigeration. These factors combined to mean that energy costs were estimated to represent ~50% of the overhead costs which could be controlled, or 20-25% of direct costs at Manufacturer Alpha's production sites. Manufacturer Alpha's network in phase II of the European Emissions Trading Scheme is illustrated in Figure 15.

Figure 15: Manufacturer Alpha's network within phase II of the European Emissions Trading Scheme



The first interactions examined were with the United Kingdom's government agency, the Carbon Trust. The Carbon Trust was tasked by government to facilitate the decarbonisation of the United Kingdom's industry. The Carbon Trust provided Manufacturer Alpha with funding to support the costs of hiring the Technical Consultant to complete a review of efficiency investment opportunities at the site. Secondly, interactions between Manufacturer Alpha, Independent Verifier 1 and the Trade Association focussed upon maintenance of the site's Climate Change Agreements with the Department of Energy and Climate Change. In a similar manner, interactions between Manufacturer Alpha, Independent Verifier 2 and Carbon Consultancy managed the site's participation in the CO_2 market of the European Emissions Trading Scheme, as administered by the Environment Agency. Figure 15 also illustrates that the Environment Agency interacted with the Department of Energy and Climate Change to manage data and compliance for pollution and prevention control in other environmental issues outside of energy and CO_2 emissions. These permits controlled other pollutants, such as hazardous chemicals and industrial wastes. Some data that related to other pollutants was linked to energy use and, as required, the Environment Agency shared this data with the Department of Energy and Climate Change.

6.3 Interactions during phase II of the European Emissions Trading Scheme

6.3.1 The Carbon Trust's energy efficiency report

The Carbon Trust had a remit to decarbonise the United Kingdom's Industry. One of the major arms of Carbon Trust's program was to increase the energy efficiency of existing sites. This was an important consideration for CO_2 markets, since any reductions in CO_2 emissions resulting from efficiency efforts could potentially be monetised on the CO_2 markets. The Carbon Trust managed an accreditation programme and kept a number of energy and carbon consultants on its books to perform energy efficiency audits at sites. In July 2008, one of the accredited consultants, referred to as Technical Consultant in Figure 15, visited Manufacturer Alpha. The Technical Consultant agreed the scope of the project to be to *"identify between 7-10 opportunities, which typically have a payback of three years or less and would provide a noticeable reduction in both energy use and carbon emissions"*. Prior to the visit, the Carbon

Trust sent a checklist, asking the site to prepare the following material: the last 12-24 months of energy meter readings and invoices; copies of any company energy policies; details of any existing energy reduction work; site plans and a list of equipment on site.

During the visit, the Technical Consultant worked with the site engineer to understand the manufacturing processes. The Technical Consultant used his existing knowledge of industry best practice to identify nine energy efficiency opportunities. These energy efficiency measures fitted into the categories summarised in Table 10.

Table 10: Energy efficiency measures recommended to Manufacturer Alpha by the Carbon Trust

1. Improving the site energy management policy. 2. Improving site metering, so that energy data would be collected automatically to be used for energy management. 3. Fitting more efficient variable speed drives in some areas. 4. Using waste heat recovery to preheat other parts of the process. 5. Improving insulation of hot processes

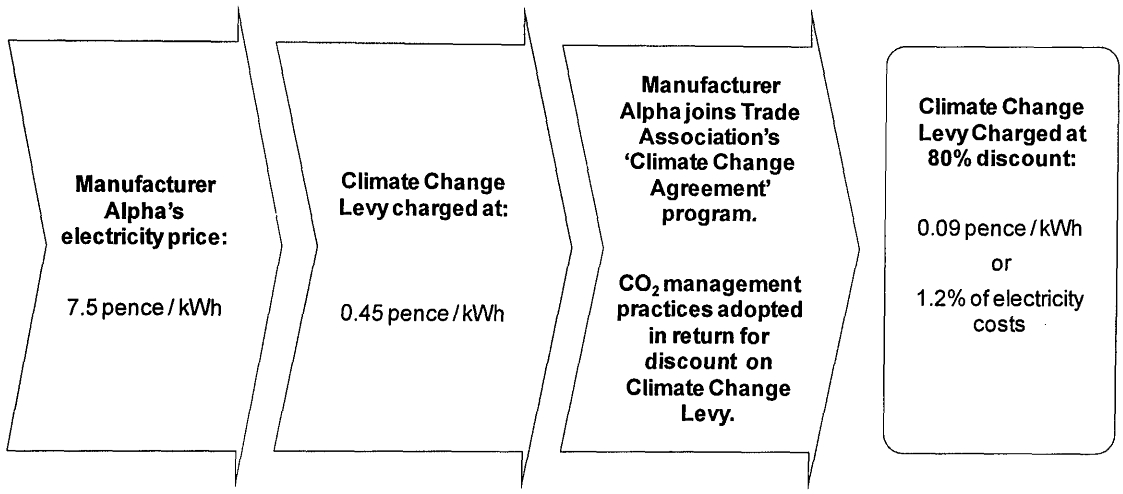
Collectively, these measures amounted to a potential saving of 5% of energy use. The average payback of the projects was around 0.5 years, with the maximum payback being 1.2 years. In the recommendations for Energy Management practices, the company was scored between 0 and 4 in the areas of Energy Policy, Organising, Training, Performance Measurement, Communication and Investment. Manufacturer Alpha's average score was 2.4, with Training and Communication highlighted as areas to work on. The energy policy was subsumed within the site's wider ISO 14001 procedures. These procedures managed environmental impacts which included, but were not limited to, energy use. It was recommended that a specific energy policy be drawn up and the appendix of the Carbon Trust report gave an example energy policy to use as a starting point. With regards to the energy efficiency projects proposed, each was detailed in a standard table. The table gave: projected savings in terms of cost, CO_2 and energy, the project payback, project details, project rationale, a risk assessment, next steps and links to relevant Carbon Trust documents which could support the project going forwards. In all, the report consisted of 34 pages and contained a significant amount of detail for the scoping stage of each project.

6.3.2 Climate Change Agreement interactions

The interactions of Manufacturer Alpha with the United Kingdom's Climate Change Levy and Climate Change Agreements are now examined. These data are important because the Climate Change Agreements influenced Manufacturer Alpha's interaction with the European Emissions Trading Scheme.

As an industrial user of electricity, Manufacturer Alpha was covered by the United Kingdom's tax on industrial energy use, the Climate Change Levy. This tax applied to electricity, gas and coal, of which Manufacturer Alpha only used electricity. For reasons of confidentiality, average electricity prices for industry are used to illustrate the net cost of the Climate Change Levy; these are illustrated in Figure 16. Issues of confidentiality relating to absolute levels of energy expenditure are managed by expressing costs in relative terms.

Figure 16: Comparison of energy and CO_2 costs due to the Climate Change Levy and Climate Change Agreements



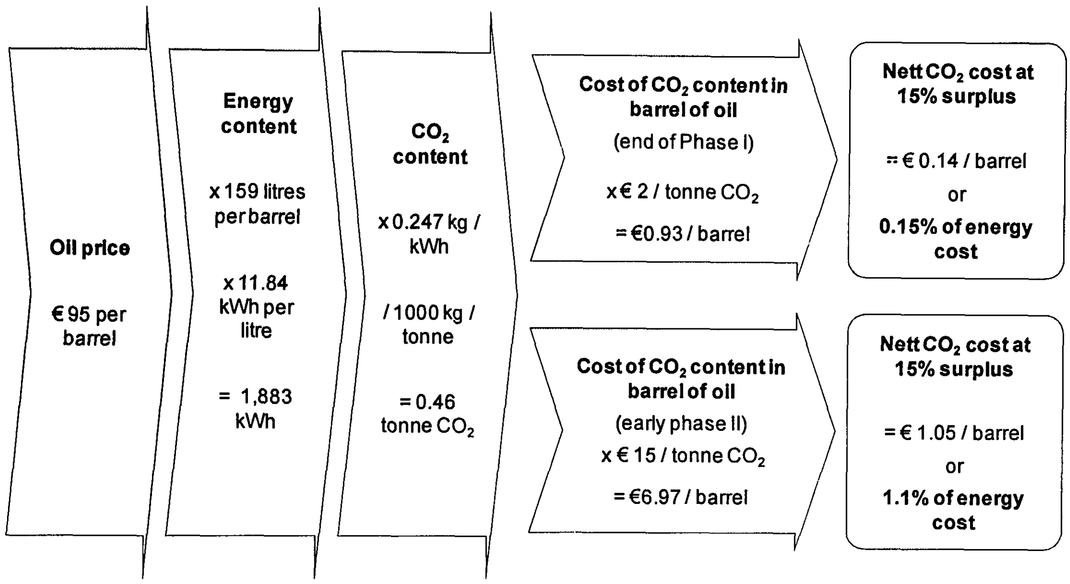
An average rate for commercial electricity costs during the time of the case was 7.5 pence per kilowatt hour. The Climate Change Levy was added to this energy cost at a rate of 0.45 pence per kilowatt hour, representing an increase in electricity costs by 6%. However, Manufacturer Alpha was able to apply for a Climate Change Agreement through their Trade Association. The Trade Association managed Climate Change Agreements on behalf of their industry and communicated efforts back to the Department of Energy and Climate Change. In signing up for a Climate Change Agreement, Manufacturer Alpha had to adopt energy management policies and best practise. In return for this, they received an 80% discount on the Climate Change Levy, meaning that they paid the Climate Change Levy at a discounted rate of 0.09 pence per kilowatt hour, instead of the original 0.45 pence per kilowatt hour. At this discounted rate, the net costs of the Climate Change Levy represented 1.2% of Manufacturer Alpha's electricity expenditure.

6.3.3 European Emissions Trading Scheme interactions

Moving on to examine Manufacturer Alpha's engagement with the European Emissions Trading Scheme requires a switch in attention to their consumption of oil. Manufacturer Alpha primarily used electricity and oil. This was because their rural location meant that they were not connected to a mains gas supply. Furthermore, electricity was not relevant to the European Emissions Trading Scheme, as it is a secondary form of energy. The European Emissions Trading Scheme covered the large primary energy consumers, i.e. the power station, rather than dealing with all the dispersed electricity consumers. Since there was no gas, and electricity was not covered by the European Emissions Trading Scheme, the only items onsite which fell under the European Emissions Trading Scheme were Manufacturer Alpha's large oil fired boilers. These were primarily used to produce steam to run the evaporators that converted the liquid product into a powder. There were two boilers, with one always running and the other kept up to temperature as a backup. These boilers are the subject of an annual European Emissions Trading Scheme verification, where the verifier checked that the energy consumption figures and their conversion to CO_2 had been carried out in accordance with the Environment Agency guidelines. Manufacturer Alpha then had the option to engage the CO_2 market in order to sell any surplus CO_2 permits, or to purchase those required to cover any end of year shortfall. During the audit of the 2008 figures, the verifier praised the systems in place and only made small changes to the volume of CO_2 emissions reported. The changes took account of a missed oil delivery and one mistake in data entry. These corrections resulted in less than a 0.5% change in the reported annual CO_2 emissions for the site and the verification was passed with only minor comments. Firstly, it was requested that the temperature of an oil meter be recorded to ensure that consumption was adjusted to take account of differences in temperature. Secondly, the verifier recommended that some of the site practices should be recorded in the existing ISO 14001 documentation.

The annual European Emissions Trading Scheme verification did not involve any discussions of the market based aspects of the European Emissions trading scheme. Instead it focussed solely upon ensuring that the correct volume of CO_2 was reported. Although Manufacturer Alpha had accumulated a significant surplus of European Emissions Trading Scheme credits for the past two years, they did not discuss or explore the option of trading these on the CO_2 market. Instead they were withheld as a 'float' to ensure compliance was possible in coming years. In other words, despite significant CO_2 credit surpluses affording a very large margin for expansion of emissions in coming years, Manufacturer Alpha did not engage the CO_2 market and monetise their surplus credits. A second consideration was that these surplus credits came from a generous allocation to Manufacturer Alpha, rather than year on year reductions in emissions. Within the European Emissions Trading Scheme, the number of allowances each site received was based upon standard factors applied to an inventory of equipment onsite. In terms of the impact of the European Emissions Trading Scheme, Manufacturer Alpha was in the position where they received more allowances than they needed to run their processes. In other words, they were and would be left with surplus CO_2 allowances at the end of each year. The surplus amounted to around a 15% over allocation of CO_2 permits. This over allocation would continue until phase II finished at the end of 2012 and the allocations were reviewed. Figure 17 compares the value of this 15% surplus in CO_2 permits to Manufacturer Alpha's corresponding energy costs.

Figure 17: Comparison of energy and CO_2 costs due to phase II of the European Emissions Trading Scheme



At the time of the case, oil prices were around \$70 or €95 per barrel (EIA, 2010). One barrel of oil represents 159 litres of oil and at 11.84 kilowatt hours per litre this is equivalent to 1,883 kilowatt hours of energy (Carbon Trust, 2008). Oil has a CO_2 content of 0.247 kilograms of CO_2 per kilowatt hour, meaning that one barrel of oil is roughly equivalent to 0.46 tonnes of CO_2 (Carbon Trust, 2008). At the time of the case, the price of CO_2 credits in the European Emissions Trading Scheme had crashed to less than €2 per tonne (ECX, 2010). This was due to the over allocation of credits during phase I of the scheme, as discussed in chapter four. At €2 per tonne, the CO_2 content of a barrel of oil represented a cost of €0.93, or approximately 1% of the cost of the barrel of oil. Given that Manufacturer Alpha received a surplus allocation of CO_2 credits of around 15%, the total financial surplus recognised by Manufacturer Alpha due to the European Emissions Trading Scheme was around 0.15% of their energy expenditure. Even taking account for the timing of the case which corresponded with a temporary crash in the price of the CO_2

credits, this does not make a significant difference to the calculations. For example, taking a more representative cost of CO_2 credits at €15 per tonne (ECX, 2010) still only gave a financial surplus that represented around 1.1% of Manufacturer Alpha's energy expenditure.

6.3.4 Manufacturer Alpha's responses

The case was developed through separate interviews with the plant manager, engineer, accountant and compliance manager. It quickly became clear that they were very concerned about the cost of energy and the fact that it represented almost 50% of their controllable overhead costs. In discussions about CO_2, they did not question the validity of concern over Climate Change. However, they did state that they found it a much less tangible issue to work with, when compared to energy costs. They also spoke about the Environment Agency's CO_2 regulation in terms of compliance and standards. This and CO_2 as a whole was spoken of as an issue that had to be managed as a risk of potential non compliance, rather than a strategic, or business concern relating to participating in the CO_2 markets. There were a number of examples that illustrated that the cost of CO_2 was yet to factor in the strategic decisions of Manufacturer Alpha. Decision making processes at Manufacturer Alpha were examined though the project planning and appraisal processes and the Key Performance Indicators used to drive operational decision making.

Looking to the site's CapEx plan, the projects were split into four levels of priority, 'Strategic approved capital', 'Normal approved budget', 'CapEx to be considered' and finally 'CapEx on hold'. In the first category, one of the two projects would have a significant impact upon CO_2 emissions. The second category included sixteen projects, of which seven would have a significant impact upon energy efficiency. Notably, about half of the projects identified by the Carbon Trust were rolled into one of the level two projects. Finally, one in four of the projects in level three had a significant impact upon energy efficiency and none of the three CapEx projects on hold impacted upon energy efficiency. When asked how a project came to be considered as Strategic Approved Capital, it was stated that this judgement was somewhat subjective, but would usually involve concerns of increasing production, improving quality performance, or reducing cost. Efficiency and Climate Change were seen as a subset of the third criteria of cost, but not as a strategic concern in their own right.

A further exploration of the allocation of CapEx was made through an examination of the project appraisal sheet that all CapEx proposals were submitted on. This was a five page document, Table 11 summarises the structure of the document.

Table 11: Summary of Manufacturer Alpha's standard CapEx appraisal sheet

Page 1:	Project details, such as project name, manager, site contact details etc. This included a tick box section where a project was to be classified as one of the following: 'Replacement', 'Extension', 'Efficiency', 'New developments / Markets', 'Quality', 'Environment / Safety'.
Page 2:	Two free text boxes for completion, titled 'Motivation for capital project' and 'Description of project'.
Pages 3 + 4:	Titled 'Financial Information'. Requested details on expenditure level, project timing, specification and plan.
Page 5:	Risk analysis with four questions: What happens if we do not invest? Influence on environment and safety? Influence on automation? Influence on factory throughput and storage capacity?

The details above illustrate how Climate Change was incorporated into decisions affecting future investments. Attention is now turned to how CO_2 markets influenced day to day management of the Manufacturer Alpha. Day to day decision making was examined through the site's key performance indicators. At the corporate level, the site reported performance against a number of indicators under the headings given in Table 12.

Table 12: Manufacturer Alpha's Key Performance Indicators (KPIs)

1. Deliver products at a competitive cost
2. Deliver and provide complete orders, on time and to specification
3. Adherence to plan
4. Optimise utilities efficiency
5. Materials recovery variance
6. Manufacture right-first-time
7. Customer complaints trends analysis
8. Factory expenses

The fourth KPI given in Table 12 was where energy efficiency was accounted for. 'Utilities' refers to site energy supplies. In the case of Manufacturer Alpha, the two main concerns were that the boilers were run efficiently to produce steam and that the steam was used efficiently to produce product. The ultimate measure was tonne of product produced / litre of oil used. This high level target was then broken down to tonne of steam produced / litre of oil used and tonne of product / tonne of steam. The disaggregation was useful, since the first metric gave a performance measure for the team running the boilers and the second was a measure of the production team's efficiency in using the steam. Supplementing these two measures, there were two further metrics which tracked compliance with the site's Climate Change Agreements and the number of environmental complaints received.

6.4 Manufacturer Alpha's final response

This case has outlined the three relationships held by Manufacturer Alpha in relation to CO_2 markets. It has illustrated how the incentives and information introduced had not significantly influenced the medium-term decision making processes of the company, or the day to day management of manufacturing sites. At the time of the case, seven months after the Carbon Trust survey was completed, there had only been one further interaction with the Carbon Trust. This was when the Carbon Trust's account manager had enquired as to progress with the projects for his reporting purposes. The projects had not yet been started, but the site engineer had taken a few of them forwards. Around half of the projects identified by the Carbon Trust were rolled into a project assigned the second level of priority. The relationships around the Climate Change Agreements and European Emissions Trading Scheme were both treated in much the same way as Manufacturer Alpha responded to previous environmental regulation. The CO_2 reporting exercise was seen as a compliance requirement and the required support was hired to ensure that the correct reporting procedures were followed. However, the price of CO_2 which the Environment Agency had intended to change the decision making and management practices of CO_2 market participants did not achieve this objective in Manufacturer Alpha's case. Both schemes had negligible financial impacts of less than 1% of annual energy expenditure and as such did not significantly impact upon the company's overall operations. Furthermore as well as not representing a material cost, CO_2 itself was not recognised as a variable to guide the decision making of Manufacturer Alpha.

6.5 Summary

This case examined phase II of the CO_2 market of the European Emissions Trading Scheme, which was designed to deliver European obligations under the Kyoto Protocol's commitment period of 2008-2012.

This case started with an introduction to Manufacturer Alpha and their industrial network. Next the case gave details of an audit from the Carbon Trust that was designed to flag CO_2 reduction opportunities at Manufacturer Alpha. The case described interactions with independent verifiers, the Department of Energy and Climate Change and the Environment Agency. These concerned management of Manufacturer Alpha's participation in the United Kingdom's Climate Change Agreements and the European Emissions Trading Scheme. Finally, the case examined the influence of Manufacturer Alpha's capital appraisal process and operational key performance indicators upon engagement with the European Emissions Trading Scheme.

The material presented in this case leads into case three, which examined the extension of phase III of the European Emissions Trading Scheme to cover the aviation industry.

CHAPTER 7:

EMPIRICAL FINDINGS (CASE 3)

7 CASE 3: AN ENERGY SUPPLIER'S RESPONSE TO AVIATION'S INCLUSION IN PHASE III OF THE CO_2 MARKET OF THE EUROPEAN EMISSIONS TRADING SCHEME

7.1 Introduction

The third case examines the extension of phase III of the European Emissions Trading Scheme to cover the aviation industry. This case details the response of a large multinational energy company, NRG, to these changes. Data were collected through participant observation as an Energy Efficiency and Climate Change analyst at NRG between April and December 2008.

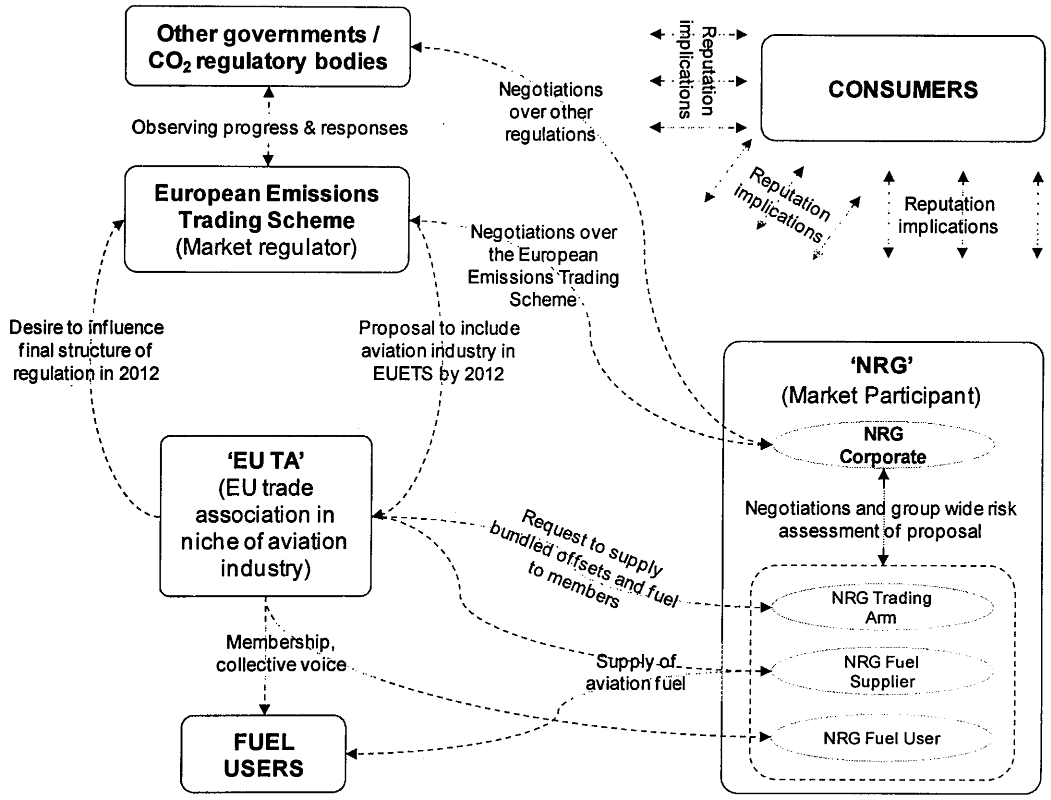
The case starts with an introduction to NRG and their industrial network. Next the proposed updates to the European Emissions Trading Scheme, which would draw in the aviation industry, are summarised. The case then examines the interactions between different parts of NRG and a European Trade Association, EUTA, which was active in a niche of the aviation industry. These interactions took place during the development of an offering which bundled aviation fuel with CO_2 permits equivalent to those which would be emitted during the burning of the aviation fuel. The case also describes the influence of NRG's relationships with regulators of other anticipated CO_2 markets. In addition, the case draws in consumers' views of CO_2 offsetting, since they significantly influenced the response of NRG to phase III of the European Emissions Trading Scheme. The case closes with a description of how NRG ultimately responded to the proposed partnership with EUTA and how NRG's internal teams managed the new obligations faced by parts of the company that were active in the aviation industry.

Phase II of the CO_2 market of the European Emissions Trading Scheme was examined in the second case. Phase II was designed to deliver European obligations under the Kyoto Protocol's commitment period of 2008-2012. The purpose of the third case was to examine the extension of phase III of the European Emissions Trading Scheme to cover the aviation industry.

7.2 A business network affected by aviation's inclusion within phase III of the European Emissions Trading Scheme

This case describes network interactions by an anonymised 'NRG', a large multinational energy company, when faced with the opportunity to respond proactively to their future inclusion in the CO_2 market of the European Emissions Trading Scheme. The business network which was affected by the proposed changes to the European Emissions Trading Scheme is illustrated in Figure 18. The core announcement triggering events described in the case was the inclusion of the aviation industry within the European Emissions Trading Scheme as of 2012, as detailed in the following section. As well as the deadline for inclusion of the aviation industry, the European Union announced that early action in the years leading up to 2012 would potentially be recognised by the final structure of the extension of the European Emissions Trading Scheme.

Figure 18: NRG'S network as a proposed participant within phase III of the European Emissions Trading Scheme



The multinational energy company NRG was embedded in a network of business relationships with other actors, with whom they interacted in response to the inclusion of aviation in the European Emissions Trading Scheme. Figure 18 shows the industrial network and the interactions taking place. NRG had a number of different parts of its business which were affected by the changes, these are examined next through the customer and other actor relationships affected.

7.3 *Interactions to include aviation within phase III of the CO_2 market of the European Emissions Trading Scheme*

7.3.1 Proposed changes to the market

From 2013 onwards, the European Emissions Trading Scheme will enter phase III and expand in scope to encompass additional sectors, including the aviation industry. Aviation was a fast growing sector and was politically charged with regards to Climate Change. European regulators were looking to include the aviation industry within the CO_2 market of the European Emissions Trading Scheme post 2012 and were also keen to incentivise early action before then. Figure 19 illustrates the timeline for inclusion of aviation with the European Emissions Trading Scheme.

Figure 19: Timeline for inclusion of aviation within phase III of the European Emissions Trading Scheme

2004 – 2006:	Baseline years used to set target	
2007:		Opportunity for proactive response, influencing and setting precedents
2008:	Data collection and recording required for free permit application	
2009:	Application deadline for free permits	
2010:	Data collection test year	
2011 onwards:	Inclusion of internal EU flights	
2012 onwards:	Inclusion of all flights arriving or departing within EU	

One of the core debates surrounding phase III of the European Emissions Trading Scheme was over how to allocate CO_2 permits to market participants. Previously, permits were allocated for free, with their value arising from their scarcity and the fact that they could either be sold into the CO_2 market, or surrendered to achieve compliance. There were proposals that instead, some or all permits should be auctioned, rather than allocated for free in phase III of the European Emissions Trading Scheme. This development built upon experience gained during the first phase of the European emissions trading scheme which ran from 2006 until 2008. During this practice phase, permits were allocated for free, based upon applications made by individual sites or companies. Since the permits were allocated for free, there was an incentive to apply for a 'generous' allocation. The aim of auctioning permits was that sites would no longer have an incentive to apply for more permits than they required. The mechanism was also designed to encourage early reporting of data. One of the key incentives for early action was that companies in the aviation industry which collected and submitted their CO_2 performance data early would be rewarded through being given the chance to apply for free CO_2 emission permits.

Cooperation with this early data submission process could result in financial savings for the companies which adhered to the early implementation timeline illustrated in Figure 19. Financial projections were that aviation's inclusion within the European Emissions Trading Scheme would increase the costs of flights within Europe by €2-€9 and by around €40 for flights between the United States and Europe (Bebbington & Larrinaga-Gonzalez, 2008; Pais, 2008). Since almost all input costs for these calculations were variable, it was difficult to say what percentage of airlines' fuel costs would eventually be made up by the costs of CO_2 emissions permits. However, some projections had been made regarding the anticipated overall impact upon flight fares. Anger and Köhler provide a review of this work (2010), as summarised in Table 13.

Table 13: Projected increases in aviation fares due to inclusion within the European Emissions Trading Scheme

(Anger & Köhler, 2010)

	Projected percentage increase in air fare		
	Minimum	Median	Maximum
Short haul	0.2%	1.5%	2.5%
Medium haul	0.1%	1.4%	2.3%
Long haul	0.2%	0.6%	2.0%

The review by Anger and Köhler split cost projections between short, medium and long haul flights. In each case they gave minimum and maximum projected impacts of the European Emissions Trading Scheme upon air fares. In short haul flights, estimated cost increases ranged between a minimum of 0.2% and a maximum of 2.5%, the median being 1.5%. In medium haul flights, estimated cost increases ranged between a minimum of 0.1% and a maximum of 2.3%, the median being 1.4%. Finally, for long haul flights, estimated cost increases ranged between a minimum of 0.2% and a maximum of 2.0%, the median being 0.6%. The absolute maximum projected increase in fares due to aviation's inclusion in the European Emissions Trading Scheme was 2.5% and the median figure was between 0.6% and 1.5%, depending upon the length of the flight.

7.3.2 NRG Fuel Supplier selling aviation fuel to Fuel Users

NRG had a business arm, NRG Fuel Supplier, which specialised in the supply of fuel to the aviation industry. NRG Fuel Supplier's commercial relationships were affected by the inclusion of Aviation within the European Emissions Trading

Scheme. This was because Fuel Users still required the fuel they had always purchased, but would now also need support to trade CO_2 within the European Emissions Trading Scheme. As such, this relationship was open to a new business opportunity and also new competitive pressures from alternative suppliers offering to provide emissions permits for the European Emissions Trading Scheme. There was also a shorter-term demand from customers for support as the regulation was finalised and implemented. This is where the link to EUTA, the trade association active in a niche of the European Aviation Industry, became relevant. Firstly, the majority of NRG Fuel Supplier's customers were members of EUTA. Secondly, NRG had had strong links to EUTA, since its own aviation craft NRG Fuel User were members. NRG's relationship with EUTA increased in importance, since they eventually developed a joint offering in response to aviation's inclusion within the European Emissions Trading. More details on each of these interactions are given below.

7.3.3 NRG Fuel User as a member of EUTA

The second relationship affected by the inclusion of aviation within a CO_2 market was between NRG's aircraft, NRG Fuel User and EUTA. EUTA was the trade association active in the European aviation industry. EUTA wanted to support their members in responding to and influencing the new regulations. As mentioned previously, a large number of EUTA's members already had an existing relationship with NRG Fuel Supplier and NRG Fuel User was already a member of EUTA. EUTA approached NRG Fuel User as members of the trade association and proposed to set up a service where, through EUTA, members could buy fuel bundled with the required CO_2 emission permits for compliance. The initial approach was for NRG Fuel User to join this initiative as a member of EUTA. However, the discussions quickly moved from participation in the initiative, to the potential for NRG Trading Arm and NRG Fuel Supplier to support the initiative as suppliers of bundled CO_2 emissions permits and aviation fuel respectively. This offer is explored further in the following section.

7.3.4 NRG Trading Arm and NRG Fuel Supplier as potential new suppliers to EUTA. NRG Corporate as a mediator for the wider CO_2 market implications

After the approach from EUTA to NRG Fuel User outlined above, NRG Trading Arm and NRG Fuel Supplier proposed to provide support to EUTA's offering to their members. This support was proposed to be in the form of NRG Trading Arm and NRG Fuel Supplier providing bundled emission permits and aviation fuel respectively. The offer would be made through EUTA, but contracts for fuel or emissions permits would be directly with NRG, many of them as extensions to existing commercial relationships. This offer changed the nature of aviation fuel, which had been essentially a commodity, into a service that offered Fuel Users support with participation in the mandatory CO_2 market. This was a potential point of differentiation for NRG Fuel Supplier and EUTA, as well as a potential new market for NRG Trading Arm. NRG Corporate had a coordinating role and was responsible for managing potential impacts in other relationships. These related to the wider development of the European Emissions Trading Scheme and other CO_2 markets. These considerations introduced potential conflicts of interest within NRG, the management and resolution of which was the responsibility of NRG Corporate. The new opportunities in aviation were part of a much wider debate on energy and CO_2 management for the whole of industry. Later, the case explored how CO_2 markets were under discussion for all other sectors and how the issues of precedent setting and consistency were the concerns of the central NRG Corporate team.

7.3.5 Interactions between NRG Corporate and regulators of different regions and industries

The interactions between regulators of different industries and regions were an important contributing factor in the guidance eventually given by NRG Corporate. For example, the European Union was actively *"examining whether it could be possible to...provide for the recognition of... [CO_2] allowances [from] ETS [Emissions Trading Schemes] including the United States' Regional Greenhouse Gas Initiative and the Californian ETS"* (Marr, 2007: 6). Similar discussions were also under way between the European regulators and Australian regulators attempting to develop CO_2 markets (Marr, 2007). It was also the case that the scope of the European Emissions Trading scheme was much wider than that of just the aviation industry. As discussed in the industry definition chapter in more detail, the European Emissions Trading Scheme also covered approximately 10,500 sites from the electricity generation, iron and steel production, manufacturing, mineral processing and pulp and paper processing industries (Europa, 2010). Interacting with European regulators on the treatment of aviation within the European Emissions Trading Scheme provided the possibility to intentionally or unintentionally influence the development of CO_2 markets for other industries or geographical regions. NRG Corporate was aware that the response to aviation would have to be placed in the wider context of the developments of CO_2 markets as a whole; they were active in a wide range of parallel negotiations. CO_2

markets were being discussed in Australia, the United Kingdom and the United States. Furthermore, aviation was only one of a number of industries covered by the European Emissions Trading Scheme.

7.3.6 Consumer scepticism with regards corporate CO_2 responses

The role of final consumers, such as aviation passengers and domestic transport fuel users, in shaping the response to aviation's inclusion in the European Emissions Trading scheme could not be ignored. At the time of the announcement in 2008, there were a number of consumer 'scandals' which received significant press coverage. These centred on widespread scepticism with regards the practice of offsetting, which is introduced in chapter four and explored in detail later in this case. Examples include headlines from the New York Times: *"Carbon-Neutral is Hip, but is it Green?"* (Revkin, 2007), the Guardian: *"Not carbon offsets, but carbon upsets"* (Kysar, 2010) and German consumers' accusations that offsetting amounted to 'selling pollution' (Engels, 2001). These issues introduced significant reputational concerns which influenced the response of all parties to the changes, but were of particular concern to NRG Corporate.

7.3.7 EUTA's initial proposal to NRG

In response to their future inclusion in the European Emissions Trading Scheme, actors within the aviation industry saw the potential to proactively influence the CO_2 market. The formalised opportunities to gain recognition for early action were detailed in section 7.3. This section explores how actors sought to take further early action to demonstrate potential modes of compliance, with the hope of influencing the final regulatory design.

It is important to recognise that in this case, early action by the aviation industry would be offsetting, i.e. the purchase of CO_2 permits outside of a legally binding CO_2 market. This was unavoidable, since it was not possible to engage in emissions trading until the scheme became legally binding in 2012. The widespread scepticism and concerns with regards the practice of offsetting were introduced in chapter four. As the case will show, NRG's corporate policy team had to provide guidance to help avoid the potential technical and reputational pitfalls of offsetting.

EUTA, a trade association active in a niche of the European Aviation Industry, approached NRG Fuel User as a member and offered to supply a new fuel offering based upon bundling the aviation fuel and CO_2 permit together. This would provide a potential compliance method for EUTA members covered by the European Emissions Trading Scheme, one built into the fuel purchase itself. The initial intention of the approach was that NRG Fuel User would eventually purchase the offering, rather than be directly involved in its development and delivery.

The changes impacted on a number of areas of NRG's business. These areas overlapped and in some ways caused conflicts of interest within the company. NRG Fuel Supplier and NRG Trading Arm saw the proposal as a potentially attractive business opportunity. They gave NRG Fuel User strong feedback to steer the proposal towards using NRG Fuel Supplier and NRG Trading Arm as suppliers of the fuel and emission permits. NRG were to supply fuel and emission permits, while

EUTA would bring economies of scale by acting to aggregate the demand of its members. EUTA members would benefit from a unified approach to compliance that would bring increased influence on the regulator to accept their 'bundled fuel and offset' method as a compliance option once the aviation was included in 2012. NRG Fuel User also saw the proposal as a response to external pressures from CO_2 interest groups. The proposal for a partnership between NRG and EUTA was then put forward to NRG Corporate. With the broad proposal outlined, NRG Corporate had the responsibility to coordinate and oversee the actions taken by NRG Fuel User, NRG Trading Arm and NRG Fuel Supplier. Climate Change, offsetting and the emissions of the aviation industry were all high profile issues. The main responsibilities of NRG Corporate were twofold: to manage the risk of setting difficult precedents with other customers or regulators and to avoid damage to NRG's reputation, by ensuring the environmental validity of the proposals. The key tensions experienced by NRG Corporate and the resulting interactions are now examined.

7.3.8 The CO_2 conundrum: Make or buy?

'Make' or 'buy' is one of the main discussion points within the wider CO_2 community. It is a result of the structure of CO_2 markets, which is a cap and trade system, a detailed explanation of such markets and their alternatives is given in chapter four. NRG had to decide whether to 'make' or 'buy' when faced with the option to put forward a proactive response to the inclusion of the aviation industry in the European Emissions Trading Scheme. They had to choose whether to 'make' the CO_2 reductions required in-house, or 'buy' the emission permits from other parties via the CO_2 market. This was the first point of discussion within the different groups of NRG. NRG Trading Arm, NRG Fuel Supplier and NRG Fuel User all felt that a 'buy' response through purchasing CO_2 reductions, offsets if purchased before 2012, was the most appropriate response. This preference was in line with initiatives taken by competitors who had previously offered the chance for customers to supplement their flight ticket with an offsetting option. This offering had allowed passengers to offset the emissions generated during the flight by buying reduction certificates from the CO_2 market. Along these lines, NRG Trading Arm saw the opportunity to extend its CO_2 trading operations to a new area. NRG Fuel Supplier saw the partnership with EUTA as presenting an opportunity to achieve increased market share. NRG Fuel User saw the offering as being the least cost and most convenient option to comply with the forthcoming CO_2 market. NRG Corporate however, saw the proposal as potentially damaging in a number of other areas in NRG's wider network.

Aviation competitors had previously offered offsets as an optional product for purchase by consumers. However, if NRG bundled the offset and fuel together and used it to influence proposed regulation, they would set a precedent in the aviation industry. At the same time, it was noted that competitors would most likely be considering the same idea and so the fear of setting a precedent had to be weighed against the desire not to miss an opportunity. NRG Corporate developed a group policy on offsetting in order to deal with these concerns. There were two parts to the policy, the first dealt with who provided the offsets and the second with the type of offset to be used. The first part of the policy stated that any offsets purchased by NRG must come from their trading arm, rather than a third party. It was felt that this would maximise the business opportunities for NRG, while at the same time avoiding the risk of dealing with a third party in a potentially controversial market. The second part of the policy gave guidance on what type of offset to offer. It was quickly decided that although voluntary offsets were the least-cost solution, they would not be used. This was due to their lack of transparency and the low level of consumer trust of offsetting. The decision was taken that offsetting would be done using CO_2 emission permits supplied by either the United Nations' Kyoto Protocol, or by the European Emission Trading Scheme. The external verification of compliance-based offsets by such authorities was seen as justifying their extra cost over voluntary offsets.

7.3.9 The issue of precedent setting

A wide range of CO_2 markets were being developed in parallel at the time of the announcement of aviation's inclusion in the European Emissions Trading Scheme. As with many energy companies at the time, NRG publicly supported the European Emissions Trading Scheme and was calling for CO_2 markets, in order to create a level playing field and to have the ability to assign a monetary value to CO_2 reductions. However, NRG Corporate was acutely aware that different regulators were interacting and that a precedent set in one region or industry could easily spread to others. For example Californian regulators were known to be working with Chinese and European regulators. Furthermore, the Stern team which published the influential Stern Review (Stern, 2006) were known to be working upon a similar report to support CO_2 markets in developing countries. The existing relationships and interactions between regulators meant precedents set in one particular region or industry would quickly influence other pending CO_2 markets. This made it essential that any proactive response to aviation's inclusion in the European Emissions

Trading Scheme was viewed within the wider context of the development of other CO_2 markets. NRG Corporate had a role of helping NRG Trading, NRG Fuel Supplier and NRG Fuel User in understanding the wider implications of their proposals for a proactive response. NRG Corporate also played a part in explaining the environmental robustness and capital efficiency of the different potential compliance options.

The interaction of NRG Corporate with other areas of NRG and also in its engagement with EUTA performed two functions. Firstly, NRG Corporate steered the proposal through careful treatment of CO_2 offsetting. Secondly, they acted as advisors on the technical validity of proposals in terms of environmental soundness and regulatory acceptability. While precedents had already been set externally on offsetting within the aviation industry and other sectors with equally public profiles, no one had yet offered the fuel and offset as a bundled product. NRG corporate was nervous that in setting the precedent it could have unintended circumstances in other future CO_2 markets. NRG Corporate was also concerned that any actions taken should acknowledge consumer attitudes towards offsetting. Consumer interest in Climate Change was at an all time high and it was felt that consumers valued low CO_2 offerings. However it was also recognised that consumers viewed offsetting with a scepticism that had been magnified by critical press articles and material released by CO_2 interest groups.

7.4 NRG's final response

NRG assessed the reputational risks, observed the offsetting precedents in the aviation industry and weighed up the likelihood of setting a precedent that would spread to other CO_2 markets. NRG finally went ahead with the proposal, subject to two conditions. Firstly, in order to maximise the business opportunity and minimise exposure to risk through third parties, NRG Trading Arm would be the sole supplier of offsets and likewise NRG Fuel Supplier with regards aviation fuel. This would ensure the supply of robust offsets and give full transparency as to their sourcing and treatment. Secondly, it was considered that it was acceptable to meet external demand for such offerings by using compliance based offsets. However, to mitigate reputational risks, NRG would make further efficiency efforts in-house. Due to the external opinions of offsetting, NRG Fuel User preferred to take a mix of both 'make' and 'buy' actions to manage CO_2 emissions. NRG Fuel User would join the EUTA project and 'buy' offsets, while at the same time 'making' significant emissions reductions in-house through energy efficiency measures. This decision was partly due to external network pressures and partly to align with NRG's group-wide drive for efficiency improvements. In addition NRG Fuel User would supply emissions data in line with the timeframe illustrated in Figure 19. This would enable the application for free emissions permits when the scheme became legally binding.

7.5 Summary

This case examined the extension of phase III of the European Emissions Trading Scheme to cover the aviation industry. The case detailed the response of NRG, a large multinational energy company, to these changes.

The case began with an introduction to NRG and their industrial network. Next the case gave a summary of the proposed updates to the European Emissions Trading Scheme in order to draw in the aviation industry. The case then examined the interactions between different parts of NRG and a European Trade Association, EUTA, which was active in a niche of the aviation industry. These interactions took place during the development of an offering which bundled aviation fuel with CO_2 permits. The CO_2 permits were equivalent to the CO_2 emitted during the burning of the aviation fuel. The case also described the influence of NRG's relationships with regulators of other anticipated CO_2 markets. In addition, the case drew in consumers' views of CO_2 offsetting, since they significantly influenced the response of NRG to their inclusion within phase III of the European Emissions Trading Scheme. Finally, the case closed with a description of how NRG ultimately responded to the proposed partnership with EUTA and how NRG's internal teams which were active in the aviation industry managed the new obligations which they faced.

Case one provided an examination of efforts to extend the global CO_2 market of the Kyoto Protocol beyond its end in 2012. The second case examined phase II of the CO_2 market of the European Emissions Trading Scheme. Phase II was designed to deliver European obligations under the Kyoto Protocol's commitment period of 2008-2012. The purpose of the third case was to examine the extension of phase III of the European Emissions Trading Scheme to cover the aviation industry. The remaining cases examine a third CO_2 market: the United Kingdom's Carbon Reduction Commitment. The Carbon Reduction Commitment targeted commercial companies which represented the next tier down of energy users.

CHAPTER 8:

EMPIRICAL FINDINGS (CASE 4)

8 CASE 4: MANUFACTURER AND TRADE ASSOCIATION RESPONSES TO THE CONSULTATION ON THE UNITED KINGDOM'S CO_2 MARKET, THE CARBON REDUCTION COMMITMENT

8.1 Introduction

Case four examines a manufacturer's and trade association's responses to the consultation on the United Kingdom's CO_2 market, the Carbon Reduction Commitment. If the European Emissions Trading Scheme was a 'child' of the Kyoto Protocol, then the Carbon Reduction Commitment could be its 'grandchild'. The Carbon Reduction Commitment targeted the next tier down of energy users. These represented commercial companies which were not covered by the European Emissions Trading Scheme which focussed upon industrial scale operations.

Data were collected between January and October 2009 through participant observation as a Carbon Consultant supporting Manufacturer Beta. The case begins with an explanation of the consultation format. Next Manufacturer Beta's submission to the Environment Agency's consultation process is examined. Then the public response of the Confederation of British Industry to the consultation process is examined. The case closes by comparing the consultation responses with the outcome of the consultation process and gives a description of the final structure of the Carbon Reduction Commitment.

As well as describing the development of the Carbon Reduction Commitment during its consultation phase, this case also gives important data on the structure of the

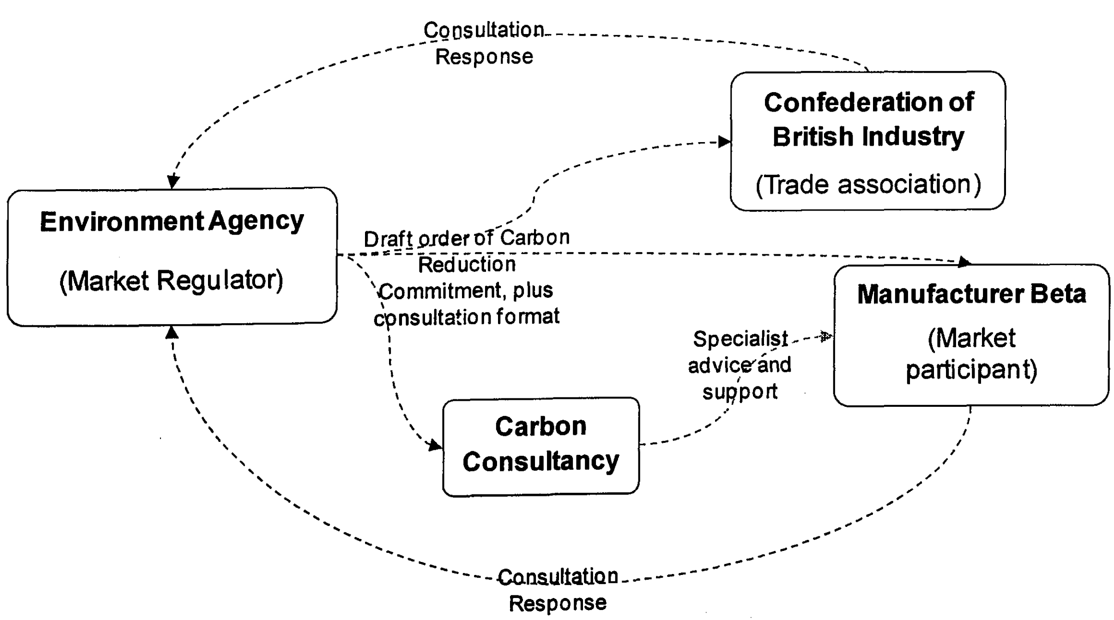
Carbon Reduction Commitment which is the starting point for cases five and six which examine the launch of the Carbon Reduction Commitment.

8.2 A business network involved in the consultation phase of the Carbon Reduction Commitment

This case details the response of Manufacturer Beta and the Confederation of British Industry to the consultation on the draft order of the Carbon Reduction Commitment. The draft order outlined the proposed structure of the Carbon Reduction Commitment ahead of its launch in April 2010.

Figure 20 introduces Manufacturer Beta, The Confederation of British Industry and the network within which they responded to the Carbon Reduction Commitment.

Figure 20: Manufacturer Beta and the Confederation of British Industry as part of the Environment Agency's network during consultation on the Carbon Reduction Commitment



Manufacturer Beta had their head office and over 100 sites within the United Kingdom. They also had multiple manufacturing bases and global export markets. Manufacturer Beta was a high-tech manufacturing company; however their specific industrial sector has been withheld for reasons of confidentiality. Manufacturer Beta was supported in their response to the Carbon Reduction Commitment and other CO_2 markets by a Carbon Consultancy who specialised in sustainable energy and CO_2 reporting. Data were collected through participant observation at Carbon Consultant at Carbon Consultancy.

The Confederation of British Industry was a prominent industrial lobby group within the United Kingdom which was formed in 1965. They introduced themselves as *"...the UK's top business lobbying organisation, [exerting] unmatched influence with government, policymakers and legislators mean[ing] [they] can get the best deal for business – at home and abroad"(CBI, 2009a)*. The Confederation of British Industry was chosen for the case for several reasons. They represented 420,000 organisations within the United Kingdom, meaning that their reach across the estimated 5,000 Carbon Reduction Commitment participants was very broad. In addition, they had a specialist Climate Change Task Force that was well placed to comment on the draft order of the Carbon Reduction Commitment.

The case now outlines the format and process of the consultation, before giving details of Manufacturer Beta's and the Confederation of British Industry's response.

8.3 Interactions during the consultation on the Carbon Reduction Commitment

8.3.1 Consultation format

The consultation for the development of the Carbon Reduction Commitment was carried out in three stages. The first stage questioned the form that the regulation should take. This is not examined here; the logic that regulators presented for the selection of CO_2 markets over other regulatory options was given in chapter four. The second consultation stage developed the design of the scheme's draft order, as covered in section 4.7.6, where the draft order of the Carbon Reduction Commitment was introduced. Finally, the third stage of the consultation asked for feedback on the Carbon Reduction Commitment's draft order which detailed the proposed structure and timelines of the Carbon Reduction Commitment. Participating businesses were using the draft order to plan their response to the Carbon Reduction Commitment during 2009. The scheme was due to start in April 2010 but the final consultation didn't finish until 7 October 2009 (DECC, 2009d). The narrow timescales meant that companies started preparing for the Carbon Reduction Commitment on the basis of the draft order. By the time the final consultation was completed, there was little time left to prepare before the launch of the scheme. Table 14 gives a summary of the consultation format and content. The consultation was presented in the form of 66 questions, to which respondents were asked to make a direct response by selecting one of a number of multiple choices. In around half of the questions, the respondents were given the chance to explain their response by typing a free text comment. These 66 questions were grouped according to a number of concerns. Table 14 sorts them into eight categories which correspond with the main points raised during the consultation.

Table 14: Categorisation of the 66 questions asked by the consultation on the Carbon Reduction Commitment

Category 1:	Treatment of groups- finding the highest parent company and its subsidiaries
Category 2:	Landlord tenant issues- assigning responsibilities
Category 3:	Qualification criteria and the registration process
Category 4:	Managing exemptions and overlaps with other CO_2 regulatory schemes
Category 5:	Reporting requirements
Category 6:	Administrative requirements
Category 7:	League table publication and CO_2 trading requirements
Category 8:	Penalties and fines for non compliance

The first category dealt with the treatment of groups of companies which were owned by a parent organisation. The questions aimed to ensure that the final wording found the highest parent company and its subsidiaries. This was important, because rules which aggregated groups brought smaller businesses into the Carbon Reduction Commitment that would not have qualified on their own. The legal structure defined by the Carbon Reduction Commitment also specified which companies would ultimately be liable for the cost of CO_2 permits and any penalties or fines for non compliance.

The second category of questions examined landlord tenant issues, aiming to clarify how to assign responsibilities between landlords and tenants. This was important because any building usually had both a landlord and a tenant. It was necessary to define which of these two parties would be required to participate in the Carbon Reduction Commitment. In the draft order, the default responsibility lay with the landlord. However it was argued that in many cases, tenants had more control over energy consumption and so should be liable for Carbon Reduction Commitment participation instead of the landlord.

The third category of questions dealt with the Carbon Reduction Commitment's qualification criteria and registration processes. These processes were important since the ultimately determined which businesses had to participate in the Carbon Reduction Commitment.

The fourth category looked at how best to manage exemptions and overlaps with other CO_2 markets. At the time of the launch of the Carbon Reduction Commitment, some businesses within the United Kingdom were already participating in the European Emissions Trading scheme and /or the United Kingdom's Climate Change Agreements. The Environment Agency wanted to avoid double regulation of any one CO_2 emissions source due to the potential conflicts and administrative waste that this could cause.

The fifth category related to clarification of a number of reporting requirements. The original draft order had left some ambiguity in terms of the reporting requirements of the Carbon Reduction Commitment. It had also included some direct errors that required correction and clarification. For example, the definition of 'voluntary automatic meter reading' is dealt with later in this case. Two potential definitions gave rise to the potential to put certain participants at either the top or bottom of the scheme's league table, depending upon which definition was chosen.

The sixth category looked at the administrative requirements of the scheme and clarified certain routine aspects such as how long records would have to be kept and exactly when and how participants would register for participation.

The seventh category dealt with the process of league table publication and participation in the Environment Agency's annual auction of CO_2 allowances.

Finally, the eighth category sought comment on the proposed penalties and fines for non compliance with the Carbon Reduction Commitment. These fines were potentially significant, because the Carbon Reduction Commitment was based upon self reporting. Penalties had to be significant enough to prevent businesses from simply ignoring the scheme and then paying a fine. Space was given in the consultation to comment upon each of the eleven different types of fine.

8.3.2 Manufacturer Beta's consultation response

Manufacturer Beta's response to the Carbon Reduction Commitment consultation is now described. All organisations had to respond to the same set of questions, this amounted to responding to the 66 questions summarised by the eight categories in Table 14. The process of responding to the consultation represented about 8 hours of work and was informed by the 18 months of preparations for the Carbon Reduction Commitment undertaken by Manufacturer Beta and the Carbon Consultancy. The Carbon Consultancy performed an initial scan of the document and proposed responses to the 66 questions. There was then a review meeting with Manufacturer Beta's property lawyer to revise and agree responses. Although many of the consultation questions were not relevant to a manufacturing company, such as those relating to the treatment of National Health Service organisations, Schools or Universities; Manufacturer Beta did identify a number of concerns. The following section reviewed Manufacturer Beta's concerns within each of eight categories of consultation question as summarised in Table 14.

Firstly, the treatment of groups did not cause any concerns for Manufacturer Beta. They had a United Kingdom parent company and a number of subsidiaries which they had already identified. Therefore defining the legal structure of the company was not a complicated issue for them and they did not provide any feedback on this issue.

However, the second category regarding the assignment of responsibilities between landlord / tenants was of particular relevance to Manufacturer Beta. Manufacturer Beta were landlords at some of their sites and tenants at others. Question 10 asked *'Do you agree with Government's proposal not to proceed with the option of allowing limited transfers of emissions responsibility from the landlord to the tenant?"* (DECC, 2009d). Manufacturer Beta stated that they did not agree with this proposal. They gave an example where they had responsibility for the purchasing of energy on behalf of their tenants. Manufacturer Beta stressed that this meant they would have responsibility for Carbon Reduction Commitment reporting and compliance which related to end use by a third party tenant. Manufacturer Beta argued that they had little or no operational control over their tenants with which to encourage CO_2 emission reductions and stressed that they felt that transferring Carbon Reduction Commitment responsibilities to their tenants would give the responsibility to those with operational control of the relevant CO_2 emissions. Manufacturer Beta suggested that default responsibility for the Carbon Reduction Commitment should be with the landlord, but that a landlord should be able to take it upon themselves to prove responsibility of a tenant for emissions. When such proof was given, transfer of responsibility was proposed to be on the basis of acceptance by the tenant. Once the transfer of responsibility had been agreed, CO_2 emissions for the site would be apportioned between the two parties, then reported and traded within each party's Carbon Reduction Commitment account.

The third category regarding qualification criteria for the Carbon Reduction Commitment was not of particular relevance to Manufacturer Beta. They were large enough to qualify for the Carbon Reduction Commitment with certainty, meaning that there was no need to seek clarification or consideration of a borderline case of qualification for the scheme.

Similarly, the fourth category, which was concerned with managing exemptions and overlaps with other CO_2 markets, did not cause any major concerns for Manufacturer Beta. The company was comfortable with the Environment Agency's proposals for managing the overlaps between the Carbon Reduction Commitment, Climate Change Agreements and the European Emissions Trading Scheme. The management of these exemptions and overlaps is dealt with later in this chapter when the final structure of the Carbon Reduction Commitment is given.

The fifth category which dealt with reporting requirements of the Carbon Reduction Commitment did flag a number of concerns for Manufacturer Beta. Question 18 asked *'Does the wording in the Draft Order around the calculation of a participant's footprint lead* *to any unforeseen consequences?"* (DECC, 2009d). Here Manufacturer Beta highlighted a concern which was related to the process of converting energy use into the equivalent CO_2 emissions. This process relies upon what are called 'emissions factors'. These are multiplication factors for the CO_2 content of each type of fuel. The Environment Agency typically sets these and mandates the use of these standard factors to ensure consistent reporting across scheme participants. Manufacturer Beta pointed out that reporting for the Carbon Reduction Commitment would cover sites which were also participants in the United Kingdom's Climate Change Agreements and the European Union's Emissions Trading Scheme. Reporting for a single site would thus require three sets of processes and records, one for each scheme. It was argued that the Environment Agency should look to address these requirements, since they represented a disproportionate burden upon CO_2 market participants. In subsequent responses to questions 41, 43 and 44 Manufacturer Beta gave specific examples of where such overlapping reporting requirements were out of line due to inconsistencies in CO_2 emissions factors between different CO_2 markets. Another concern regarding reporting requirements related to the proposal of the Environment Agency to allow small emissions sources to be estimated. Question 47 asked *'Do you agree with the proposed approach to establishing when an energy bill counts as an estimate for the purposes of applying a 10% emissions uplift?"* (DECC, 2009d). This proposal was welcomed by Manufacturer Beta, who used the consultation response to show their support and request clarification on the details of the estimation process. The estimation techniques were viewed as being more efficient and appropriate for reporting small, locally procured, energy accounts. The 10% uplift applied to estimated CO_2 emissions was seen as a price worth paying.

The sixth category of questions relating to administrative requirements of the scheme did not raise specific concerns with Manufacturer Beta. They were familiar and comfortable with the proposals on record keeping, registry account management, audit processes and the level and types of annual administrative fees due. These are summarised later in this chapter, when the final structure of the Carbon Reduction Commitment is given.

The seventh category of questions covered the publication of the Carbon Reduction Commitment league table and CO_2 emissions trading requirements. Here, Manufacturer Beta flagged concern with regard to the Carbon Reduction Commitment's Early Action Metrics. The Early Action Metrics were proxy measures for good energy management that would be used in the first years of the Carbon Reduction Commitment, they are introduced in detail in section 4.7.6. In the first year of the Carbon Reduction Commitment there would not be any previous CO_2 emissions data to make year on year comparisons of savings achieved by each participant. The emissions data would also still be of questionable quality while the scheme 'found its feet' in years two and three. Therefore, the Early Action Metrics were required to fill this gap in the data by giving proxy measures for good energy management. One of the Early Action Metrics proposed by the Environment Agency was the level of installation of 'Automatic Meter Reading'. The Environment Agency believed that companies going to the extra effort of collecting energy data were likely to be managing energy well. Question 30 asked "*Does the wording in the Draft Order around the calculation of the Early Action metric lead to any unforeseen consequences?*" (DECC, 2009d). Manufacturer Beta pointed out that there was the potential for unforeseen circumstances and asked for clarification over what types of

Automatic Meter Reading would qualify for the Early Action Metric. Their concern was that in sites with high electricity consumption, such meters were already mandated. The Environment Agency was proposing to only recognise voluntarily installed Automatic Meter Reading. Manufacturer Beta wanted to avoid being penalised at sites where the majority of their supply was already mandated to have Automatic Meter Reading, leaving them no opportunity to install it voluntarily.

The consultation questions ended with a number of questions which related to the level and types of penalties and fines for non compliance. Manufacturer Beta agreed with the proposals of the Environment Agency, subject to the request for the use of discretion in acknowledging the difficulties faced by participants due to delays caused by the Environment Agency missing deadlines. For example the Environment Agency had already missed a number of deadlines for providing information relating to the Carbon Reduction Commitment processes and requirements. These delays had left Manufacturer Beta little time to prepare for the launch of the Carbon Reduction Commitment. The consultation process reported back in October 2009, only six months before the scheme was due to commence.

Finally, the consultation template left space at the bottom for additional comments to be given at the discretion of the respondent. Manufacturer Beta took the opportunity to present four concerns. Firstly, the Environment Agency was planning to send Carbon reduction Commitment qualification packs to each site that they knew of, instead of to companies head offices. Manufacturer Beta argued that in a large multisite company this would cause confusion and start local work to respond to the Carbon Reduction Commitment. This risked duplicating what the corporate centre was already doing to respond to the Carbon Reduction Commitment. It was requested that the Environment Agency send each company's qualification packs to a central focal point to aid the coordination process across large companies. Secondly, the Environment Agency had run a number of training events on the structure and timings of the Carbon Reduction Commitment. Further training dates were requested because there was still a low general understanding regarding the technicalities of the Carbon Reduction Commitment. Thirdly, it was known to Manufacturer Beta that a pilot of the Carbon Reduction Commitment registry account website was being tested with a number of companies. It was requested that this pilot site be made public, in order to help with preparations for the Carbon Reduction Commitment. This would also remove the unfair advantage being given to the businesses in the pilot. Finally, one request based upon experiences from the European Emissions Trading Scheme was made. The European Emissions Trading Scheme was administered in the United Kingdom by an Environment Agency team which could only be contacted by email. This made processes of querying and clarification of technicalities of the European Emissions Trading Scheme complicated and drawn out. It was requested that the Carbon Reduction Commitment team be contactable by telephone once the scheme started in April 2010.

The consultation response was submitted in the excel template provided by the Environment Agency. Once submitted, there was no individual response from the Environment Agency. Instead the Environment Agency collated the returns and produced a document summarising the submissions and their response to this aggregated summary. The case now details how the Confederation of British

Industry responded to the consultation on the draft order of the Carbon Reduction Commitment. Following this discussion, the case closes by giving a summary of the response of the Environment Agency to the consultation feedback and by describing the final structure of the Carbon Reduction Commitment.

8.3.3 Confederation of British Industry's consultation response

The trade association examined here is The Confederation of British Industry, they made their consultation response publicly available from their website (CBI, 2009b). As representatives of British industry, they prepared an eight page open letter which dealt with the keys topics summarised in Table 15.

The Confederation of British Industry's open letter started with an acknowledgement that mainstreaming energy efficiency would deliver environmental and cost benefits and that as such, the Confederation of British Industry supported the Carbon Reduction Commitment. The Confederation of British Industry had historically supported the European Emissions Trading Scheme and they placed their response to the Carbon Reduction Commitment within the stance that they supported economy-wide pricing of CO_2. The Carbon Reduction Commitment was acknowledged to be targeting the remainder of the business community, nominally the commercial sector. Their introduction closed with the request that, subject to achieving the objectives signed up to above, regulations should be as simple as possible and administrative costs as low as possible.

Table 15: Summary headings of Confederation of British Industry's response to Carbon Reduction Commitment Consultation

1. Assess impact on companies' cash-flow in light of economic conditions ahead of first payment.
2. Allow businesses flexibility in determining Carbon Reduction Commitment administration most relevant to their operations and therefore allow large subsidiaries to operate in the Carbon Reduction Commitment in their own right.
3. Reward good carbon management, irrespective of business change, through exploring the use of sector specific metrics and benchmarks in the capped phase.
4. Incentivise companies to invest in renewable energy generation within the Carbon Reduction Commitment.
5. Expand the Early Action Metric to include other accredited carbon management schemes and standards.
6. Recognise the burden that the Carbon Reduction Commitment will place on landlords, provide sufficient guidance and permit allowance transfers between landlords and tenants.
7. Ensure consistency between the Carbon Reduction Commitment and other carbon reporting requirements to make it easier for companies to administer.
8. Minimise the regulatory burden of multiple Climate Change policies by analysing interaction and overlap.

More detail is now given on each of the headings in Table 15. Firstly, the Confederation of British Industry expressed concerns over the cash flow implications of the Carbon Reduction Commitment. They did not quantify the anticipated the scale of the impacts, but the calculations given in case five give an estimate of cash flow impacts of approximately 7.5% of annual electricity expenditure. In the Confederation of British Industry letter to the Environment Agency they stressed that scheme administration costs, the part of the cost of CO_2 allowances which would be recycled and the potential civil penalties were all costs over and above those borne to fund energy efficiency improvements. The point made by the Confederation of British Industry was that they wished to protect their members from administrative cash flow challenges since this reduced the money available for spending upon real energy efficiency projects and was, in their opinion, an unnecessary burden upon CO_2 market participants.

The second request from the Confederation of British Industry was that participants in the Carbon Reduction Commitment be given some flexibility as to how to treat their subsidiary companies. The original draft order specified that all subsidiaries must report through their parent company, to give one aggregated Carbon Reduction Commitment participant. The Confederation of British Industry raised concerns over whether this would create additional administrative burdens. In a lot of companies, the legal structure did not match the operational structure. This could mean that CO_2 data would have to undergo complex apportionment exercises to allow reporting up to the highest parent company. The Confederation of British Industry's request was that certain large organisations could participate as a number of subsidiaries in the Carbon Reduction Commitment instead. Furthermore, the Confederation of British Industry argued that flexibility in defining the participant's structure would help to avoid a parent company reporting the performance and bearing the penalties / rewards for performance of a subsidiary over which they had little or no operational influence. In such cases it was argued that the subsidiary would better recognise the incentives embedded within the Carbon Reduction Commitment if allowed to participate directly.

The third point raised by the Confederation of British Industry focused upon the fact that the Carbon Reduction Commitment targeted absolute CO_2 emissions reductions. They pointed out that there were two mechanisms within the scheme to incentivise these reductions. These were the cap to the number of CO_2 allowances available in phase II of the scheme, plus the fact that the league table would be dominated by measures of absolute reductions in CO_2 emissions. The Confederation of British Industry raised two concerns, one was that businesses may grow or shrink their emissions for reasons other than good or bad CO_2 management. The first example they gave was that project based companies would fluctuate their position in the league table based upon the number of projects they were awarded over any one reporting period. The second example was that of a hypothetical company with excellent CO_2 management performance that was growing in scale of operations. Since this company's absolute emissions would be growing, they would be penalised by the league table, despite their best practice in CO_2 management. The growth metric measured the change in a business's scale of operations through their financial turnover. The growth metric, as introduced fully in chapter four, could be applied for to bring up to a 25% uplift in the business's targets due to an increased scale of business operations. The Confederation of British Industry also raised one lower level concern related to the growth metric. They were uncomfortable with the use of turnover as a measure of business growth. The Confederation of British Industry argued that a number of other factors affected turnover and hence it could not be relied upon to have a stable relationship to the scale of business activity or thus to the level of CO_2 emissions. Instead of using turnover as a measure of growth for normalising CO_2 emissions in the league table, it was requested that sector specific benchmarks would be developed to give a more accurate indication of business growth.

The issue of onsite renewables generation was raised in the fourth section of the Confederation of British Industry's consultation response. Here it was acknowledged that the separate government scheme of 'Renewables Obligations Certificates' (ROCs) was already incentivising companies to invest in renewables technologies and that the Carbon Reduction Commitment had correctly avoided double counting of CO_2 through its proposed treatment of onsite renewables generation. The Confederation of British Industry acknowledged the need to continue to avoid double counting of emissions, but requested that the Carbon Reduction Commitment find another way to incentivise renewables through a parallel but non conflicting mechanism. It was pointed out that Renewables Obligation Certificates targeted large energy producers. The Confederation of British Industry requested that companies whose primary business was not energy generation could be awarded financial subsidy to help them invest in renewables, or extra league table points to recognise their investment in renewables.

The fifth concern of the Confederation of British Industry related to the treatment of Early Action Metrics. Reference back to chapter four gives the full details of two proxy metrics for good CO_2 management, these were named 'Early Action Metrics'. The Environment Agency introduced the Early Action Metrics to deal with early stages of the Carbon Reduction Commitment where there would be no or little CO_2 emissions reduction data on which to base the league table. It was argued that the level of coverage of the Carbon Trust's standard and the coverage of voluntary

Automatic Meter Reading would be good proxy measures of a company's progress on energy and CO_2 management. The Confederation of British Industry accepted the logic of needing the Early Action Metrics, but proposed that their scope be widened to recognise a number of what they argued to be substitutes for the Carbon Trust Standard or Automatic Meter Reading. Namely, they asked that the Early Action Metrics be expanded in scope to recognise two alternative energy and CO_2 management standards. These were the international ISO 14064 and the upcoming European EN 16001 standard, established in summer 2009. A small change was also requested for treatment of emissions which were covered by voluntary automatic meter reading. In the proposed structure of the scheme, any emissions covered by automatic meter reading would be subject to a higher level of scrutiny within the scheme rules. It was requested that where the installation of the automatic meter reading was voluntary, this higher level of scrutiny be waived, in order to avoid a disincentive to invest in voluntary automatic meter reading.

Landlord-tenant issues were the focus of the sixth concern expressed in the consultation response. Although it may not sound relevant to a lot of companies, the challenge of dealing with landlord-tenant conflicts of interest was a significant issue for the Carbon Reduction Commitment. This was because many companies let or sublet parts of their properties, or even rent whole sites from a landlord who provided the energy utilities as part of the contract. This caused problems concerning ultimate responsibility for CO_2 emissions and also for Carbon Reduction Commitment participation. The Confederation of British Industry raised a number of issues relating to these concerns. Their requests amounted to asking for flexibility where there was agreement between the landlord and tenant over the preferred participant in the scheme. The Confederation of British Industry requested that landlords and tenants could jointly nominate which party should be the Carbon Reduction Commitment participant. Furthermore, it was requested that the landlord was given the right to reasonable support from its tenants in collecting the data required for Carbon Reduction Commitment submissions in instances where the landlord remained the participant on behalf of the tenant. This was in order to avoid the situation whereby the landlord was unable to comply with the Carbon Reduction Commitment due to the non cooperation of tenants who were not legally bound to provide data to their landlord.

The seventh point raised by the Confederation of British Industry was that in 2012 the United Kingdom government would be mandating that all United Kingdom companies provide a complete CO_2 footprint. Their request was that the Carbon Reduction Commitment's reporting requirements be aligned with this future requirement, primarily to avoid further reporting and administration burdens.

Related to this request, the eighth section of the response drew attention to the existing environmental (Integrated Pollution Prevention and Control regulations-IPPC) and CO_2 (Climate Change Agreements and European Emissions Trading Scheme) related regimes. The Confederation of British Industry made a request for coherent targets and aligned reporting systems that would avoid unintended incentives and unnecessary duplicated administrative and reporting efforts. Of specific concern was how companies would carve out Climate Change Agreement and European Emissions Trading Scheme CO_2 emissions from the Carbon Reduction Commitment. It was requested that Climate Change Agreement and

European Emissions Trading Scheme emissions could be taken from the last audited number of each respective scheme, rather than recalculated to a slightly different timeframe for full alignment with the Carbon Reduction Commitment.

8.4 Consultation outcomes

The Environment Agency's consultation on the draft order for the Carbon Reduction Commitment reported out in October 2009. The output was in the form of a 136 page document structured around the decision taken on each of the 66 questions asked in the original consultation. The consultation addressed a number of issues from the treatment of groups, to the penalties and fines for non compliance with the Carbon Reduction Commitment. Table 14 sorted these issues into eight categories which summarised the questions raised during the consultation. Using the same eight categories, Table 16 summarises the main decisions taken as a result of the consultation process.

The treatment of groups was important, since the Environment Agency aimed to have the Carbon Reduction Commitment administered at the level of each company's highest United Kingdom parent company. This objective served two purposes. Firstly, it was meant to capture groups of companies that would not qualify on an individual basis. Secondly, it targeted the highest level decision makers in businesses, giving CO_2 and energy management the highest possible level of exposure. During the consultation response a number of companies raised concerns relating to the technicalities of this proposed approach.

Table 16: Summary of Carbon Reduction Commitment consultation outcomes

(DECC, 2009c, 2009d; Environment Agency, 2009)

1. Treatment of groups- finding the highest parent company and its subsidiaries a) Definition of a subsidiary widened: 'Principal subsidiary' becomes 'Significant group undertaking' (SGU) b) Introduced option for voluntary disaggregation of Significant Group Undertakings
2. Landlord-tenant issues: assigning responsibilities a) No possibility for transfer of Carbon Reduction Commitment liabilities given. However, obligations on tenants introduced, obliging them to comply with landlords on Carbon Reduction Commitment reporting requirements.
3. **Qualification criteria and the registration process:** (no significant changes)
4. Managing exemptions and overlaps with other CO_2 regulatory schemes a) Climate Change Agreement exemption process brought forwards; exemption now based on qualification year emissions (2008) and confirmed at registration. This avoided the need for exempt sites to participate for one year. b) European Emissions Trading Scheme reporting simplified by allowing the use of the most recent verified European Emissions Trading Scheme year, rather than requiring apportionment to the Carbon Reduction Commitment year.
5. Reporting requirements a) Double auction of CO_2 allowances in 2011 becomes a single auction. b) Transport exemption clarified, uses 1994 Vehicle Excise and Registration Act
6. Administrative requirements a) Scheme name changed: 'Carbon Reduction Commitment (CRC)' becomes 'CRC Energy Efficiency Scheme (CRC)' b) Record keeping requirements clarified. All records must be kept for seven years and baseline data for the lifetime of the Carbon Reduction Commitment.
7. League table publication and CO_2 trading requirements a) Increased weighting and wider scope of Early Action Metrics: 100% in year one, 40% in year two, 20% in year three. It was also agreed to recognise substitutes to the Carbon Trust Standard, if an accreditation from an equivalent scheme was present. b) Tick box criteria added to give visibility to energy management efforts: – Setting long-term carbon emission reduction targets? – Reporting performance against reduction targets? – Naming a director to oversee CO_2 emissions performance? – Engagement with employees on CO_2 management? c) Percentage increase in companies' renewables generation will be published in league table, but not be used in calculating the league table position.
8. **Penalties and fines for non compliance:** (no significant changes)

Firstly, the Carbon Reduction Commitment targeted all United Kingdom organisations which broke its annual United Kingdom electricity consumption threshold. These included government agencies, hospitals, schools and so on. All of these groups often had large subsidiaries that would qualify for the Carbon

Reduction Commitment in their own right, were they not part of a larger parent organisation. The Environment Agency had decided to collect information on each of these, as a supplement to the parent company's reporting requirements. This would give the large sub organisations visibility and facilitate the transfer of responsibilities should they ever be sold or moved to a different parent organisation. Originally these organisations had been called 'principal subsidiaries', but the consultation process flagged that not all of these were commercial organisations. Accordingly, the definition was widened to 'Significant Group Undertakings'. Furthermore, in a number of instances, these Significant Group Undertakings represented common brand names, or other organisations to which public perception of their brand or company name was important. Some Significant Group Undertakings had flagged in the consultation process that they did not want to be reported in the league table as part of their parent company's aggregated return. Instead they wanted to be able to participate individually and claim the good performance that they were aiming to achieve in their own name. There was one other type of case where significant group undertakings had asked to be able to participate separately in the Carbon Reduction Commitment. This was where it was argued that the parent company did not have operational control over the significant group undertaking. In this case it was argued that Carbon Reduction Commitment participation best lay with the Significant Group Undertaking, since this gave them direct incentives and visibility in the scheme. For these reasons, the Environment Agency gave Carbon Reduction Commitment participants the chance to disaggregate Significant Group Undertakings from the central reporting process of their parent company. This would be done on a voluntary basis during registration.

The second issue that the consultation dealt with was the division of responsibilities between landlords and tenants. The Carbon Reduction Commitment assigned responsibility for emissions to whoever was named counterparty on the energy supply contract. However, it was acknowledged that in some cases this meant that Carbon Reduction Commitment responsibilities would fall on a landlord who simply charged their tenant a management fee which included utilities. Concerns were raised during the consultation that this situation placed responsibility for compliance with a party that had little actual control over energy use. In the most extreme case, it was argued that there was no obligation for tenants in this situation to help their landlords gather the data required to achieve Carbon Reduction Commitment compliance. The Environment Agency argued that contracts and rental agreements would evolve to avoid this problem and did not agree to change the Carbon Reduction Commitment to allow the transfer of responsibilities between landlords and tenants. However, they did agree to introduce obligations upon tenants to provide data to their landlords for Carbon Reduction Commitment participation.

The third category tackled during the consultation response examined qualification criteria for the Carbon Reduction Commitment and the registration process. The Environment Agency raised no particular concerns during the consultation process and neither did the consultation respondents. There were no changes to the qualification criteria or the registration process.

Managing overlaps with other CO_2 markets was the fourth category covered by the consultation process. The United Kingdom's Climate Change Agreements and the process whereby they led to an exemption for the Carbon Reduction Commitment was introduced in chapter four. In summary, if a whole company, or a significant group undertaking of a company had 25% or more of their emissions covered by a Climate Change Agreement, then they were exempt from participation in the Carbon Reduction Commitment. The original proposal was that this exemption would be proven during the first annual reporting cycle of the scheme. However, it was flagged that this would require companies that were most likely exempt to undergo a full year's compliance with the scheme before being able to prove their exemption. Of particular concern was the case where a parent company had a Significant Group Undertaking which they expected to be exempted. In this scenario the parent company would have to participate in the first Environment Agency auction before having their exemption for the Significant Group Undertaking approved. If the anticipated exemption turned out to be incorrect, this would leave the parent company with a large shortfall of CO_2 allowances, since they would not have purchased CO_2 allowances for the part of the company they expected to be exempt. In light of these concerns, the Environment Agency brought forwards the Climate Change Agreement exemption point to that of registration. This was for companies that were able to provide the data at that point in time. For those lacking the required data, they would still have to participate as originally planned and exempt themselves during the first annual cycle of the scheme on the basis of the data collected. The second CO_2 market which had overlaps with the Carbon Reduction Commitment was the European Emission Trading Scheme, as introduced in section chapter four. Any emissions covered by the European Emission Trading Scheme were not counted again for the Carbon Reduction Commitment. This principle avoided double regulation of the same CO_2 emissions and was supported in the consultation responses. However, the consultation process also flagged a concern that the annual cycles of the two schemes started at different points in the year. The Carbon Reduction Commitment would run to a United Kingdom tax year from April until March, while the European Emission Trading Scheme ran to a calendar year from January until December. Carbon Reduction Commitment participants were given the freedom to use the latest set of verified European Emission Trading Scheme accounts as an annual CO_2 emissions figure, instead of reapportioning a calendar year's emissions to a United Kingdom tax year. This was in order to minimise the burden of compliance with the Carbon Reduction Commitment. It was argued that there would be no impact on the overall performance of companies, since any anomalies arising in one year would be balanced out in the next year.

The reporting requirements of the Carbon Reduction Commitment were also changed slightly. The first auction had been scheduled to be a double auction to cover the first year of the scheme retrospectively and the second year based upon forecasts. Significant pressure was exerted on the Environment Agency to avoid the cash flow implications of the double auction. The Environment Agency conceded in this case and agreed to make the first year of the scheme reporting only, avoiding the need for a double auction in April 2011. The other reporting requirement which was clarified was the basis for the exemption of transport vehicles. These were exempted on the basis of their treatment under the Vehicle Excise and Registration Act. Any vehicle which required a road license would be excluded, while site vehicles which did not use public roads would be included in the Carbon Reduction Commitment.

Administrative requirements of the Carbon Reduction Commitment are dealt with by the sixth category of the consultation themes. Firstly, the *'Carbon Reduction*

Commitment' was renamed as the *'CRC Energy Efficiency Scheme'*. This seemingly simple renaming was in response to a broad set of lobby interests which had tried to change the focus of the Carbon Reduction Commitment in a number of ways during the consultation process. The two main lobbies were the renewables industry and those who prioritised behaviour change, rather than capital investment, in efforts to manage CO_2 emissions. These lobbies were resisted by the Environment Agency, which maintained that the primary objective of the Carbon Reduction Commitment was to incentivise the implementation of energy efficiency projects as the best starting point for CO_2 management. It was argued by the Environment Agency that renewables generation was already incentivised for utility companies through another mechanism, the 'Renewables Obligation Certificates'. It was argued that companies would make better use of their funds by first investing in reducing energy use, rather than swapping to expensive forms of low CO_2 energy generation. The interests of the group advocating staff engagement were not out of line with the original or final name of the Carbon Reduction Commitment, but they did achieve raised visibility for target setting and staff engagement. The concessions granted to the behaviour change lobbyists are covered in the next paragraph. The second administrative announcement was an important clarification for participants, but not one that materially changed the scheme. It was clarified that Carbon Reduction Commitment records would have to routinely be kept for 7 years and any relating to the baseline year would need to be kept indefinitely.

The previous section explored how the 'renewables' and 'staff engagement' lobbyists had tried to pull the Carbon Reduction Commitment in the directions of 'incentivising renewables generation' or 'engaging staff on energy use' respectively.

The seventh category of the consultation response deals with changes to the league table publication and trading requirements of the scheme which, these were used in response to the requests from the lobbyists. The first two changes were concessions to the parties who wanted to see more emphasis upon staff engagement in energy management. The first change saw an increased weighting of the Early Action Metrics, which represented proxy measures for good energy management, ahead of the actual performance data being made available. The second change saw the introduction of four tick box criteria which would be reported as an appendix to the league table. These indicated whether a company had long-term targets for CO_2 emission reductions, whether they reported performance against these targets, whether a director was named with overall responsibility for CO_2 performance and whether staff engagement on energy management was taking place. The staff engagement was recognised if it was in the form of either: widespread energy management training, the formation staff action groups, or an energy management campaign in conjunction with the relevant union. The third change was a concession to the renewables industry and companies which had prioritised renewables generation as their response to Climate Change. The overall structure of the Carbon Reduction Commitment was not changed to emphasise renewables, in fact the opposite was the case. As explained in the previous paragraph, the *'Carbon Reduction Commitment'* was renamed as the *'CRC Energy Efficiency Scheme'*. The Environment Agency argued that companies would make better use of their funds by first investing in reducing energy use, rather than swapping to more expensive forms of low carbon energy generation. The concession given was that companies would have to report their annual increase in the percentage of renewables generation achieved.

This would at least give some visibility to renewables, but while leaving the fundamental structure of the Carbon Reduction Commitment unchanged.

Finally, the questions regarding the penalties and fines for non-compliance, the eighth category of the consultation process, did not give rise to any particular concerns or changes to the scheme. Companies requested that the Environment Agency exercise discretion as the scheme started, a call that the Environment Agency acknowledged. There were some changes to the potential fines, but none which changed their nature or order of magnitude.

8.5 Summary

This case examined a manufacturer's and trade association's responses to the launch of the United Kingdom's CO_2 market, the Carbon Reduction Commitment. The case started with an explanation of the consultation format. Secondly, Manufacturer Beta's submission to the Environment Agency's consultation process was examined. Next, the public response of the Confederation of British Industry was also examined. Finally, the responses were then compared with the outcome of the consultation process and the ultimate structure of the Carbon Reduction Commitment was given.

This case also gave important data on the design of the Carbon Reduction Commitment, which was the starting point for cases five and six which examined the launch of the Carbon Reduction Commitment. The next case examines the new accounting and reporting obligations placed upon Carbon Reduction Commitment participants.

CHAPTER 9:

EMPIRICAL FINDINGS (CASE 5)

9 CASE 5: ACCOUNTING AND REPORTING OBLIGATIONS WITHIN PHASE I OF THE UNITED KINGDOM'S CO_2 MARKET, THE CARBON REDUCTION COMMITMENT

9.1 Introduction

Case five examines the new accounting and reporting obligations introduced by the Carbon Reduction Commitment. If the European Emissions Trading Scheme was a 'child' of the Kyoto Protocol, then the Carbon Reduction Commitment could be its 'grandchild'. The Carbon Reduction Commitment targets the next tier down of energy users. These represented commercial companies which were not covered by the European Emissions Trading Scheme which focussed upon industrial scale operations.

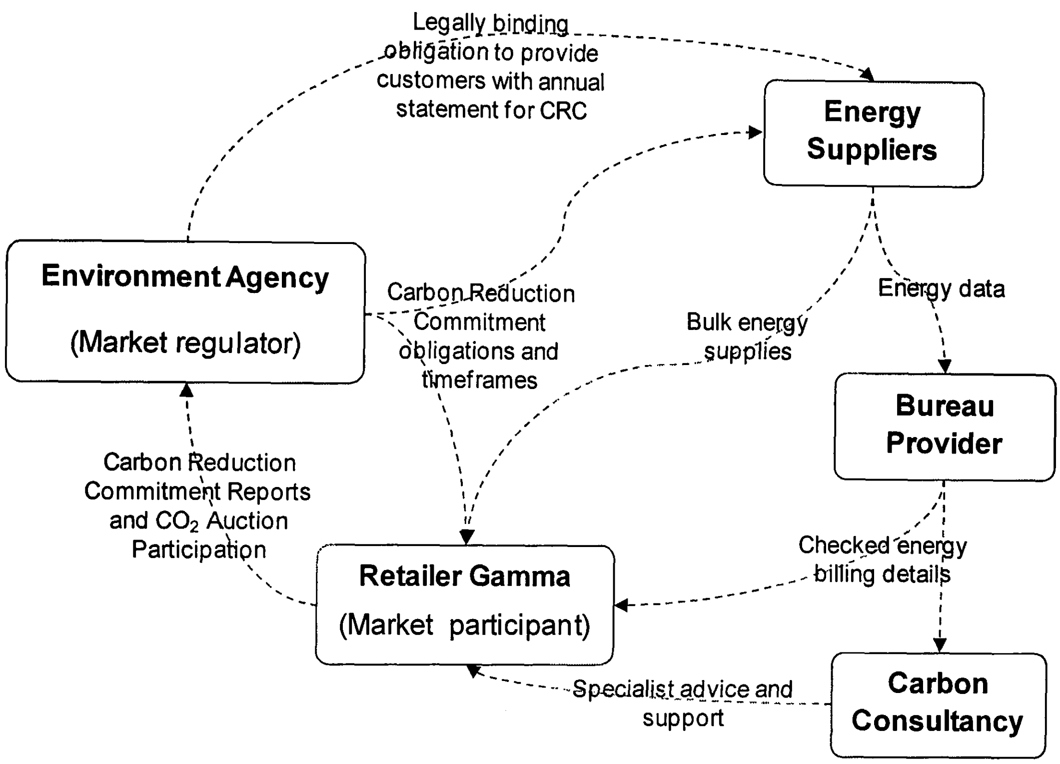
Data were collected between January 2009 and June 2010 through participant observation as a Carbon Consultancy hired by Retailer Gamma. The case starts with an introduction to Retailer Gamma and their industrial network. Interactions involved Retailer Gamma and the Environment Agency, as well as Retailer Gamma's Energy Suppliers and their Bureau Provider who checked the accuracy of their energy bills. Firstly, the process of registration with the Environment Agency for participation in the Carbon Reduction Commitment is examined. Next the implications of participation in the Environment Agency's annual CO_2 auction are discussed. Then the process of preparing and submitting the Footprint and Annual Reports is outlined. Finally, the processes driving league table publication and the allocation of recycling payments generated by the Carbon Reduction Commitment are examined.

Case four examined the consultation process and outcomes during the development of the Carbon Reduction Commitment. Case five focuses upon the accounting and reporting obligations introduced by the Carbon Reduction Commitment. Finally, case six examines the implications of the Carbon Reduction Commitment for participants and their energy supply and reporting networks.

9.2 A business network affected by phase I of the Carbon Reduction Commitment

Case five examined the issues faced by Retailer Gamma in responding to the accounting and reporting requirements introduced by the United Kingdom's Carbon Reduction Commitment. Retailer Gamma was significantly larger than the minimum size required for qualification for the Carbon Reduction Commitment. They were therefore representative of the scale of business targeted by the Carbon Reduction Commitment. Furthermore, Retailer Gamma was a major consumer retailer within the United Kingdom; they were a FTSE 100 company. Being commercial, rather than industrial in nature, they were also representative of the type of business targeted by the Carbon Reduction Commitment. Retailer Gamma had over 200 retail and associated support sites within the United Kingdom. Retailer Gamma's relationships with the Environment Agency, as the regulator for the Carbon Reduction Commitment, and a number of third party suppliers are introduced in Figure 21.

Figure 21: Retailer Gamma as a CO_2 market participant within the United Kingdom's Carbon Reduction Commitment



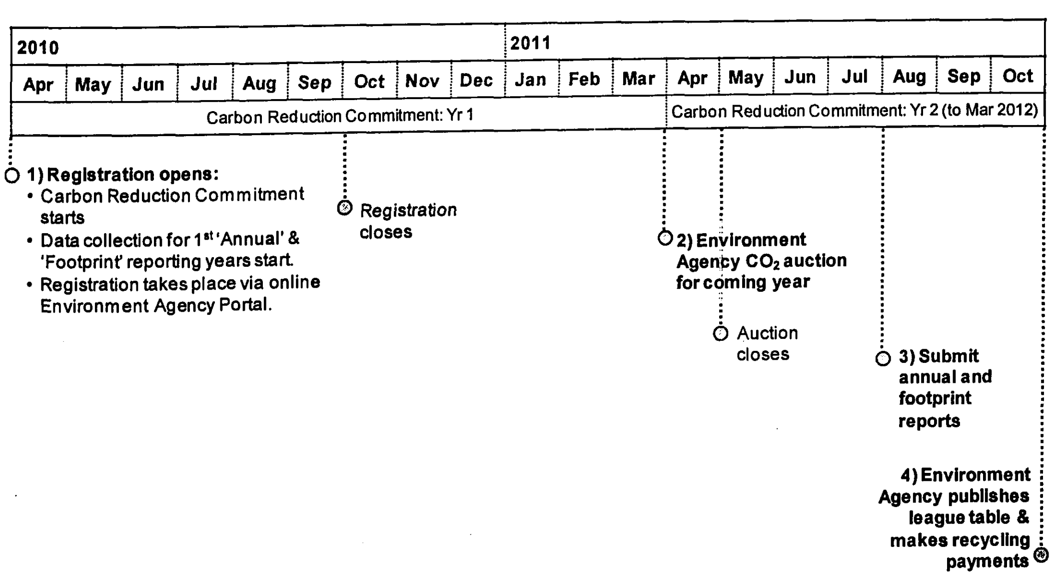
The first relationship was primarily between Retailer Gamma, as a participant in the Carbon Reduction Commitment and the Environment Agency which administrated the Carbon Reduction Commitment on behalf of the United Kingdom's government. This relationship gave Retailer Gamma accounting and reporting obligations which are summarised in

Figure 22. The Carbon Reduction Commitment also gave Energy Suppliers obligations to provide annual statements of consumption to Retailer Gamma in order to support their CO_2 reporting and trading. The second relationship involved the bulk supply of energy by Energy Suppliers to Retailer Gamma. The supporting invoicing for these energy contracts formed the basis of CO_2 emissions reporting, since conversion factors were applied to energy consumption totals in order to calculate CO_2 emissions. The relationship between Retailer Gamma and their Energy Suppliers was moderated by a Bureau Provider who checked the energy invoices ahead of payment by Retailer Gamma. This type of service was often used

by large businesses, since the specialist support of Bureau Providers was needed to cope with the large volume of billing data that was required to manage multiple large sites. Finally, Bureau Provider and Carbon Consultancy aggregated energy consumption data and converted it into the CO_2 reports required by the Environment Agency for participation in the Carbon Reduction Commitment. Retailer Gamma relied upon their Energy Suppliers and Bureau Provider for the energy consumption data and then called upon the support of Carbon Consultancy to prepare the required reports and support trading in the CO_2 market.

Figure 22 gives the accounting and reporting requirements of the Carbon Reduction Commitment during its launch and first years of operation. The temporal scope of this case is from the Carbon Reduction Commitment's start date of April 2010, until October 2011, when all required activities will have been completed at least once.

Figure 22: Carbon Reduction Commitment accounting and reporting obligations



Next each of the accounting and reporting requirements illustrated above are briefly introduced; these form the structure of the remainder of the case. The first obligation upon Retailer Gamma was to register for the Carbon Reduction Commitment between the start of the Scheme in April 2010 and the last working day in September 2010. The second obligation on Retailer Gamma was to participate in the Environment Agency's first annual CO_2 Auction in April 2011. Next, Retailer Gamma will have to submit a phase I Footprint report and the first Annual report by the last working day of July 2011. Finally, once the Environment Agency has collated the submitted reports, it will publish the Carbon Reduction Commitment league table and make the corresponding recycling payments in October 2011.

9.3 Accounting and reporting obligations within phase I of the Carbon Reduction Commitment

9.3.1 Registration

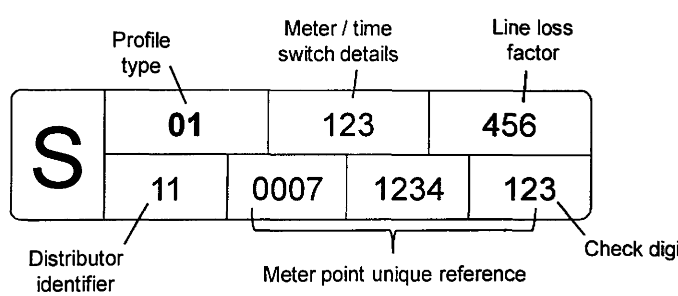
Registration for the Carbon Reduction Commitment served three major purposes. Firstly, Retailer Gamma was required to prove that they exceed the electricity consumption threshold for qualification for the scheme. Secondly, in order to submit the data, Retailer Gamma needed to setup a Carbon Reduction Commitment online registry account. This account would be used for all future interactions with the Environment Agency. Finally, it was during registration that the focal points for managing the Carbon Reduction Commitment within Retailer Gamma needed to be nominated. Each of these issues and the difficulties Retailer Gamma faced in responding to them are now dealt with in turn.

Qualification for the Carbon Reduction Commitment was based upon annual electricity consumption through an industrial class of electricity meter called a 'half hourly meter'. Retailer Gamma had to participate in the Carbon Reduction Commitment since they exceeded an annual consumption of 6,000MWh, which was roughly equivalent to an annual expenditure of £0.5M on electricity. The qualification year for the first phase of the Carbon Reduction Commitment was 2008, with consumption totals being made for all half hourly meters held by subsidiaries or joint ventures where Retailer Gamma had a shareholding of greater than 50%. The snapshot of the legal structure of the company had to be taken as per 31 December 2008. The requirement to prepare data against the qualification year of 2008 was the first challenge faced by Retailer Gamma. Large organisations typically have hundreds of legal entities and frequently buy or sell different parts of their company on an ongoing basis. The Carbon Reduction Commitment started in April 2010, meaning that preparing a detailed map of the whole company's United Kingdom energy supply infrastructure as of 2008 was a complicated and uncertain task. Within Retailer Gamma this required the collation of data from legal, property, energy management and strategy teams. The exercise amounted to identifying the legal entities which had to be reported under the Carbon Reduction Commitment, building a full list of the real estate for which these legal entities were responsible and finally determining their 2008 half hourly electricity consumption. This data gathering exercise for Retailer Gamma represented around 3 months worth of effort. Furthermore, since this was the first time such an exercise had been mandated, once it was completed there was still no way to verify whether any extra sites had been missed.

The process broke new ground at all three stages. Two examples of legal entities that were identified for the first time by the Corporate Reporting Team were a majority owned research association and American operations with autonomous facilities in the United Kingdom. Both of these organisations were required to report under the highest United Kingdom parent company. At the next level, the corporate centre expanded their United Kingdom property list by more than 40% in terms of number of properties identified. The generation of a full United Kingdom property list unearthed whole office blocks, bus depots, accommodation complexes and many other facilities that had been managed by subsidiary companies without previous oversight from the centre. Finally, even once a complete site list had been populated, it was difficult to then determine the energy supplies which went to each site. Typically around 60-70% of energy was procured centrally, but the remaining 30-40% was managed locally at the site level. For Carbon Reduction Commitment registration it was a relatively straight forward exercise to identify the large half hourly meters, but it was still difficult to gather 2008 consumption data for local energy supplies. It was not possible to make a standard mail shot requesting energy consumption details from focal points. Local energy procurement was dealt with on an ad hoc basis, usually as a portion of an employee's job, rather than as their sole responsibility. The task was complicated further by the fact that at some sites the accounts team looked after local energy procurement, at others it was a local energy manager and at others again it was the production / operations manager. This aspect of the data collection task was challenging for another reason. Local focal points did not have expert knowledge on energy procurement. As an example, identifying half hourly electricity meters that were relevant to registration for the Carbon Reduction Commitment involved a number of technical checks which are now discussed.

It was first necessary to locate the Meter Point Administration Number (MPAN) on the 31 December 2008 invoice. To do so required some prior knowledge of the energy supply terms and notations. The Meter Point Administration Number was a standard format within the energy supply industry for referencing supply meters within the United Kingdom. Figure 23 shows the Meter Point Administration Number in the format in which it is printed on energy invoices.

Figure 23: Meter point administration number- identifying half hourly meters



If the profile type, as per Figure 23, read '00', then the meter was a half hourly meter and therefore potentially relevant to the Carbon Reduction Commitment.

Secondly, the supply counterparty, the company named on the energy bill, defined legal responsibility for the meter under the Carbon Reduction Commitment. It was necessary to ascertain whether this counterparty was part of the business's legal structure as per 31 December 2008.

Asking non experts across hundreds of sites to perform these checks was the only primary source of data for locally procured energy and was perceived as a significant risk regarding successful Carbon Reduction Commitment registration by Retailer

Gamma. Furthermore, since these reporting requirements were new, there was no team within the company with obvious responsibility for managing the Carbon Reduction Commitment. This lead to a lack of accountability and in some cases infighting to either avoid or claim the role. Typically, these conflicts were between the legal, energy management and corporate reporting teams, each of which had a case to make for coordinating the efforts. These dynamics caused particular problems in the final hurdle faced at registration. The Environment Agency had set significant potential fines for non compliance with the Carbon Reduction Commitment and coupled this with a requirement that a company director, or member of staff with equivalent management control, had to sign off the final submission on behalf of the highest United Kingdom parent company. In extreme cases of fraud / negligence, there was the potential for the director who signed off the submission to face a two year custodial sentence. These potential sanctions, plus the novelty of the reporting requirements of the Carbon Reduction Commitment, meant that it was difficult to identify a member of the company who could sign with authority for the highest United Kingdom parent company. Their willingness to sign off the submission, based upon evidence collected from a dispersed and diverse set of sources was not very high. At the time of writing, the task of assigning this role was still ongoing. The United Kingdom Finance Director had been nominated to oversee the submission, but had refused to do so until the data collection practices were checked by the corporate governance team.

Setup of the Carbon Reduction Commitment online registry account did not cause any major stumbling blocks. The process was similar to setting up internet banking and was not technically challenging. Instead, registration was stalled due to the significant amount of effort going into due diligence and reassurance of the director signing off the submission before registration could be completed. These checking efforts involved requests to the Environment Agency's helpdesk to confirm the status of newly identified subsidiaries or supplies. Cross-checking was also undertaken with Energy Suppliers and Bureau Providers. However, this again was not simple, for the reason that these companies faced a conflict in interest. They wished to support existing energy supply and bill checking contracts, respectively. However, they also saw opportunities and risks in supporting data collection for the Carbon Reduction Commitment. Firstly, they were very cautious about providing data which they may later be required to substantiate in the event of an Environment Agency audit. Secondly, they saw the opportunity to sell Carbon Reduction Commitment services to Retailer Gamma and so didn't wish to let the scope of their existing contracts creep to include supporting the Carbon Reduction Commitment. These commercial developments are dealt with in more detail in the next case. This case continues with an examination of the accounting and reporting requirements introduced by the Carbon Reduction Commitment, the next being annual participation in the Environment Agency's auction of CO_2 permits.

9.3.2 Participation in the Environment Agency's CO_2 auction

Following registration, which was due by the last working day in September 2010, the next deadline for interaction with the Environment Agency falls in April 2011. At this point, the Environment Agency will hold an Auction of CO_2 permits lasting for one month. The sale is to cover the coming year's CO_2 emissions, so the first sale will cover April 2011 through to March 2012. Retailer Gamma needed to forecast their coming year's CO_2 emissions and decide upon a trading strategy. Of these two tasks, the first was the most technically challenging. Retailer Gamma had to use historic records to estimate their CO_2 emissions and then try to adjust them for anticipated changes in their operations, such as increased operations or expected mergers / divestments. Retailer Gamma also had to carve out exemptions such as CO_2 emissions already covered by the European Emissions Trading Scheme. At the time of writing, this activity had not yet taken place, but a number of concerns had been raised and efforts were underway to resolve them. These are now examined in turn.

Firstly, Retailer Gamma acknowledged the need to hold a central budget for payments made during the CO_2 auction. The Carbon Reduction Commitment was administered through a single account at the level of the highest parent company, meaning that the highest parent company had to hold a budget that could cover all costs relating to the Carbon Reduction Commitment. There was no debate around this, but there was significant debate over whether the costs which were administered at the centre should be recharged to the different parts of the business. One argument presented by energy management specialists was that they wanted to have access to potential savings generated through the Carbon Reduction Commitment. This led them to want all costs to be redistributed within the company, so that they could claim their share of future anticipated successes. This discussion was also interwoven with the discussion on target setting. At the same time as the launch of the Carbon Reduction Commitment, it was under review whether CO_2 reduction targets set should be centrally defined, or instead set by each business. By volunteering to take on the costs of the Carbon Reduction Commitment, businesses hoped to reinforce their arguments that target setting was best done locally by those with detailed knowledge of that part of the company. However, the accounting function within Retailer Gamma took a different view of the issue of whether to recharge the centrally administered costs of Carbon Reduction Commitment participation. As will be seen in the next case, the net anticipated costs of the Carbon Reduction Commitment were less than 1% of annual energy expenditure. Central accounting teams within the company proposed not to reallocate the costs for two reasons. Firstly, they were not large enough to influence business decisions and secondly, the costs of administering the reapportionment would not be justified relative to the sums of money involved. Eventually these discussions led to a compromise which was that costs would not be reallocated during the early phases of the Carbon Reduction Commitment. Later, if the costs of the Carbon Reduction Commitment rose significantly, this decision would be reviewed.

The second consideration that affected the CO_2 trading strategy of Retailer Gamma was internal rules preventing speculative activities. Similar to many large companies, there were policies in place that prohibited speculative activity outside of Retailer Gamma's core business. The rules were designed to avoid problems such as the mark to market practices that eventually led to the demise of Enron (Thomas, 2002). These rules were maintained by trading specialists who enforced them within the company. The purpose of a CO_2 market, such as Carbon Reduction Commitment, was to provide flexibility through market mechanisms which allowed CO_2 savings to be made at the cheapest reduction options available. These CO_2 savings were then traded to allow all parties to achieve compliance. This CO_2 market did not fit with Retailer Gamma's policy that speculation was not possible in any non core business activities. As such, this effectively reduced the CO_2 market to a compliance exercise. Retailer Gamma was keen to overtly and demonstrably avoid speculation. This led to a trading strategy which amounted to buying CO_2 permits equivalent to the forecast CO_2 emissions, plus a small buffer of permits to ensure compliance in the case that CO_2 emissions were slightly higher than anticipated. None of the flexibility of the CO_2 market was utilised. Retailer Gamma's trading strategy did not attempt to take account of their anticipated internal costs of reducing CO_2 emissions relative to those of the other players in the CO_2 market. The trading strategy also did not take into account the anticipated development of a secondary market for CO_2 permits.

9.3.3 Footprint and annual reports

The Carbon Reduction Commitment ultimately required businesses to report their CO_2 emissions and reduce them on a year on year basis. Two reports were designed to track this process.

Firstly, the Footprint report was due at the start of each phase of the Carbon Reduction Commitment. The Footprint report built a map of the energy supply infrastructure of the whole company, its purpose being to identify 100% of the company's CO_2 emissions. Once the full energy supply infrastructure of the company was known and the corresponding total annual CO_2 emissions calculated, this was used to provide a template against which the Annual report tracked year on year CO_2 emission reduction performance. The Footprint report served one further purpose, which was to identify and support applications for exemptions on the basis of Climate Change Agreements, transport use and so on. Once 100% of emissions were known, these were used to check whether exemption thresholds, such as 25% coverage of Climate Change Agreements, were met.

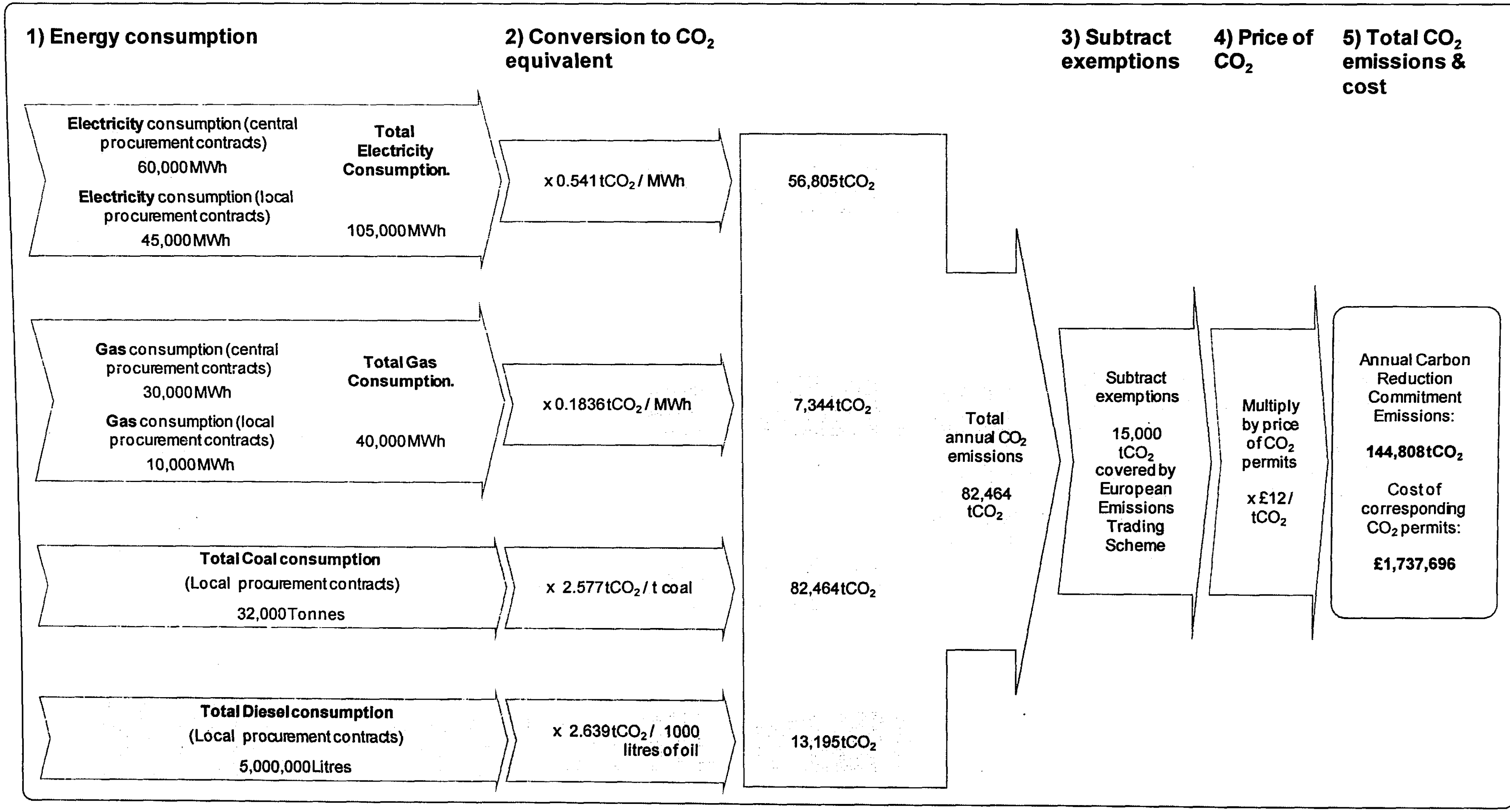
The next section examines the generation of the Annual report, which presented the annual CO_2 emissions of the energy supply infrastructure identified in the Footprint report. The annual report formed the basis of the calculations which determined performance in the Carbon Reduction Commitment league table.

The task of producing a Footprint report built upon the work required for registration for the Carbon Reduction Commitment. This case has already described how the central corporate team responsible for managing Carbon Reduction Commitment compliance had struggled to gain oversight of their full estate portfolio within the United Kingdom. This task continued into the generation of the Footprint report and expanded in scope. For the purposes of registration, the main reporting requirement was to identify all half hourly electricity meters within the company. For the Footprint report, a full map of the energy supply infrastructure required the tracking of supplies of all types of electricity meter and supplies of any other fuel such as gas, coal, oil, renewables and so on. The Environment Agency provided a list of 29 fuels which had to be tracked if they were used. This created further work to check again that all sites had been identified and that a reporting route existed for the central collection of energy data for all supplies.

The Annual report drew upon the map of the energy supply infrastructure developed by the Footprint report. To be able to generate the Annual report, processes had to be put in place to collect the relevant consumption data and convert it to equivalent CO_2 emissions presented in the format required by the Environment Agency. The next case deals with an example of how such sources of data were used and the commercial opportunities arising from these new requirements. This case focuses upon the technical requirements for manipulation of the data from raw energy consumption data through to CO_2 emissions figures required for the Annual report and trading during the auction of CO_2 permits. An example of such calculations is given in Figure 24, which uses dummy consumption data, but follows the data processing steps required to calculate the annual Carbon Reduction Commitment emissions and the cost of the corresponding CO_2 permits.

Figure 24 illustrates the five main steps involved in Carbon Reduction Commitment accounting and reporting activities. Firstly, all energy consumption must be identified and measured, from both local and central procurement contracts. Figure 24 shows that different fuels are measured in their corresponding units of consumption, for example electricity and gas in Megawatt hours, coal consumption in tonnes and diesel consumption in litres. These measures were set by the Environment Agency and each was given a corresponding CO_2 content. The second step is to convert energy consumption into equivalent CO_2 emissions. This means that energy consumption cannot be aggregated across different fuels, for example electricity has a carbon content of 0.541 tCO_2/MWh while gas's corresponding conversion factor is 0.1836 tCO_2/MWh. This helps to explain why the Environment Agency uses the Carbon Reduction Commitment to target reductions in CO_2 emissions rather than energy use. Saving the same number of MWh of gas or electricity would not reduce CO_2 emissions by the same amount; electricity has almost three times the CO_2 content of gas.

Figure 24: Converting energy consumption data into CO_2 emissions and corresponding costs



Once the total CO_2 emissions for the company have been calculated, the third step is to remove any exempted activities, such as those already covered by the European Emissions Trading Scheme. Finally, the total CO_2 emissions covered by the Carbon Reduction Commitment, 144,808 tCO_2 in Figure 24, must be multiplied by the price of CO_2 permits to form a basic forecast of CO_2 permit costs. The final conversion which may be necessary is to take account of the trading strategy for the auction. For example a 5% surplus could be purchased to give a margin for error that reduces the risk of actual emissions exceeding those purchased in the Environment Agency's auction.

9.3.4 League table publication and recycling payments

Through the Carbon Reduction Commitment, the Environment Agency aimed to make the CO_2 performance of companies public and easily comparable, thus creating reputational incentives to reduce CO_2 emissions. These reputational incentives were designed to reinforce the financial incentives introduced by the Carbon Reduction Commitment's CO_2 market. This was a new development which had not been included in previous CO_2 markets. Between July and October the Environment Agency will collate all participants' Annual reports and generate the public league table to be published on the last working day in October. On the same day of publication of the Carbon Reduction Commitment league table, participants will receive their recycling payment. The recycling payment returns the money spent during the Environment Agency's auction of CO_2 permits with a financial bonus / penalty, depending upon league table position. In early years, participants will receive their repayments with an adjustment of up to ±10%, based upon their league table position. By 2015, this will have risen to ±50% of their original outlay. Through this mechanism, the Environment Agency hopes to reward leaders and punish laggards, providing a further incentive to improve CO_2 emissions on a year on year basis. The first instance of the publication of the league table and release of the recycling payments will be in October 2011. At the time of writing this was yet to occur, however two related issues had been raised and explored by Retailer Gamma. The first was concerning management of the reputational implications of the Carbon Reduction Commitment league table. The second concerned financial implications of the Carbon Reduction Commitment. Each of these is now dealt with in turn.

The first concern of Retailer Gamma was the reputational implications of the Carbon Reduction Commitment league table. Their approach was risk averse and was primarily concerned with managing the risk of appearing in the lower half of the league table. The risk of slipping down the league table was also perceived as being important, especially in managing the transition from what were called the Early Action Metrics. The dynamics of the league table ranking during the early years of the Carbon Reduction Commitment are now examined, as summarised in Table 17.

Table 17: Weighting for Carbon Reduction Commitment league table scores

	Phase I			Future phases
	2010	2011	2012	2013 onwards
1) EARLY ACTION METRICS:	**100%**	**40%**	**20%**	**N/A**
Carbon Trust Standard (or equivalent)	(50%)	(20%)	(10%)	N/A
Level of voluntary Automatic Meter Reading	(50%)	(20%)	(10%)	N/A
2) ABSOLUTE METRIC: Based on CO_2 reduction	**0%**	**45%**	**60%**	**75%**
3) GROWTH METRIC: Increased turnover used to adjust baseline	**0%**	**15%**	**20%**	**25%**

Initially the Carbon Reduction Commitment's league table will suffer from the challenge that there will not be any previous data to allow year on year comparisons. For example, when the first annual report is submitted in April 2011 to cover 2010/2011 data, there will not be any data available for comparisons to 2009/2010. To overcome this challenge, the Environment Agency has introduced two Early Action Metrics which are proxy measures of CO_2 emission reductions. These are, firstly, the level of coverage of Automatic Meter Reading and, secondly, the level of coverage of the government's Carbon Trust Standard. Presence of Automatic Meter Reading represents collection of energy data, which is the first step in identifying and appraising CO_2 emission reductions. The Carbon Trust Standard, a voluntary accreditation framework for companies wishing to manage their emissions, would signify meaningful action to reduce emissions through adherence to an accredited CO_2 emission management process.

In later years, once there is annual CO_2 emissions data for year on year comparisons, the Early Action Metrics will be phased out. At this point, the scheme will be dominated by a measure of absolute CO_2 emission reductions. The absolute metric will be supplemented by an optional growth metric available to companies if they want to take account of a growth in their operations. However, the growth metric will only ever constitute up to 25% of a company's league table score and will be based upon growth in turnover. The main determining factor contributing to league table performance will remain as year on year reductions in absolute emissions.

Retailer Gamma recognised the need to attempt to avoid negative press as part of the Carbon Reduction Commitment, however as has been examined, they faced significant challenges in simply preparing the systems required for scheme compliance. These observations were in line with an industry survey which found that one third (33.2%) of Carbon Reduction Commitment participants rated their state of readiness for the scheme as being less than moderate and half of them (49%) stated that their existing energy management programmes were not aligned with the Carbon Reduction Commitment (CAMCO, 2009). As such, management of reputational impacts was limited to three defensive activities.

Firstly, the corporate affairs team was briefed on the nature, content and timelines of the Carbon Reduction Commitment. They did not produce any press releases, but developed their understanding of the scheme so that they were ready to respond should they be questioned on it. Secondly, the Corporate Reporting team focussed upon developing the systems required for compliance with the Carbon Reduction Commitment. They did not have the time or foundations on which to build a communications strategy for the scheme. Finally, there was a perceived risk that Retailer Gamma could enter the league table favourably, based upon Early Action Metric performance and then drop down the league table as it transitioned towards being dominated by absolute reductions in CO_2 emissions. Retailer Gamma had already met some of the Early Action Metrics, through a middling level of voluntary Automatic Meter Reading and a small number of pilot sites within the Carbon Trust Standard accreditation scheme. It was decided that no extra action would be taken to improve the scoring against Early Action Metrics, since this would reduce the risk of slipping down the league table when it would later be dominated by performance on absolute CO_2 emission reductions.

The final concern of Retailer Gamma was related to the costs of the Carbon Reduction Commitment. Upon learning of the CO_2 market, most managers immediately started to think about ways to use it in their favour. The most common suggestion was that if year on year emissions reductions would eventually dominate the league table, then perhaps planning efficiency projects should be delayed until 2012 or 2013 when these measures would replace the Early Action Metrics as dominant drivers of league table performance. However, these suggestions did not survive more detailed scrutiny. Typically, efficiency savings of at least 15% of energy use and expenditure were available for immediate implementation. In the following case it is demonstrated that the net financial implications of the Carbon Reduction Commitment for the early years of the scheme would be less than 1% of energy expenditure. Once this was realised, it was no longer seen as attractive to delay potential 15% reductions in energy costs in order to attempt to influence a cost that amounted to less than 1% of energy costs. This illustrates that although concerns relating to Carbon Reduction Commitment costs and reputational impacts were acknowledged, they were overridden by other larger financial concerns.

9.4 Summary

This case examined the new accounting and reporting obligations introduced by the Carbon Reduction Commitment. The case started with an introduction to Retailer Gamma and its industrial network. Interactions involved Retailer Gamma and the Environment Agency, as well as Retailer Gamma's Energy Suppliers and their Bureau Provider who checked the accuracy of their energy bills. Firstly, the process of registration with the Environment Agency for participation in the Carbon Reduction Commitment was examined. Next, the implications of participation in the

Environment Agency's annual CO_2 auction were examined. Subsequently, an examination of the process of preparing and submitting the Footprint and Annual Reports was made. Finally, the processes of Carbon Reduction Commitment league table publication and recycling payment generation were discussed.

Case four examined the consultation process and outcomes during the development of the Carbon Reduction Commitment. Case five focussed upon the accounting and reporting obligations introduced by the Carbon Reduction Commitment. Case six, which follows, examines the implications of the Carbon Reduction Commitment for scheme participants and their energy supply and reporting networks.

CHAPTER 10:

EMPIRICAL FINDINGS (CASE 6)

10 CASE 6: A MANUFACTURER'S RESPONSE TO THE LAUNCH OF PHASE I OF THE UNITED KINGDOM'S CO_2 MARKET, THE CARBON REDUCTION COMMITMENT

10.1 Introduction

Case six details the response of Manufacturer Beta and its energy supply and reporting network to the launch of the Carbon Reduction Commitment. If the European Emissions Trading Scheme was a 'child' of the Kyoto Protocol, then the Carbon Reduction Commitment could be its 'grandchild'. The Carbon Reduction Commitment targeted the next tier down of energy users. These represented commercial companies which were not covered by the European Emissions Trading Scheme which was more focussed upon industrial scale operations.

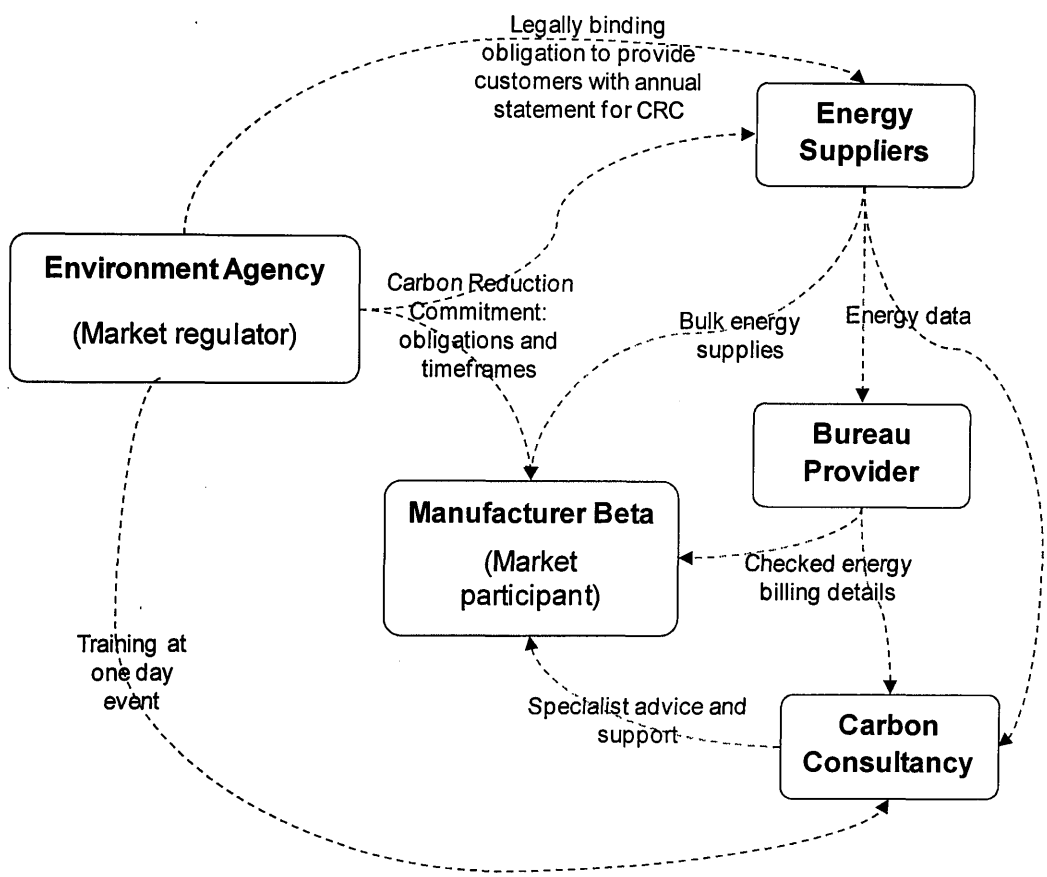
Data were collected through participant observation between January 2009 and June 2010. The participant observation role involved the researcher acting as a Carbon Consultant advising Manufacturer Beta. The case starts with a description of Manufacturer Beta and their industrial network. Next the financial implications of the Carbon Reduction Commitment for Manufacturer Beta are examined. The influence of the Carbon Reduction Commitment upon Manufacturer Beta's relationships with their Energy Suppliers, bill checking service provider and their Carbon Consultancy were then examined. The case ends with a description of Manufacturer Beta's final selection between multiple Carbon Reduction Commitment service offerings put to them by their service providers.

Case four examined the consultation process and outcomes during the development of the Carbon Reduction Commitment. Case five focussed upon the accounting and reporting obligations introduced by the Carbon Reduction Commitment. Finally, this case completed the examination of the Carbon Reduction Commitment by describing the changes which the scheme brought about in participants, their energy supply and reporting networks.

10.2 A business network affected by phase I of the Carbon Reduction Commitment

Manufacturer Beta had their head office and over 100 sites within the United Kingdom. They also had multiple manufacturing bases and global export markets. Manufacturer Beta was a high-tech manufacturing company. However their specific industrial sector has been withheld for reasons of confidentiality. Manufacturer Beta was supported in their response to the Carbon Reduction Commitment and other CO_2 markets by their Carbon Consultancy who specialised in sustainable energy and CO_2 reporting. It was through employment at this Carbon Consultancy that data were collected through participant observation. Figure 25 details the relationships affected by the launch of this CO_2 market, the case starts by introducing each in turn.

Figure 25: Manufacturer Beta's network as a CO_2 market participant within phase I of the United Kingdom's Carbon Reduction Commitment



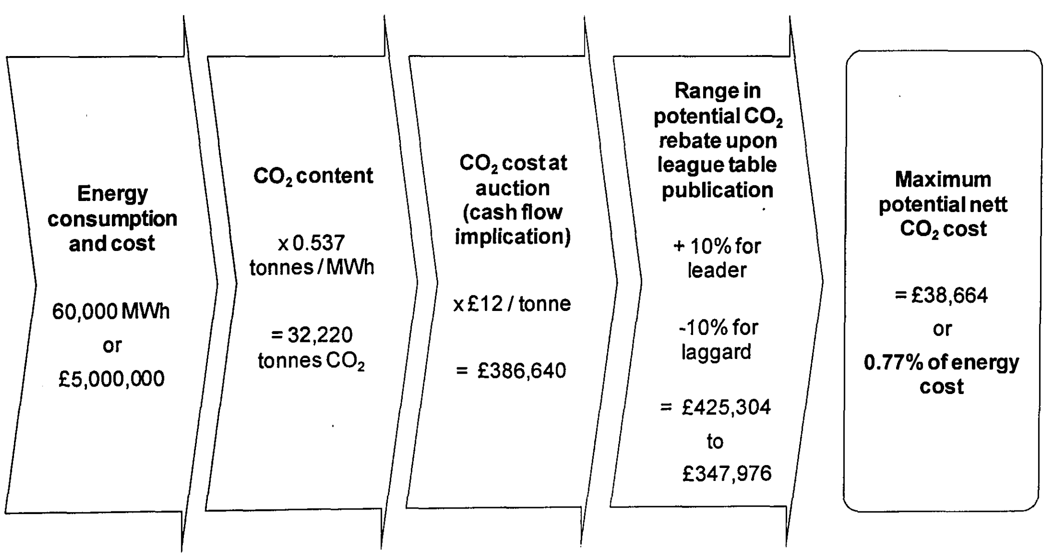
The first relationship was between the Environment Agency as the regulator, and Manufacturer Beta as a Carbon Reduction Commitment participant. The second relationship affected by the Carbon Reduction Commitment was between Manufacturer Beta and their Energy Suppliers. This relationship was primarily over the provision of bulk supplies of gas and electricity as inputs to Manufacturer Beta's operations. However it also encapsulated a lot of Manufacturer Beta's energy consumption data, which was the basis of their CO_2 emissions reporting and forecasting. This data was essential for participation in the CO_2 market. The third relationship involved the Bureau Provider checking the hundreds of invoices generated by Energy Suppliers, verifying energy costs ahead of payment of the invoices by Manufacturer Beta. Finally, this bill checking exercise also overlapped with CO_2 emissions reporting, since it was a source of data that was more reliable than the unchecked invoices. This data fed into the Carbon Consultancy who provided compliance support to Manufacturer Beta. Manufacturer Beta was involved in the two CO_2 markets of the European Emissions Trading Scheme and the Carbon Reduction Commitment, as well as the CO_2 tax of the Climate Change Levy. Carbon Consultancy had been hired to lead compilation and verification of the various reports required for each scheme and had had a longstanding business relationship with Manufacturer Beta since 2001. The manufacturing processes employed by Manufacturer Beta were energy intensive. Around ten of their largest sites were covered by the European Emissions trading Scheme and the United Kingdom's Climate Change Agreements. Manufacturer Beta had dealt with these two historical schemes at the level of the business unit, through a team of energy managers who met on a quarterly basis and employed the Carbon Consultancy to complete their annual returns for each scheme. As a result of the launch of the Carbon Reduction Commitment, all of Manufacturer Beta's sites in the United Kingdom would now be required to participate in a CO_2 market.

10.3 Interactions during the launch of the Carbon Reduction Commitment

10.3.1 Financial implications of the Carbon Reduction Commitment

Manufacturer Beta exceeded the electricity consumption threshold for inclusion within the Carbon Reduction Commitment. For reasons of confidentiality, their annual electricity expenditure will not be disclosed. However, this does not prevent an examination of the financial implications of the Carbon Reduction Commitment for them. This is because what mattered in terms of impact of the scheme were the ratios between energy costs, energy consumption, carbon content and carbon costs. Since these were effectively fixed for all participants, there is no requirement to deal with absolute figures for the purpose of the following discussion. Instead Figure 26 gives the costs of the Carbon Reduction Commitment expressed as a percentage of a nominal annual energy expenditure.

Figure 26: Financial implications of the Carbon Reduction Commitment



Due to confidentiality restrictions the figures are based upon a nominal annual electricity expenditure of £5m, instead of quoting Manufacturer Beta's actual energy expenditure. This would be equivalent to around 60,000MWh of electricity, or ten times the threshold for inclusion in the Carbon Reduction Commitment. Using the Environment Agency's conversion factor for the CO_2 content of grid electricity of 0.537tonnes/MWh, this amounts to approximately 32,000tonnes of CO_2 per annum

(Carbon Trust, 2008: 3). In phase I of the Carbon Reduction Commitment, this would cost £12/tonne, meaning that the purchase of CO_2 permits during the annual auction would cost approximately £380,000 per year. This would be equivalent to about 7.5% of annual electricity expenditure. At the end of the year, following publication of the league table, the money spent during the auction would be recycled with a bonus or penalty of ±10% in the first year, rising to ±50% by 2015. Therefore the maximum potential net cost or benefit due to the Carbon Reduction Commitment would be approximately ±£38,000 in 2011. This represents less than 1% of the annual electricity expenditure of £5M. By 2015 this has the potential to approach a net cost of 5-10% of electricity expenditure, taking account of the likely rise in cost of CO_2 permits and the heavier weighting of the league table performance bonus / penalty. As explained earlier, these conversions are linear. The conversion from electricity consumption in MWh to rough energy cost was a multiplication of the price of electricity per unit. Converting from electricity consumption to tonnes CO_2 was also fixed by the electricity generation mix in the national grid, i.e. a weighted average of the carbon content of nuclear, coal, gas and renewables generation. Finally, the price of carbon credits in phase I was fixed at £12/tonne. As such, any other company which performed such a calculation would forecast similar financial implications relative to annual energy expenditure. Thus the costs of the Carbon Reduction Commitment represented cash flow implications of around 7.5% of annual electricity expenditure and a net cost or benefit of less than 1% of annual electricity expenditure. These costs were set to rise in coming years, but not to a level whereby they were considered significant in terms of financial implications for Manufacturer Beta.

10.3.2 Interactions between the regulator and manufacturer

Dealing first with the compliance based implications of the Carbon Reduction Commitment for Manufacturer Beta; case four explored the process whereby the Environment Agency engaged with industry on the proposed draft order during the consultation process. Case four ended with a summary of the outcomes of the consultation process, the final structure of the Carbon Reduction Commitment is given in Table 18.

Table 18: Key elements of the Carbon Reduction Commitment
(DECC, 2009c, 2009d; Environment Agency, 2009)

KEY ELEMENT	STRUCTURE
1. Market price for CO_2 emissions developed through an annual auction of CO_2 permits.	· No auction in first year of the scheme, reporting only. · £12/tonne CO_2 for remainder of phase I. · Price set by Environment Agency auction after 2013.
2. Public league table on CO_2 emission reduction performance.	· Published annually for all 5,000 participants. · First three dominated by 'Early Action Metrics'- proxy measures for carbon management best practise · Eventually dominated by absolute CO_2 emissions reduction performance.
3. Recycling payments (rebates) given on CO_2 costs. Bonus / penalty set by league table performance.	· Starts at ± 10% of the money spent in the Environment Agency auction · Rises to ± 50% by 2015.
4. Text supplements to the league table, published without influencing weighting of league table scoring.	1) Tick box criteria added to give visibility to: · Setting long-term CO_2 emission reduction targets? · Reporting performance against reduction targets? · Named a director managing CO_2 emissions performance? · Employee engagement s on CO_2 management? 2) Percentage increase in companies' renewables generation will be published in league table.

This case examined Manufacturer Beta's interactions resulting from the new obligations introduced by the Carbon Reduction Commitment. The case shows how the CO_2 market led to opportunities for the Bureau Provider and Carbon Consultancy to offer what were loosely termed as Carbon Reduction Commitment compliance services. The case also describes how Manufacturer Beta responded to the structures of the Carbon Reduction Commitment as an issue of compliance, rather than as an opportunity.

The Carbon Reduction Commitment greatly increased the scope of Manufacturer Beta's exposure to CO_2 markets. Prior to the development of the Carbon Reduction Commitment, less than 10 of Manufacturer Beta's sites were part of a CO_2 market. These were the larger sites covered by the European Emissions Trading Scheme, or the United Kingdom's Climate Change Agreements. The Carbon Reduction Commitment brought all of Manufacturer Beta's sites in the United Kingdom into a CO_2 market. To be able to cope with the tenfold increase in data flow, Manufacturer Beta had to develop CO_2 reporting and compliance processes. These were seen as essential, in order to mitigate the risk of potential fines and negative press for non compliance with the Carbon Reduction Commitment. This need for support in forecasting, tracking and trading CO_2 was further emphasised by the fact that the CO_2 reporting requirements of the Carbon Reduction Commitment were not targeted at individual sites within a company, as had been the case in previous schemes. Instead, the highest United Kingdom parent company had to aggregate emissions data through all sites, business units and subsidiaries to one single number for the whole of Manufacturer Beta. The annual report had to be signed off by a director, or another member of staff with equivalent management control. In extreme cases of non compliance there was the potential for this individual to face a 2 year custodial sentence. These penalties for individuals were backed up with potentially significant fines to the company. With these risks in mind, staff in the Corporate Reporting department of Manufacturer Beta sought external support with the preparation and verification of these reports. This led to new business opportunities for Bureau Provider and Carbon Consultancy to offer new services in carbon reporting, forecasting and trading support. These carbon management offerings are dealt with later on in the case.

The wider considerations of the Carbon Reduction Commitment concerned how to deal with the league table, the CO_2 permit costs and the recycling payments received following the publication of the league table. Staff in the Corporate Reporting department at Manufacturer Beta saw the annual publication of a Carbon Reduction Commitment league table as a significant reputational issue. They were worried about being positioned in the lower half of the league table and how they would be placed compared to their peers. This issue was not viewed as being financially problematic. In fact, in light of the relatively low costs involved, it was planned to manage the budget for participation in the CO_2 auction from a central corporate account. The costs of the Carbon Reduction Commitment would not be reallocated to the businesses, since their scale did not justify the administrative effort of reallocation. Although the reputational concerns linked to the league table were given significant attention, Manufacturer Beta perceived that they were unlikely to drive business decisions. Instead, the focus was upon minimising exposure to negative press. It was perceived by the Corporate Reporting Department that there was a significant gap to bridge even in achieving compliance and accordingly most management effort was applied to developing the required CO_2 reporting systems.

Finally, the questions included in the annual report caused a great deal of concern to the Corporate Reporting department at Manufacturer Beta. Manufacturer Beta would only be able to satisfy one of the four optional requirements at the start of the Carbon Reduction Commitment. The company did not have a corporate target for CO_2 emission reductions and thus neither had a director named as responsible for the target, nor reported progress against the target. The only question to which they would give a positive response was whether they had staff engagement on energy and Climate Change. The team managing compliance with the European Emissions Trading Scheme had piloted this engagement approach and it was decided to roll this out across the company. The worries of Manufacturer Beta were softened slightly by the fact that less than half of their peer companies had set targets on energy and CO_2 performance and so they did not see that this would present them as being any worse than average within their sector. These new public reporting obligations did however give a new level of visibility to energy and CO_2 management within Manufacturer Beta. What had previously been an issue for local or regional energy managers became an issue that directors, investor relations and legal teams took a keen interest in. Again, this gave rise to new business opportunities for Energy Suppliers, Bureau Provider and Carbon Consultancy to support a rapid development of capability and objectives in CO_2 management and target setting.

Having examined the primary aspects of the compliance relationship between the regulator of the Environment Agency and Manufacturer Beta as a scheme participant, the affects of these developments upon other companies with which Manufacturer Beta had business relationships are now explored. The affected relationships were with their Energy Suppliers, their Bureau Provider and their Carbon Consultancy.

10.3.3 Interactions between the manufacturer and energy suppliers

Manufacturer Beta had a number of long-term contracts for the bulk supply of gas and electricity for use in their manufacturing operations. The Energy Suppliers held multimillion pound supply contracts and provided a number of supporting services to develop and protect their relationships with Manufacturer Beta. These extra services were not of significant financial value to the Energy Suppliers and were viewed more as being account management type activities. However, these services are still important for this case, since they were in competition with the core offerings of the Bureau Provider and the Carbon Consultancy.

The major overlap between Energy Suppliers and carbon reporting was that energy consumption data formed the basis for calculating CO_2 emissions. Once energy consumption had been measured, it was converted to CO_2 emissions by multiplying by the CO_2 content factor for the fuel in question. The fact that the Energy Suppliers held fuel consumption data for their billing processes made them owners of the data for the first step in calculating CO_2 emissions. This consumption data was then checked by the Bureau Provider and compiled by the Carbon Consultancy before being converted into the relevant reports for submission to the Environment Agency. The energy consumption data was used primarily for billing purposes, but was also made available real-time online. The web portal for viewing this data allowed site energy managers to track energy performance and support decision making at sites. There was a separate contract to provide extended automatic meter reading to a wider range of sites and supplies at Manufacturer Beta, since energy management was becoming a core issue. Once installed, the automatic meters simplified billing and improved accuracy. They also gave more live data for real-time energy management. The Energy Suppliers were starting to see a much higher level of concern regarding energy and CO_2 performance. Accordingly they had developed small teams of in-house consultants to provide support in energy and CO_2 management, including guidance on the Carbon Reduction Commitment.

Another aspect which emphasised the importance of the Energy Suppliers in responding to the Carbon Reduction Commitment was a new obligation placed upon them by the Environment Agency. Energy Suppliers were legally obliged to provide customers with annual statements for their Carbon Reduction Commitment related energy consumption. Importantly, the liability for errors in this report lay with the Energy Supplier, rather than scheme participants. This altered the market dynamics for carbon compliance support, since it made reliance upon Energy Suppliers' statements attractive, due to the transfer of risk. Such considerations emphasised the importance of the Energy Suppliers' data and somewhat undermined the value of the checked data held by the Bureau Provider.

Later the case explores how Energy Suppliers attempted to provide Carbon Reduction Commitment support services as an extension to their energy management support offered to customers. This move was viewed by Energy

Suppliers as an account management type activity, protecting their energy supply contracts which they still viewed as their core business.

10.3.4 Interactions between the manufacturer and bureau provider

The Carbon Reduction Commitment also had implications for the bill checking services provided by Bureau Provider to Manufacturer Beta. A bureau company typically checks the hundreds of invoices generated by their client's Energy Suppliers, ahead of payment by the client. This overlaps with CO_2 emissions reporting, since the checked invoice data has an extra level of verification and reliability over that received direct from the Energy Suppliers. Although this was a useful by product of the bill checking service, it was not paid for explicitly and was a secondary concern relative to the original purpose of detecting multi million pound errors in energy invoices. In other words, carbon compliance services were not a core business offering for Bureau Provider. However, supporting Manufacturer Beta in their response to the Carbon Reduction Commitment was of interest to Bureau Provider. This was because the original value of their bill checking service was being eroded. Bureau services were a historic element of the energy supply industry which had emerged during an era when invoicing was a manual process which was prone to errors. Automatic meter reading had since cut out a large number of billing errors. In addition, increased competition in the energy supply market, plus the vigilance of the Bureau Providers themselves had further improved the accuracy of energy invoicing. This erosion of their original bill checking business model meant that the Bureau Provider was aggressively attempting to move into the provision of services in Carbon Reduction Commitment compliance support.

10.3.5 *Interactions between the manufacturer and carbon consultancy*

The Carbon Reduction Commitment also brought changes in the relationship between Carbon Consultancy and Manufacturer Beta. Carbon Consultancy was a small specialist consultancy that had previously dealt with Manufacturer Beta's sites that were part of the European Emissions Trading Scheme and the United Kingdom's Climate Change Agreements. This support involved calculating Manufacturer Beta's CO_2 emissions and preparing the reports for Manufacturer Beta's submissions to the Environment Agency. These previous interactions with the Environment Agency meant that Carbon Consultancy had a good working knowledge of the Environment Agency's processes. Carbon Consultancy attended free Environment Agency training on the structure and timelines of the Carbon Reduction Commitment and also made use of an Environment Agency email address for enquiries and clarification regarding the scheme. These communications gave the Environment Agency a quick and informal means to fix problems with the structure of the Carbon Reduction Commitment as they arose. Carbon Consultancy also benefited from the process, since they could answer questions on the Carbon Reduction Commitment faster and in more detail than other relative newcomers to the space. Although all communication channels used were free and available to any company, this informal route to gathering data gave some advantages to specialist firms such as Carbon Consultancy, who were active in the right forums to be able to hear about and capitalise upon such opportunities.

Carbon Consultancy spent the 18 months prior to the launch of the Carbon Reduction Commitment supporting Manufacturer Beta in the definition of administrative and reporting responsibilities introduced by the scheme. This work involved developing an energy supply inventory for all sites in the United Kingdom, determining the most reliable source of consumption data for each of these supplies and helping to specify a reporting system to be used once the Carbon Reduction Commitment went live in April 2010. Previously, CO_2 reporting had been carried out manually using spreadsheets, but the Carbon Reduction Commitment brought a scale of reporting that was not possible on this manual basis.

The Carbon Reduction Commitment represented a maturing of CO_2 reporting requirements. Following the introduction of the scheme, the majority of industrial and commercial emissions in the United Kingdom were covered by a CO_2 market. This increased market size justified the development of new database services which supported Carbon Reduction Commitment reporting. This meant that Carbon Consultancy saw a large part of their core business eroded by these new competitors who made it hard for niche players to compete using manual processes. Carbon Consultancy saw these changes and started to seek out the next innovative niche in energy and CO_2 management, anticipating that compliance support would be commoditised by database providers in less than 5 years. Carbon Consultancy developed a new focus upon supporting staff engagement campaigns for energy awareness. This was seen as the next step once CO_2 reporting and compliance was in place at a company. With a view to moving on to tackle staff engagement, Carbon Consultancy started introducing its customers to database solutions for compliance management. The logic behind these introductions was that these databases were a better long-term solution to energy and CO_2 reporting. Further emphasising the need for scalability, Manufacturer Beta chose to use the Carbon Reduction

Commitment reporting requirements to develop a database reporting system that would later be able to deal with anticipated CO_2 markets in other regions and markets. Carbon Consultancy supported the selection of the database provider and provided training for a new Carbon Compliance Manager who was recruited within the Corporate Reporting Department at Manufacturer Beta. The following section examines how the CO_2 compliance database provider was selected.

10.4 Manufacturer Beta's final selection between multiple compliance service offerings

Eventually, all three suppliers to Manufacturer Beta proposed a service to support compliance with the Carbon Reduction Commitment. In this section the offerings are described and the final selection made by Manufacturer Beta is explained. This discussion is supported by Figure 27, which illustrates the stages that raw data passed through before finally being submitted to the Environment Agency in the form of an annual report for the Carbon Reduction Commitment. Figure 27 also illustrates that different data are required for energy management, as opposed to CO_2 compliance reporting. Energy management data must be fresh enough to inform timely decision making and this comes at the expense of accuracy. CO_2 compliance data are only required at annual intervals, but must undergo a number of checks, presentation in the correct format, and preferably independent verification, before it is ready to submit to the regulator. These ideas are illustrated in the first three rows of the table. The last two rows show how Manufacturer Beta collected and reported CO_2 emissions data before and after the Carbon Reduction Commitment came into being. The first of these shows Manufacturer Beta's original CO_2 data chain for the small number of sites originally affected by the European Emissions Trading Scheme and the United Kingdom's Climate Change Agreements. The second shows Manufacturer Beta's final CO_2 data chain for the large number of sites eventually affected by the Carbon Reduction Commitment.

Figure 27: Chain for conversion of raw energy data to CO_2 compliance reports

	1) Data collection	2) Data checking	3) Report preparation	4) Third party verification	5) Registry account mgt	6) CO_2 trading
Data frequency	Live, hours,	Days, weeks	Months	Yearly	Yearly	Yearly
Suitability for energy management	High	Medium	Low	-	-	-
Suitability for CO_2 compliance reporting	-	-	Legal minimum	Best practice	Mandatory	Mandatory
1) MANUFACTURER BETA'S ORIGINAL CO_2 DATA CHAIN (~10 sites for European Emissions Trading Scheme and UK's Climate Change Agreements)	Energy Supplier	Bureau Provider	Carbon Consultancy	Carbon Consultancy + Independent verifier	Carbon Consultancy	Carbon Consultancy
2) MANUFACTURER BETA'S FINAL CO_2 DATA CHAIN (>100 UK sites once Carbon Reduction Commitment goes live)	Database subscription + Compliance manager	Database subscription + Compliance manager	Database subscription + Compliance manager'	Compliance manager' + Independent verifier	Compliance manager	Compliance manager'

The first Carbon Reduction Commitment service was proposed by the primary electricity supplier to Manufacturer Beta. Figure 27, shows that Energy Suppliers held live energy data that was well suited to energy management purposes. This live data was the basis of their online energy monitoring package that managers at Manufacturer Beta used to monitor energy performance on site. It was proposed to Manufacturer Beta to extend this system into Carbon Reduction Commitment compliance services. However, in the first proposal meeting it became clear that the database was not capable of holding, checking and providing a verifiable trail of data for the purpose of compliance reporting. Manufacturer Beta continued to view the package as being useful for supplying timely data for energy management, but they did not see a feasible route towards it supporting Carbon Reduction Commitment compliance reporting. For this reason, the discussions with the energy supplier were not taken any further.

The second proposal for a Carbon Reduction Commitment compliance service came from the Bureau Provider. They held their own database and proposed to complete all stages of compliance reporting using their internal systems. In the original compliance reporting system they had provided checked data to Carbon Consultancy for compilation into the required Environment Agency reports. The proposal from Bureau Provider was the lowest cost option for compliance with the Carbon Reduction Commitment. However, the corporate team in Manufacturer Beta viewed the development of CO_2 reporting capabilities in-house as being of key importance and as being much wider than simply responding to the Carbon Reduction Commitment. Manufacturer Beta were concerned that outsourcing the task to Bureau Provider would not build any internal capabilities and would not start to build a system that could be used in the future to respond to upcoming CO_2 markets in other regions. These doubts were reinforced by the weakening of the original business model of Bureau Provider. The need to check bills was being eroded by automatic meter reading and by better billing accuracy. Combined, these considerations meant that Manufacturer Beta did not wish to outsource what was seen as a critical activity to a partner whose long-term business relationship was already under question.

Finally, Carbon Consultancy had a good oversight of the compliance market and had recognised the development of a number of database products that would replace the first three steps of the compliance reporting process shown in Figure 27. This would give a standard system for collecting, checking and preparing emissions data. Carbon Consultancy supported Manufacturer Beta in selecting the most appropriate database and committed to shadow the reporting process for the first 3 years of the Carbon Reduction Commitment. This was on the agreement that, once the system was robust enough, reporting and compliance activities would be centralised and all run through the same database. Carbon Consultancy presented this as a 3 year transition during which systems would be developed and embedded within Manufacturer Beta. In addition to purchasing access to the database service, Manufacturer Beta also recruited a new member of staff with the job title of Carbon Compliance Manager. This new staff member was responsible for developing and maintaining the database and project managing the Carbon Reduction Commitment data collection processes. At the end of the 3 year transition, the new staff member would take over the activities performed by Carbon Consultancy.

10.5 Summary

This case detailed the response of Manufacturer Beta and its energy supply and reporting network to the launch of the Carbon Reduction Commitment. The case started with a description of Manufacturer Beta and their industrial network. Next the financial implications of the Carbon Reduction Commitment for Manufacturer Beta were examined. The case then examined the influence of the Carbon Reduction Commitment upon Manufacturer Beta's relationships with their Energy Suppliers, bill checking service provider and the Carbon Consultancy who prepared their accounts for the different CO_2 markets in which Manufacturer Beta participated. The case ended with a description of Manufacturer Beta's final selection between multiple Carbon Reduction Commitment service offerings proposed to them by their service providers.

Case four examined the consultation process and outcomes during the development of the Carbon Reduction Commitment. Case five focussed upon the accounting and reporting obligations introduced by the Carbon Reduction Commitment. Finally, this case completed the examination of the Carbon Reduction Commitment, by describing the changes it brought about in scheme participants and their energy supply and reporting networks.

Case six was the final case presented by this research. The following chapter moves on to analyse the cases by confronting them with the conceptual framework which was developed in the literature review.

CHAPTER 11:

ANALYSIS

11 ANALYSIS OF EMPIRICAL FINDINGS

11.1 Introduction

This chapter confronts the six case studies with the conceptual framework for the study of market design and operation which was proposed at the end of the literature review. The conceptual framework is presented in Figure 4 on page 73. The first section of this chapter reviews the research questions. The second section presents the actors involved during CO_2 market design and operation. The third and fourth sections analyse the network-level and macro-level aspects of CO_2 market design and operation. The chapter closes with a brief conclusion, leading into chapter twelve which discusses the conclusions and implications of the research.

11.2 Review of research questions

This section reviews the research questions which informed the application of the conceptual framework during the analysis of the six empirical cases. The remainder of the analysis in this chapter is then presented in the order of the research questions. The research questions were introduced in section 1.2 and discussed in more detail in sections 2.4.4 and 2.5.4, which dealt with network-level and macro-level aspects of CO_2 market design and operation respectively. For convenience, the research questions are reviewed below.

Firstly, section 11.3 answers the research question *"Who are the actors involved in CO_2 market design and operation?"*. It was important to identify these actors, because the remaining sections refer to them during the discussion of each case study. The next two sections of the chapter then discuss CO_2 market design and operation. Section 11.4 examines the network-level aspects of CO_2 market design and operation, answering research questions 2, 3 and 4. Research question 2 asked *"How do exchange practices affect CO_2 market design and operation and what is their influence upon representational and normalising practices?"*. Research question 3 asked *"How do representational practices affect CO_2 market design and operation and what is their influence upon exchange and normalising practices?"*. Research question 4 asked *"How do normalising practices affect CO_2 market design and operation and what is their influence upon exchange and representational practices?"*. Section 11.5 examines the macro-level considerations for CO_2 market design and operation, answering research questions 5, 6 and 7. Research question 5 asked *"How are technical considerations affecting CO_2 market design and operation?"*. Research question 6 asked *"How are temporal considerations affecting CO_2 market design and operation?"*. Research question 7 asked *"How are uncertainty-based considerations affecting CO_2 market design and operation?"*. The structure of sections 11.4 and 11.5 follow that of the conceptual framework presented in Figure 4 on page 73.

The following section answers research question 1, by introducing the actors involved during CO_2 market design and operation.

11.3 Actors involved in CO_2 markets

This section identifies the actors involved in CO_2 market design and operation. The discussion was prompted by the first research question which asked *"Who are the actors involved in CO_2 market design and operation?"*. Research question one acknowledges that the network perspective of CO_2 market design and operation which was adopted emphasises the interdependence between CO_2 regulators and CO_2 market participants. The literature review showed that current theories of CO_2 market design place a disproportionate emphasis upon the desires and objectives of CO_2 market regulators. This first research question aimed to redress the balance, by identifying the other network actors who are involved during CO_2 market design and operation. These findings contributed to a more detailed empirical understanding of the networks which operate CO_2 markets.

The answer to research question 1 is given initially in a general sense in Table 19. Table 19 identifies the thresholds that regulators have set in order to identify the actors who must participate in the CO_2 markets. A second answer is given in Table 20, which identifies the specific actors involved in each of the six cases and the generic types of CO_2 market actor which they represent. The actors identified in Table 20 include the CO_2 market participants, regulators, providers of products or services relating to energy and CO_2, final customers, business associations, research and academic institutions and Non-Governmental Organisations that are involved during CO_2 market design and operation.

The process whereby CO_2 market participants are identified is now discussed. This discussion is summarised in Table 19. Efforts to extend the CO_2 market of the Kyoto Protocol were discussed in the first case study. The Kyoto Protocol is administered by the United Nations and governments can sign up to the protocol on a voluntary basis. Phase I of the Kyoto Protocol runs from 2008-2012 and has 37 member state signatories, as well as the European Union which has signed up as a region. The second CO_2 market, as discussed in cases two and three, was the European Emissions Trading Scheme. The European Emissions Trading Scheme was different from the Kyoto Protocol, in that it mandated the participation of sites from specific industries. The participation of individual sites from within these industries was determined by reference to thresholds for participation based upon annual energy usage. Phase I and phase II of the European Emissions trading scheme targeted the electricity generation, iron and steel, manufacturing, mineral processing and pulp and paper processing industries. All sites from these industries with total site combustion facilities of greater than 20MW were mandated to participate in the European Emissions Trading Scheme. This threshold resulted in approximately 10,500 sites across the European Union being included in phases I and II of the European Emissions Trading Scheme. Phase III of the European Emissions Trading scheme will raise the qualification threshold to 35MW of combustion facilities, to allow some smaller facilities to exit the scheme. The scope of the European Emissions Trading Scheme has also been extended in phase III to include aviation and carbon capture and storage, as well as producers of aluminium, ammonia and petrochemicals. These changes will bring an estimated further 1,500 to 4,500 sites within the CO_2 market of the European Emissions Trading Scheme. Finally, the third CO_2 market, as examined by cases four, five and six was the United Kingdom's Carbon Reduction Commitment. Like the European Emissions Trading Scheme, the Carbon Reduction Commitment mandates its participants through setting a threshold based upon energy consumption. However, the Carbon Reduction Commitment does not discriminate in its choice of participating industries. The Carbon Reduction Commitment also avoids targeting single sites and instead targets whole organisations. The Carbon Reduction Commitment's participation threshold is annual electricity consumption through an industrial class of electricity meter of greater than 6,000MWh. This threshold represents annual energy expenditure of approximately £500,000 across the whole organisation. CO_2

market participants in the Carbon Reduction Commitment include government authorities, landlords, office based organisations, retailers, smaller manufacturers and universities. The number of CO_2 market participants in the Carbon Reduction Commitment is typically defined at the level of individual organisations. There are an estimated 5,000 organisations participating in the Carbon Reduction Commitment. These 5,000 organisations are estimated to represent between 25,000 to 150,000 sites, as compared to the 10,500 sites in phases I and II of the European Emissions Trading Scheme.

Table 19: CO_2 market entry criteria and results

	Case studies covered						ENTRY THRESHOLD	TYPES OF PARTICIPANT	NUMBER OF PARTICIPANTS
	1	2	3	4	5	6			
KYOTO PROTOCOL	✓						Voluntary participation	Governments	37 countries, plus European Union
EUROPEAN EMISSIONS TRADING SCHEME:									
phase I		✓					Total site combustion facilities of >20MW	- Electricity generation - Iron & steel - Manufacturing - Mineral, pulp and paper processing	Approximately 10,500 sites
phase II		✓							
phase III			✓				Total site combustion facilities of >35MW	As above, plus: - Aluminium - Carbon Capture and Storage - Ammonia - Aviation - Petrochemicals	Estimated 12,000 - 15,000 sites
CARBON REDUCTION COMMITMENT				✓	✓	✓	Annual electricity consumption >6,000MWh through an industrial class of electricity meter	- Government authorities - Landlords - Office based organisations - Retailers - Smaller manufacturers - Universities	Estimated 25,000-150,000 sites or 5,000 organisations

The previous discussion identified the generic types of CO_2 market participant and the means by which their participation in each CO_2 market is decided. The discussion now moves to specific examples of CO_2 market participants and the actors who influenced or were influenced by their participation in some way. Table 20 introduces the regulators, market participants, providers of products or services relating to energy and CO_2, final customers, business associations, research and academic institutions and Non-Governmental Organisations that were identified in each of the six case studies. Each type of actor is discussed below.

Table 20: Types of actors involved in forming CO_2 markets

ACTOR TYPE	Case studies covered						SPECIFIC EXAMPLES
	1	2	3	4	5	6	
1) REGULATORS	✓						- United Nations
		✓	✓				- European Union
		✓					- Department of Energy & Climate Change
		✓		✓	✓	✓	- Environment Agency
2) CO_2 MARKET PARTICIPANTS	✓						- Governments
		✓					- Manufacturer Alpha
			✓				- NRG
			✓				- Fuel Users
				✓		✓	- Manufacturer Beta
					✓		- Retailer Gamma
3) ENERGY & CO_2 PRODUCT / SERVICE PROVIDERS		✓					- Technical consultant
		✓					- Independent verifier 1
		✓					- Independent verifier 2
		✓		✓	✓	✓	- Carbon Consultant
					✓	✓	- Bureau Provider
					✓	✓	- Energy Suppliers
4) FINAL CUSTOMERS			✓				- Consumers
5) BUSINESS ASSOCIATIONS		✓					- Trade Association
			✓				- EUTA
				✓			- Confederation of British Industry
6) RESEARCH & ACADEMIC INSTITUTIONS	✓						- Stern Review team
		✓					- Carbon Trust
7) NON- GOVERNMENTAL ORGANISATIONS	✓						- Stop Climate Chaos - World Business Council for Sustainable Development

The first type of actor involved during CO_2 market design and operation is the regulator. In case one this was the United Nations which administers the Kyoto Protocol. In cases two and three the European Union administered the European Emissions Trading Scheme. Finally, in cases four, five and six the Department of Energy and Climate Change set the structure of the Carbon Reduction Commitment and the Environment Agency administered its operation on a day to day basis. Both of these entities were part of the United Kingdom's government. Inclusion of the regulator within discussions of CO_2 markets was essential, since the regulator provides the legal basis for each CO_2 market's design and also for mandating organisations' participation within the CO_2 market. One exception to the regulators' typical role of mandating participation is the governance of the Kyoto Protocol. The United Nations still provides a framework for the operation of the Kyoto Protocol, but they are unable to mandate participation of governments within the scheme.

The second type of actor involved during CO_2 market design and operation is CO_2 market participants. CO_2 market participants are those actors which are required to purchase CO_2 credits as direct market participants. In case one, the participants within the Kyoto Protocol were governments. In cases two and three, the CO_2 market participants examined were Manufacturer Alpha in phases I and II of the European Emissions Trading Scheme and the multinational energy Company 'NRG' and aviation 'Fuel Users' in phase III. Finally, Manufacturer Beta and Retailer Gamma were examined in cases four, five and six which dealt with the Carbon Reduction Commitment. Inclusion of CO_2 market participants was essential to the examination of CO_2 markets. The remaining CO_2 market actors are those who influenced or were influenced by the CO_2 market, but who do not purchase CO_2.

The next types of CO_2 market actor are energy and CO_2 product and service providers. These actors are consultants, independent verifiers, bureau providers and energy suppliers. The role of each of these actors is now discussed. Consultants are often hired to support CO_2 market participants in calculating and reporting their CO_2 emissions. Independent verifiers are hired by the CO_2 market participants to check their annual CO_2 reports. This verification process is mandatory in the European Emissions Trading Scheme and voluntary in the Carbon Reduction Commitment. Bureau providers are important CO_2 market actors that predate the launch of CO_2 markets. Bureau providers use complex databases to check and challenge their customers' energy bills. Bureau providers therefore held the most accurate set of energy data for most CO_2 market participants. During the launch of CO_2 markets, these bureau providers have been attempting to provide new services to convert this energy data into the CO_2 reports required by CO_2 market regulators. Finally, energy suppliers are an important CO_2 market participant, as their energy supplies are the source of most of the CO_2 emissions of market participants. Energy suppliers have seen CO_2 markets as an opportunity to support their customers and provide added benefits to their core offering of energy services. Furthermore, the latest CO_2 market, the Carbon Reduction Commitment has mandated that energy suppliers must provide accurate annual energy use statements for use by the market participant during CO_2 reporting and trading. All of these energy and CO_2 product and service providers are important actors in CO_2 markets, as they influence the CO_2 reporting and reduction activities undertaken by CO_2 market participants.

The next set of CO_2 market actors, 'final customers' are not prominent in the case studies presented. One exception is that case three gives an example of how consumers' concerns regarding CO_2 markets and offsetting were managed. However, the majority of cases did not deal directly with end customers. Instead of being consumer-led, CO_2 markets were found to be primarily regulator-led.

The anonymised 'Trade Association', 'EUTA', as well as the Confederation of British Industry are examined in cases two, three and four. Business associations are important actors in CO_2 Markets, since they represent their members' interests and attempt to influence the development of CO_2 markets.

Research and academic institutions are also important actors during CO_2 market design and operation, since they provide technical data upon the likely impact of Climate Change and on the possible actions that business could take to reduce their CO_2 emissions. These actors tended to be more important at the macro-level, rather than the operational level of CO_2 markets. The Stern Review team and Carbon Trust were included in case one which examined the extension of the Kyoto Protocol. The remaining case studies examined operational aspects of CO_2 markets, where research and academic institutions had stepped back from the day to day market operation.

Finally, Non-Governmental Organisations were important CO_2 market actors, as they attempted to mobilise action on Climate Change. Again, like research and academic institutions, the Non-Governmental Organisations tended to focus upon high level negotiations, rather than operational aspects of CO_2 markets. Hence the inclusion of Stop Climate Chaos and the World Business Council for Sustainable Development in case one which dealt with the extension of the Kyoto Protocol.

This section has answered research question 1, by identifying the actors involved during CO_2 market design and operation. Sections 11.4 and 11.5 now examine network-level and macro-level aspects of CO_2 market design and operation. The analysis is undertaken by confronting the conceptual framework for the study of market design and operation developed in the literature review with the contextual data on CO_2 markets from chapter four, plus the empirical data from the six case studies presented in chapters five to ten.

11.4 Network-level aspects of CO_2 markets

This section analyses the network-level aspects of CO_2 market design and operation which were identified by confronting the cases with the conceptual framework developed in the literature review. The conceptual framework for the analysis of market design and operation is discussed in section 2.6 and summarised in Figure 4 on page 73. Figure 4 is repeated below for convenience.

Figure 4: Conceptual framework for the study of CO_2 market design and operation (repeated for convenience)

NETWORK LEVEL ASPECTS	**Exchange**	Interests
		Measurements
	Representational	Results
		Descriptions
	Normalising	Rules and tools
		Measures and methods of measurement
MACRO LEVEL ASPECTS	**Technical**	Technological
		Public goods and resource limits
	Temporal	Windows of opportunity
		Lock ins
	Uncertainty	Problem uncertainty
		Cognitive biases

This analysis deals with research questions 2, 3 and 4. Research question 2 asked *'How do exchange practices affect CO_2 market design and operation and what is their influence upon representational and normalising practices?'*. Exchange practices relate to the economic exchanges taking place within the market and the supporting activities which surround them, these are analysed in section 11.4.1. Research question 3 asked *"How do representational practices affect CO_2 market design and operation and what is their influence upon exchange and normalising practices?"*. Representational practices are those which aim to depict markets and how they work, these are analysed in section 11.4.2. Finally, research question 4 asked *"How do normalising practices affect CO_2 market design and operation and what is their influence upon exchange and representational practices?"*. Normalising practices are those which aim to introduce normative guidelines for how a market should work, these are analysed in section 11.4.3.

11.4.1 Exchange in CO_2 markets

Aspects of CO_2 market design and operation relating to exchange practices are now analysed. This section answers research question 2 which asked *"How do exchange practices affect CO_2 market design and operation and what is their influence upon representational and normalising practices?"*. Exchange practices relate to the economic exchanges taking place within the market and the supporting activities which surround them. The first half of research question 2 seeks to understand how exchange practices affected CO_2 market design and operation. The second half of research question 2 looks at how exchange practices influenced representational and normalising practices. This part of the question focused attention upon the two translations of: 'interests', which link exchange practices to normalising practices and 'measurements', which link exchange practices to representational practices (Kjellberg & Helgesson, 2006, 2007b, 2007a). Interests are stakes or involvement in an undertaking which drive exchange practices and inform efforts to influence a market's representational and normalising practices. Measurements are descriptions of exchange which influence how actors represent the market and respond to it. Interests and measurements during CO_2 market design and operation are now discussed.

The following discussion of interests during CO_2 market design and operation is summarised in Table 21. The interests of the market regulators and business participants are presented by CO_2 market and also by case study.

Table 21: Interests in CO_2 markets

	Case studies covered						Regulator's interests	Businesses' interests
	1	2	3	4	5	6		
KYOTO PROTOCOL	✓						- Reduction of greenhouse-gasses by >5% between 2008 and 2012. - CO_2 emission reductions at least cost to society.	- Profit maximisation - Need for 'level playing field' - Need for CO_2 market to monetise CO_2 ahead of business action.
EUROPEAN EMISSIONS TRADING SCHEME:								
phase I		✓					- Reduction of CO_2 emissions by 8% between 2008 and 2012. - CO_2 emission reductions at least cost to society.	- Profit maximisation. - Increased production throughput and quality. - Cost minimisation. - Regulatory compliance.
phase II		✓						
phase III			✓				- Support EU ambition to cut CO_2 emissions by 20-30%, by 2020. - CO_2 emission reductions at least cost to society.	- Manage reputational impact. - Avoid setting difficult precedents. - Regulatory compliance.
CARBON REDUCTION COMMITMENT				✓	✓	✓	- Reduction of CO_2 emissions by 4.4 million tonnes by 2020, ~3% of the projected total 2020 UK CO_2 emissions. - CO_2 emission reductions at least cost to society.	- Cost management - Build CO_2 reporting capabilities. - Regulatory compliance.

In each study, the CO_2 market regulator's primary interests were to achieve CO_2 reductions at the least cost to society. Although all regulators agreed on the need for capital efficiency, each regulator expressed their interest in reducing CO_2 emissions in different ways. In case one the United Nations' set a target for the Kyoto Protocol to achieve a reduction of greenhouse-gasses by >5% between 2008 and 2012 (UNFCCC, 2005). The European Union set a CO_2 reduction target for phase I and II of the European Emissions Trading Scheme to achieve an 8% reduction in CO_2 emissions between 2008 and 2012 (Braun, 2009; Delay & Grubb, 2008; Sandoff & Schaad, 2009). In phase III of the European Emissions Trading Scheme, the European Union has not yet set a binding reduction target. Instead, the target will be aligned with the wider European ambition to reduce CO_2 emissions by 20% by 2020 if no global replacement for Kyoto Protocol is agreed (Europa, 2008). This target will be ratcheted to 30% by 2020, if other countries ratify and strengthen the Kyoto Protocol's second phase in 2013. Finally, the United Kingdom's government has set a target of annual savings of 4.4 million tonnes of CO_2 through the Carbon Reduction Commitment by 2020 (DECC, 2009d). This is equivalent to approximately a 3% saving of the projected total United Kingdom CO_2 emissions in 2020 (DEFRA, 2006). Although these interests differ in their detail, it can be seen that the regulators consistently expressed their interests as being to achieve absolute reductions in CO_2 emissions through a method that will do so at the least cost to society. This interest was aligned with the theoretical principles underpinning the design of CO_2 markets to achieve capital efficiency (Aldy et al., 2003; DEFRA, 2007; Haug et al., In press; Kolk & Pinkse, 2004; Levin & Espeland, 2002; MacKenzie, 2009; McKibbin & Wilcoxen, 2002; Sanden & Azar, 2005; Wittneben, 2009).

Moving on to analyse the interests of the CO_2 market participants in each case, it can be seen that their interests are quite different to those of the CO_2 market regulators.

In case one, during negotiations to extend the Kyoto Protocol, businesses expressed interests of profit maximisation, the need for a level playing field and the need for CO_2 markets to lead business action on Climate Change. The calls for a level playing field mostly reflected the concerns of businesses based in the Western world. These businesses wished to avoid competitive distortions that could arise if they were subject to a market for CO_2 that did not include, for example, Chinese or Indian manufacturers. Furthermore, businesses stressed that they could not justify a proactive response to Climate Change to their shareholders without a price for CO_2 that would allow them to build the cost of CO_2 into their business decisions. Within phases I and II of the European Emissions Trading Scheme, Manufacturer Alpha's interests were profit maximisation through increased production throughput and quality, as well as cost minimisation. Manufacturer Alpha also expressed an interest that they wished to comply with CO_2 markets. Discussions within NRG about phase III of the European Emissions Trading Scheme primarily centred upon interests in managing the reputational impact of aviation's inclusion within the European Emissions Trading Scheme. NRG also expressed an interest in avoiding setting difficult precedents in other CO_2 markets. NRG also expressed an interest in ensuring regulatory compliance with phase III of the European Emissions Trading Scheme. Finally, in their responses to the United Kingdom's Carbon Reduction Commitment, Manufacturer Beta and Retailer Gamma expressed interests of cost management and regulatory compliance. However, they also expressed an interest that was not seen in the first three cases, they saw that the Carbon Reduction Commitment represented a maturing of CO_2 markets which required the development of CO_2 reporting capabilities in-house.

Business interests were essentially aligned across all case studies. Business participants in CO_2 markets saw their primary interests in maximising profit, managing the reputational impact of CO_2 markets and achieving compliance with the CO_2 markets. These interests were strikingly different to those of the regulators. The observations were however aligned with a small body of research which challenges the traditional view of CO_2 markets through empirical observations of business responses to CO_2 markets (Engels, 2009; Reid & Toffel, 2009; Spash, 2010). Below, the analysis of the case studies continues with a discussion of measurements during CO_2 market design and operation.

The following discussion of measurements during CO_2 market design and operation is summarised in Table 22. The measurements of the market regulators and business participants are presented by CO_2 market and also by case study.

Table 22: Measurements during CO_2 market design and operation

	Case studies covered						Regulators' measurements	Businesses' measurements
	1	2	3	4	5	6		
KYOTO PROTOCOL	✓						- Absolute cost of CO_2 in $/tonne	- n/a (Kyoto Protocol is between governments, no direct business participation)
EUROPEAN EMISSIONS TRADING SCHEME:								
phase I		✓					- Absolute cost of CO_2 in €/tonne	- Relative cost as % of energy expenditure
phase II		✓					- Absolute cost of CO_2 in €/tonne	
phase III			✓				- Absolute cost of CO_2 in €/tonne	- Costs not directly discussed - Reputational impacts
CARBON REDUCTION COMMITMENT				✓	✓	✓	- Absolute cost of CO_2 in £/tonne	- Relative cost as % of energy expenditure - Reputational impacts

Subject to differences in local currency, the regulators' measurements of all three CO_2 markets covered by the cases were undertaken in terms of the absolute cost of CO_2 in either $/tonne CO_2 for the global Kyoto Protocol, €/tonne CO_2 for the European Emissions Trading Scheme, or £/tonne CO_2 for the United Kingdom's Carbon Reduction Commitment. These measurements, in terms of the absolute cost of CO_2, were aligned with the regulators' interests in achieving CO_2 reductions at the least cost across society.

The measurements employed by the business participants in the CO_2 markets were not aligned with those of the regulators. Instead of measuring the absolute costs of CO_2, business participants measured the relative costs of CO_2 as a percentage of their annual energy expenditure. One exception to this was in case three, where NRG did not directly discuss the cost of CO_2 and instead measured the market in terms of reputational impacts. This attempt to measure reputational impacts was also undertaken by Manufacturer Beta and Retailer Gamma in cases four, five and six. These measurements by the business participants in the CO_2 markets were significant. Later the analysis of the results of the measurements will show that CO_2 markets have a negligible financial impact when compared to energy expenditure. This provides a fundamental challenge to literature, for example (Barrett, 2007; Bebbington & Larrinaga-Gonzalez, 2008; Braun, 2009; Coase, 1960, 1988; Dales, 1968; Demsetz, 1966; Kolk et al., 2008; Lohmann, 2005, 2009; MacKenzie, 2009; Okereke, 2007; Stern, 2006), which presents CO_2 markets as fostering Climate Change mitigation through the monetisation of CO_2 emissions.

The analysis now discusses representations during CO_2 market design and operation, starting with a discussion of the results of the measurements introduced above.

11.4.2 Representations of CO_2 markets

This section analyses representational aspects of CO_2 market design and operation. The discussion answers research question 3, which asked *"How do representational practices affect CO_2 market design and operation and what is their influence upon exchange and normalising practices?"*. Representational practices are those which aim to depict markets and how they work. The first half of research question 3 seeks to understand how representational practices affected CO_2 market design and operation. The second half of research question 3 looks at how representational practices influenced exchange and normalising practices. This part of the question focused attention upon the two translations of: 'results', which link representational practices to exchange practices and 'descriptions', which link representational practices to normalising practices (Kjellberg & Helgesson, 2006, 2007b, 2007a). Results of measurements drive exchange practices by influencing how market participants view the outcome of their exchanges. Descriptions of markets drive normalising practices by informing participants' representations of the markets which they are seeking to regulate in some way. Results and descriptions are now discussed.

The following discussion of results during CO_2 market design and operation is summarised in Table 23. The results of measurements made by the market regulators and business participants are presented by CO_2 market and also by case study.

Table 23: Results in CO_2 markets

	Case studies covered						**Regulators' results**	**Businesses' results**
	1	2	3	4	5	6		
KYOTO PROTOCOL	✓						- ~\$20/tonne CO_2	- n/a (Kyoto Protocol is between governments, no direct business participation)
EUROPEAN EMISSIONS TRADING SCHEME:								
phase I		✓					- ~€2 / tonne CO_2	- ~0.15% of energy expenditure
phase II		✓					- ~€15 / tonne CO_2	- ~1.1% of energy expenditure
phase III			✓				- €?? / tonne CO_2 (future price in 2013 unknown)	- 0.6 - 1.5% increase in air fares (Median estimated increase in air fares due to aviation's inclusion in phase III)
CARBON REDUCTION COMMITMENT				✓	✓	✓	- £12/tonne CO_2 (price fixed in 2012 and 2013)	- ~0.77% of energy expenditure

The regulator's results of their measurements of each CO_2 market were expressed as measurements of the absolute costs of CO_2, as discussed above. The history of these costs is given in detail in Figure 12, with the costs quoted in Table 23 relating to those at the time of each case study. The most commonly traded CO_2 credit within the Kyoto Protocol was the 'Certified Emission Reduction' Unit (CER), this was typically traded at around $20/tonne CO_2 (trade association data provided on anonymous basis). Within the European Emissions Trading Scheme, CO_2 permits averaged around €2/tonne CO_2 during phase I and around €15/tonne CO_2 in phase II (ECX, 2010). At the time of writing, the future price of CO_2 within phase III of the European Emissions Trading Scheme was unknown. The lack of ability to predict future prices in CO_2 markets is discussed later as a macro-level consideration due to the uncertainty during CO_2 market design and operation. Finally, within the Carbon Reduction Commitment, the United Kingdom's Government had set a fixed price of CO_2 at £12/tonne during the early years of the CO_2 market (DECC, 2009c).

The discussion now switches to analyse the results of measurements of the CO_2 market made by businesses. As can be seen in Table 23, all market participants converted the absolute costs of CO_2 into a percentage of energy expenditure. These measurements gave results which were CO_2 costs of ~0.15% of energy expenditure in phase I of the European Emissions Trading Scheme, ~1.1% during phase II of the European Emissions Trading Scheme and ~0.77% of energy expenditure during phase I of the Carbon Reduction Commitment. The estimated increases in air fares given following aviation's inclusion in phase III of the European Emissions Trading Scheme were not undertaken by NRG. Instead, these come from academic research discussed in the literature review. NRG had focussed upon managing reputational impacts due to aviation's inclusion in phase III of the European Emissions Trading Scheme. The research on possible increases in air fares due to aviation's inclusion in phase III of the European Emissions Trading Scheme estimated increases of 0.6-1.5% on the median air fare. Finally, the CO_2 costs introduced by the Carbon Reduction Commitment represented around 0.77% of energy expenditure. This analysis shows that although the absolute costs of CO_2 were real, they were not significant in terms of their cost relative to the energy expenditure of CO_2 market participants. While literature, for example (Barrett, 2007; Bebbington & Larrinaga-Gonzalez, 2008; Braun, 2009; Coase, 1960, 1988; Dales, 1968; Demsetz, 1966; Kolk et al., 2008; Lohmann, 2005, 2009; MacKenzie, 2009; Okereke, 2007), emphasises the financial incentives introduced by CO_2 markets, there is a lack of discussion of the scale of these costs, or their comparison to other costs faced by businesses. The insights developed from the case studies as to the relatively low costs of CO_2 markets starts to help to explain why these markets have not significantly influenced businesses' behaviour.

The analysis now deals with descriptions during CO_2 market design and operation. Table 24 summarises the following discussion. The descriptions of the markets by the regulators and business participants are presented by CO_2 market and also by case study.

Table 24: Descriptions in CO_2 markets

	Case studies covered: 1	2	3	4	5	6	Regulator's descriptions	Businesses' descriptions
KYOTO PROTOCOL	✓						- Kyoto Protocol aiming to realise the full potential of market-based opportunities to respond to Climate Change.	- CO_2 market as an issue of regulatory compliance. - Local CO_2 markets as potential threats to global competitiveness. - CO_2 markets required to monetise businesses' CO_2 emissions.
EUROPEAN EMISSIONS TRADING SCHEME:							- Market mechanism delivering CO_2 reductions at the least cost across industry. - Two key design criteria of: avoiding unnecessary regulatory burdens and achieving flexibility in modes of compliance available to businesses. - CO_2 as a strategic concern for businesses	- CO_2 market as a compliance scheme. - CO_2 costs as <1% of energy costs.
phase I		✓						
phase II		✓						
phase III			✓					- CO_2 market as an opportunity to differentiate commodity of aviation fuel. - Risk management exercise to avoid setting adverse precedents for other CO_2 markets and to avoid consumer concerns regarding CO_2 offsetting.
CARBON REDUCTION COMMITMENT				✓	✓	✓	- Market based mechanism designed to introduce a price for CO_2 emissions. - Supplementary public CO_2 performance league table designed to introduce reputational incentives to reduce CO_2 emissions.	- Complex and extensive reporting scheme requiring development of new CO_2 reporting infrastructures to ensure compliance. - CO_2 costs as <1% of energy costs. - Reputational driver managed defensively.

The descriptions of CO_2 markets by regulators are now analysed. The United Nations described the Kyoto Protocol in terms of a mechanism which was designed to realise the full potential of market-based opportunities to respond to Climate Change. Descriptions by the European Union of the European Emissions Trading Scheme were similar. Again, the market based elements were discussed and the ambition to achieve CO_2 reductions at least cost was reiterated. The market based mechanism was described as relying upon flexibility in compliance modes and the avoidance of unnecessary regulatory burden in order to achieve this capital efficiency. The European Union described CO_2 as a strategic concern for businesses. Finally, the Carbon Reduction Commitment was described as a market mechanism which would introduce a price for CO_2 emissions. The regulator's description of the Carbon Reduction Commitment also made reference to the performance league table, which was designed to introduce reputational incentives to reduce CO_2 emissions.

The descriptions of each CO_2 market by their business participants are now analysed. Businesses' descriptions of the Kyoto Protocol during negotiations over its extension focussed primarily upon CO_2 markets as a compliance issue for business. They also described the potential for local CO_2 markets to cause threats to global competiveness, while still acknowledging the need for CO_2 markets to provide businesses with a means of monetising and therefore reducing their CO_2 emissions. Manufacturer Alpha described phases I and II of the European Emissions Trading Scheme as a compliance scheme similar to other environmental regulation administered by the United Kingdom's Environment Agency. Manufacturer Alpha also described the CO_2 costs as being less than 1% of energy expenditure and therefore not significant enough to influence investment or operational decisions. During the inclusion of aviation in phase III of the European Emissions Trading Scheme, NRG described the CO_2 market as an opportunity to differentiate the commodity of aviation fuel. However, the opportunity was not described in terms of a reduced CO_2 offering, but instead as a means of offering a bundled aviation fuel and compliance package. The descriptions focussed upon the need to manage the risk of reputational damage and to avoid setting difficult precedents in other CO_2 markets by region or industry. Finally, the Carbon Reduction Commitment was described by Manufacturer Beta and Retailer Gamma as a complex and extensive scheme which required the development of new CO_2 reporting infrastructures in order to ensure compliance. The costs of the Carbon Reduction Commitment were presented as not being material enough to drive business decisions, as they represented less than 1% of energy expenditure. Furthermore, the reputational driver introduced by the Carbon Reduction Commitment's public league table was managed defensively as a risk, rather than as an opportunity. The ambition was to avoid being in the bottom half of the league table, but also not to risk the exposure of aiming for the top of the league table either. These descriptions of CO_2 markets, as compliance based mechanisms triggering risk management type responses, certainly affected the exchange and normalising efforts within the CO_2 markets. These observations of descriptions as affecting, as well as resulting from, market practices are aligned with literature which emphasises the normative power of representations (Hardie & MacKenzie, 2007; Kjellberg & Helgesson, 2006, 2007b, 2007a). The stark differences between the descriptions of CO_2 markets by regulators, versus the descriptions of businesses demonstrate the multiplicity of perceptions within a single market (Ford et al., 2003; Geiger & Finch, 2010; Henneberg et al., 2006; Henneberg et al., 2010; Leek & Mason, 2010; Ramos & Ford, in press). Acknowledging these differences in perceptions is an important step in explaining the exchange and normative practices which were observed in the network.

11.4.3 Constitutions of CO_2 markets

Aspects of CO_2 market design and operation relating to normalising practices are now analysed. This section answers research question 4 which asked *'How do normalising practices affect CO_2 market design and operation and what is their influence upon exchange and representational practices?'*. Normalising practices are those which aim to introduce normative guidelines for how a market should work. The first half of research question 4 seeks to understand how normalising practices affected CO_2 market design and operation. The second half of research question 4 looks at how normalising practices influenced exchange and representational practices. This part of the question focused attention upon the two translations of: 'rules and tools', which link normalising practices to exchange practices and 'measures and methods of measurement', which link normalising practices to representational practices (Kjellberg & Helgesson, 2006, 2007b, 2007a). Rules and tools are used to perform and influence exchange practices. Measures and methods of measurement influence representational practices by setting what aspects of markets are measured and how they are measured. Rules and tools and measures and methods of measurement are now discussed.

The following discussion analyses rules and tools during CO_2 market design and operation, as summarised in Table 25. The rules and tools recognised by the regulators and business participants are presented by CO_2 market and also by case study.

Table 25: Rules and tools in CO_2 markets

	Case studies covered: 1	2	3	4	5	6	**Regulator's rules and tools**	**Businesses' rules and tools**
KYOTO PROTOCOL	✓						- Voluntary participation. - Target setting and scheme administration discussed at annual Conference of Parties.	- Obligations to maximise shareholder value. - Compliance with CO_2 market mandatory.
EUROPEAN EMISSIONS TRADING SCHEME:								
phase I		✓					- Participation mandatory for sites with > 20MW of combustion plant. - CO_2 permits allocated for free. - Annual CO_2 reporting and audits. - Penalties for non-compliance.	- Management of throughput, quality and costs drives investment and operational decisions. - Compliance with CO_2 market obligatory.
phase II		✓						
phase III			✓				- Participation mandatory for sites with > 35MW of combustion plant. - CO_2 permits auctioned, but participants providing data early will receive free permits in early years. - Annual CO_2 reporting and audits. - Penalties for non-compliance.	- Decisions driven by efforts to manage reputational concerns and precedents set in other CO_2 markets. - Compliance with CO_2 market mandatory.
CARBON REDUCTION COMMITMENT				✓	✓	✓	- Participation mandatory for companies using >6,000MWh of electricity per year. - CO_2 permits auctioned. - League table ranks participants' CO_2 reduction performance. - Rebates on CO_2 auction expenditure; league table sets bonus / penalty. - Random audits to verify accuracy of CO_2 reports. - Penalties for non-compliance.	- CRC compliance costs to be minimised - Policy prohibiting speculation in non core business activities. - Compliance with CO_2 market mandatory.

The main rules and tools of the CO_2 market which were set by regulators related to: determining which organisations should participate in the market, the mechanism by which CO_2 permits were allocated, guidance on how to report CO_2 emissions and the methods of verifying and enforcing participants' compliance with the CO_2 market. These are now discussed in turn.

The only CO_2 market whose members were selected on a voluntary basis was the Kyoto Protocol. This market was administered by the United Nations which had a role to encourage and coordinate the global CO_2 market. However, the United Nations did not have any authority to force nations to join the Kyoto Protocol. Participation in all other CO_2 markets was determined by thresholds of energy consumption, whereby any organisation breaking the threshold would have to join the CO_2 market by law. For phases I and II of the European Emissions Trading Scheme, the threshold for participation was measured at the site level and encompassed all sites with combined combustion facilities of greater than 20MW capacity (DTI, 2004). This threshold was raised to 35MW for phase III of the European Emissions Trading scheme, in order to allow some of the smaller sites to avoid what was deemed to be a disproportionate burden of compliance (Europa, 2008). The United Kingdom's Carbon Reduction Commitment measured the threshold for participation at the level of a legal entity / business rather than by site. A business was required to join the scheme if their total electricity consumption through all commercial scale electricity meters exceeded 6,000MWh per year (DECC, 2009c).

Having determined the participants for each CO_2 market, the next step was to examine how their CO_2 reporting and trading was undertaken. The Kyoto Protocol involved trading between governments, however their targets have not been enforced, due to the voluntary nature of the scheme. This lack of enforcement meant that trading has not taken place to ensure compliance with the Kyoto Protocol's reduction targets. Instead an annual Conference of the Parties continues to review progress and to negotiate the terms of longer-term cooperation after phase I of the Kyoto Protocol expires in 2012. Within phases I and II of the European Emissions Trading Scheme, CO_2 permits were allocated to market participants for free. At the end of each compliance year the true CO_2 emissions of each organisation were reported and then equivalent CO_2 permits surrendered. In order to comply, each participant could either sell excess CO_2 permits, or purchase any shortfall on the CO_2 market. The European Union provided strict guidelines on how to calculate and report CO_2 emissions. The European Emissions Trading Scheme mandated that participants must have these calculations checked by a third party independent verifier ahead of their submission each year. Phase III of the European Emissions Trading Scheme will work in the same way as described above, except that CO_2 permits will be auctioned, rather than allocated for free. The auctioning will be phased in, representing a shift so that CO_2 will be paid for in full, rather than the initial allowance being free and any shortfall being purchased upon the CO_2 market. This change was necessary, since in a free allocation it is in every participant's interest to apply for as many CO_2 permits as possible. Auctioning encourages participants to buy only what they believe they need, as each tonne of CO_2 requested must be paid for. These steps are aligned with literature that advocates the design of markets to avoid adverse economic incentives (Barnett, 1986, 2003; Hurwicz, 1973; McMillan, 2003; Roth, 2002, 2007a, 2008). However, the alignment of these incentives does not mean that they are at a scale that will be significant enough to change businesses' behaviour. It is this second consideration, of the scale of incentives, that is flagged by the case studies, but which is not explicit in the literature. Finally, the Carbon Reduction Commitment starts the annual cycle in the same way as described above for phase III of the European Emissions Trading Scheme. Firstly, market participants forecast their requirements and purchase CO_2 permits in an annual auction. Next they report their CO_2 emissions and surrender the required number of permits. At this point the Carbon Reduction Commitment differs from the other CO_2 markets in three ways. Firstly, a reputational incentive is introduced as the CO_2 reduction performance of each participant will be published in a public league table. Secondly, a further financial incentive is introduced as the majority of the expenditure during the CO_2 auction will be repaid to participants with a bonus or penalty that is based upon performance in the league table. Thirdly, the Carbon Reduction Commitment will not force participants to have their CO_2 emissions reports verified before submission. Instead, the Environment Agency will audit participants on a random basis approximately once every 5 years. The final aspect of the European Emissions Trading Scheme and the Carbon Reduction Commitment is that they are both backed up by significant fines which encourage businesses to participate in the scheme and to report their CO_2 emissions accurately. These fines are considerably higher than the costs of participation in the scheme, making it cheaper to comply with, rather than to ignore the CO_2 markets.

The rules and tools employed by the business participants in CO_2 markets are now discussed. Although each participant did acknowledge and comply with the regulator's rules which were just discussed, it will be seen that the rules set out by the regulators did not drive businesses' decisions. Business responses to the negotiations to extend the Kyoto Protocol focussed upon rules and tools which emphasised that the primary obligation for businesses was to maximise shareholder value. CO_2 markets were not ignored, but were seen as a compliance issue, rather than as a driver of decision making. Again, within phases I and II of the European Emissions Trading Scheme, profit maximisation through the management of throughput, quality and cost were seen as the rules which drove manufacturer Alpha's operational and investment decisions. Compliance with the CO_2 market was seen as mandatory, but not as a strategic concern. During the future extension of phase III of the European Emissions Trading Scheme, NRG planned to comply with the CO_2 market, but spent the majority of its preparatory effort on managing reputational concerns and attempting to avoid setting difficult precedents within other regions or industries covered by CO_2 markets. Finally, Manufacturer Beta and Retailer Gamma responded to the Carbon Reduction Commitment in ways designed to minimise compliance costs. They also followed company policies that prohibited speculation outside of their core business activities. To a certain extent, this internal rule short circuited the make or buy decision at the heart of the capital efficiency of CO_2 markets. Internal trading specialists were very wary of trading in CO_2 markets for purposes other than to obtain CO_2 permits required for market compliance, since any further trading could be seen as speculative activity.

The differences between the constitutions of the rules and tools employed by the regulators versus the businesses are important aspects which have significantly influenced the operation of CO_2 markets. Such observations are aligned with the work of Mouzas and Ford (Mouzas, 2006a; Mouzas & Ford, 2009). While the rules and tools introduced by the regulator were followed, they did not deliver the desired reductions in business CO_2 emissions. This failure to influence business behaviour was partly because other business rules and tools overrode those introduced by CO_2 markets. The discussion now moves to examine the measures and methods of measurement employed by regulators and businesses during CO_2 market design and operation.

Table 26: Measures and Methods of Measurement in CO_2 markets

	Case studies covered						Regulator's measures and methods of measurement	Businesses' measures and methods of measurement
	1	2	3	4	5	6		
KYOTO PROTOCOL	✓						- CO_2 price: \$ or € per tonne CO_2, set by market. - CO_2 volume: Standard conversion factors to define CO_2 content of fuels.	- n/a (Kyoto Protocol is between governments, no direct business participation)
EUROPEAN EMISSIONS TRADING SCHEME:								
phase I		✓						- Relative cost as % of energy expenditure.
phase II		✓						
phase III			✓					- Reputational impacts. - Impacts upon CO_2 markets in other regions or industries.
CARBON REDUCTION COMMITMENT				✓	✓	✓	- CO_2 price: Fixed during early years. - CO_2 volume: Standard conversion factors to define CO_2 content of fuels.	- Relative cost as % of energy expenditure. - Reputational impacts.

Regulator's measures and methods of measurement related to the determination of the CO_2 prices and volumes for which CO_2 market participants had to account. This challenge of making different activities commensurable within markets has already received a significant level of attention in the literature (Azimont & Araujo, 2007; Callon & Muniesa, 2005; Christiansen & Wettestad, 2003; Cochoy, 2008; Finch, 2007; MacKenzie, 2004, 2007, 2009; Tenbrunsel et al., 2000). In all CO_2 markets, except for the early phases of the Carbon Reduction Commitment, the CO_2 price was set by the market. In early years of the Carbon Reduction Commitment, the CO_2 price was fixed in order to allow participants to focus upon collecting and reporting their CO_2 volumes. In all CO_2 markets the CO_2 volume to be accounted for was calculated using the participant's energy consumption plus standard conversion factors which defined the CO_2 content of each fuel. Although the processes of calculating CO_2 emissions involved the same steps, one source of complaints from market participants was that the CO_2 conversion factors were not consistent across the different CO_2 markets. In other words the same fuels could result in different amounts of CO_2 emissions, depending upon which CO_2 market covered them. This lack of consistency was a frustration for market participants, but it was not their primary concern with regards to CO_2 markets.

Businesses acknowledged the measures and methods of measurement imposed by the regulator in order to calculate the relevant CO_2 prices and volumes. However, these calculations were undertaken as reporting and compliance exercises. The measures and methods of measurement which actually drove business decisions are now discussed. In phases I and II of the European Emissions Trading Scheme, Manufacturer Alpha measured the European Emissions Trading Scheme in terms of its financial impact as a percentage of their energy expenditure. During discussion of aviation's inclusion in phase III of the European Emissions Trading scheme, NRG paid primary attention to concerns relating to reputational impacts and impacts of precedents set upon CO_2 markets in other regions or industries. The lack of a measure of the cost of CO_2 markets by NRG could arguably be explained by their previous engagement in other CO_2 markets which had proven that CO_2 costs were not material. The lack of cost calculations could also have been due to the problems of predicting the future price of CO_2 in a market. Finally, the measures and methods of measurement employed by Manufacturer Beta and Retailer Gamma during the launch of the Carbon Reduction Commitment were CO_2 costs as a percentage of energy expenditure and the reputational impact of the Carbon Reduction Commitment's league table. The main point raised by this analysis is that the focus of the attention of previous literature upon the intricate details of the regulator's measures and methods of measurement has overlooked a much more significant challenge faced by CO_2 markets. This challenge is that the costs introduced by CO_2 markets have so far proven to be too little to significantly influence businesses' behaviour. The regulator's measures and methods of measures of measurement were technically robust and logically sound; however they neglected to take account of the measures employed by businesses. This problem has been overcome by taking a network perspective of markets and studying the practices within the network, actor by actor (Araujo, 2007; Araujo et al., 2008; Kjellberg & Helgesson, 2006, 2007b, 2007a; Mouzas & Ford, 2009; Reverdy, 2010). Such an approach has highlighted empirical inconsistencies between regulators' and businesses' measures and methods of measurement which have been largely undetected in the literature to date.

This section has discussed exchange, representational and normalising practices as network-level aspects of CO_2 market design and operation. In the following section the discussion moves on to examine macro-level aspects of CO_2 market design and operation.

11.5 Macro-level aspects of CO_2 markets

This section analyses the macro-level aspects of CO_2 market design and operation which were identified by confronting the cases with the conceptual framework developed in the literature review. The conceptual framework for the analysis of market design and operation is discussed in sections 2.5.4 and 2.6 and summarised in Figure 4 on page 73. Figure 4 is repeated below for convenience.

Figure 4: Conceptual framework for the study of CO_2 market design and operation (repeated for convenience)

NETWORK LEVEL ASPECTS	**Exchange**	Interests
		Measurements
	Representational	Results
		Descriptions
	Normalising	Rules and tools
		Measures and methods of measurement
MACRO LEVEL ASPECTS	**Technical**	Technological
		Public goods and resource limits
	Temporal	Windows of opportunity
		Lock ins
	Uncertainty	Problem uncertainty
		Cognitive biases

During the literature review, three macro-level aspects of CO_2 market design and operation were identified, these were technical, temporal and uncertainty based considerations, as examined in research questions 5, 6 and 7. Technical aspects relate to physical and scientific aspects of market design and operation, these are analysed in section 11.5.1. This section answers research question 5 which asked *'How are* *technical considerations affecting CO_2 market design and operation?"*. Temporal aspects of market design and operation are analysed in section 11.5.2. This section answers research question 6 which asked *"How are temporal considerations affecting CO_2 market design and operation?"*. Uncertainty based aspects of CO_2 market design and operation are analysed in section 11.5.3. This section answered research question 7 which asked *"How are uncertainty-based considerations affecting CO_2 market design and operation?"*. The analyses given in these sections are simpler in structure than the network-level analyses which were performed individually for each case study in section 11.4. The analysis is not split between each case, since macro-level aspects encompass all CO_2 markets. Following this discussion of the macro-level aspects of CO_2 market design and operation, the chapter closes with a summary which leads into the final chapter of the dissertation.

11.5.1 Technical aspects of CO_2 markets

Technical aspects of CO_2 market design and operation are now analysed. This section answers research question 5, which asked *"How are technical considerations affecting CO_2 market design and operation?"*. The conceptual framework proposed in the literature review identified technical considerations within 'technological' aspects of market design and operation and considerations due to 'public goods and resource limits'. Technological aspects are immutable physical laws, or limits of today's technological knowledge and capabilities. For example, the laws of thermodynamics impose efficiency limits upon certain technologies, limiting their potential to adapt to CO_2 markets (Okereke, 2007; Shi et al., 2008; Teppo, 2006; Tsoutsos & Stamboulis, 2005; Walawalkar et al., 2007). The second technical aspect of market design and operation relates to environmental constraints upon markets. Public goods are particularly hard to regulate, given that they are non-excludable and non-rival in their consumption (Cornes & Sandler, 1986; Groves & Ledyard, 1977; Hardin, 1968; Olson, 1965; Peattie & Ratnayaka, 1992). In other words, public goods are available for everyone and their consumption by one actor does not prevent others from consuming them as well. Technical aspects of CO_2 market design and operation are summarised in Table 27 and then discussed in turn.

Table 27: Technical aspects of CO_2 markets

	Technical aspects
Technological	- CO_2 emissions are widely dispersed across many parts of the economy and society. - Heavy manufacturing processes are inherently energy and CO_2 intensive. - Technical expertise regarding CO_2 reduction opportunities is often weak in-house. - Market based regulatory approach required to retain control over CO_2 reduction target and push reductions to least cost opportunities within industry. - Energy consumption data cannot be used directly for CO_2 market compliance reporting. Further checks and conversions are required before annual CO_2 accounts can be presented. - Expertise for conversion of raw energy data into equivalent CO_2 emissions is not available in-house. - Many businesses lack a central record of all real estate and energy supplies where they have an interest. - Database systems are required to process the large volumes of data which are generated.
Public goods and resource limits	- CO_2 is free to move within the atmosphere, meaning that CO_2 emissions can only be managed globally. - Local efforts to reduce CO_2 emissions are potentially subject to 'free riding'.

Technological aspects of CO_2 market design and operation include the nature of CO_2 as a pollutant, the means of production of goods and finally the challenges in reporting and trading CO_2 emissions. Firstly, as discussed in section 4.5, CO_2 is a widely dispersed pollutant, having sources across many parts of industry and society. This can explain the empirically observed reach of CO_2 markets across sectors as diverse as electricity generation, iron and steel production, manufacturing, mineral processing, pulp and paper processing, aviation, carbon capture and storage, aluminium, ammonia and petrochemical production, government authorities, landlords, office based organisations, retailers, smaller manufacturers and universities. The dispersed nature of sources of CO_2 emissions means that there is no simple target for CO_2 reductions. Furthermore, there are not many easy substitutes for the processes which emit CO_2. In contrast, the global response to the problem of ozone depletion faced fewer challenges, since there were readily available substitutes and their use was restricted to a relatively small number of industrial applications (Harrison, 1998; Harrison & Easton, 2002). In the case of CO_2, heavy manufacturing processes are often inherently energy and CO_2 intensive, as was observed in case two. Furthermore, technical expertise regarding CO_2 reduction opportunities is often weak inside organisations, as was observed in all cases. The lack of options within existing technology and the lack of expertise regarding potential CO_2 reductions severely hampered businesses' ability to respond to CO_2 markets, as had also been observed by previous research (Okereke, 2007; Shi et al., 2008; Teppo, 2006; Tsoutsos & Stamboulis, 2005; Walawalkar et al., 2007). Furthermore, the discussion of the relatively insignificant costs imposed by CO_2 markets given in section 11.4.2 explains why businesses were not making significant efforts to overcome these technological barriers. The costs introduced by CO_2 markets did not justify the investments required to develop lower CO_2 technologies.

The remaining technological aspects of CO_2 market design and operation relate to a number of technological details of the function of CO_2 markets. Firstly, as discussed in section 4.6, technological considerations originally led to the selection of a market based method of regulating CO_2 emissions (Kolk & Pinkse, 2004; MacKenzie, 2009; McKibbin & Wilcoxen, 2002). This market based approach was required in order to retain control over the CO_2 reduction target and to push reductions to least cost opportunities within industry. A CO_2 tax did not achieve capital efficiency or set a reduction target at the outset and a mandated CO_2 reduction allowed a reduction target to be set, but did not achieve capital efficiency. The selection of a market based approach to CO_2 regulation is the technological reason for much of the uncertainty which is discussed in section 11.5.3. A CO_2 tax or mandate could have avoided much of the uncertainty which is inherent in CO_2 markets (Wittneben, 2009). Technological challenges with respect to CO_2 reporting requirements were also observed in cases two, five and six. For example, energy consumption data cannot be used directly for CO_2 market compliance reporting. Further checks and conversions were required before annual CO_2 accounts could be presented. The expertise for conversion of raw energy data into equivalent CO_2 emissions was often not available in-house and furthermore, many businesses lacked a central record of all real estate and energy supplies where they had an interest. These technological aspects necessitated the development of database systems to process the large volumes of data which were generated as part of CO_2 market compliance. These systems were comparable in levels of complexity to the financial accounting systems that have been in place inside companies for decades. As discussed in the fifth and sixth cases, building such CO_2 reporting systems represented a significant challenge during the design and operation of CO_2 markets. These challenges were acknowledged by the Carbon Reduction Commitment which set a 3 year practice phase at the start of its CO_2 market. During the first 3 years of the Carbon Reduction Commitment the price was fixed at £12 / tonne CO_2 with no cap on the CO_2 volume available (DECC, 2009c). This fixed price phase was to allow participants to focus upon setting up systems to gather and report their CO_2 data.

The nature of CO_2 as a public good and the limited resource of air quality were also important aspects of CO_2 market design and operation. Access to release gases into the atmosphere is a public good, in that any party can do so and doing so does not stop any other from doing the same (Cornes & Sandler, 1986; Groves & Ledyard, 1977; Hardin, 1968; Olson, 1965; Peattie & Ratnayaka, 1992). Furthermore, CO_2 is free to move within the atmosphere. If the atmosphere was a locally bounded resource, it would not be a public good (Kjellberg, 2008; Lohmann, 2005). For example, China would not be able to pollute the USA's air, or vice versa. In such a scenario, the management of Climate Change would become a local concern, with much simpler incentives and potential regulatory structures. The public good aspects of Climate Change mean that CO_2 emissions can only be managed globally. Therefore CO_2 markets will only be successful if between them they cover the majority of global emitters, or if one single global market is developed. These types of concern were not prominent in cases two to six which dealt with day to day aspects of CO_2 markets. However, they were raised during the discussion of the extension of the Kyoto Protocol in case one. These concerns were important to regulators, but sat outside the profit seeking objectives of businesses. As such, these environmental considerations do not form part of the mainstream business literature. There is a wider literature on sustainability which promotes business accountability to people, planet and profit (Brundtland, 1983; BSI, 2006; Elkington, 1994; Elkington, 1997; GRI, 2010a). However, this view of business is not widely recognised by practitioners who recognise the dominant form of enterprise as being the public limited company, which is primarily obligated to maximise profit for shareholders.

The discussion now moves to examine temporal aspects of CO_2 market design and operation.

11.5.2 Temporal aspects of CO_2 markets

Temporal aspects of CO_2 market design and operation are now analysed. This section answers research question 6, which asked *"How are temporal considerations affecting CO_2 market design and operation?"*. Temporal aspects of CO_2 market design are proposed as 'windows of opportunity' and 'lock ins'. Windows of opportunity are important during market design and operation, as many markets will be subject to a window of opportunity, after which there is little possibility to solve the problem or meet the needs which the market has been designed to tackle. The second temporal aspect relates to decisions which have long-term impacts due to the lock ins which they create and decisions which are subject to delayed rewards. Delays in reward cause time delays, as even once a decision is taken, the anticipated benefits may not be received for a certain period of time. Temporal aspects of market design and operation due to windows of opportunity and lock ins are summarised in Table 28 and are now analysed in turn.

Table 28: Temporal aspects of CO_2 markets

	Temporal aspects
Windows of opportunity	- The opportunity for mitigation of Climate Change is subject to a 20-30 year window of opportunity. - Projections of business as usual CO_2 emissions growth leads to dangerous atmospheric levels of CO_2 in the next 20-30 years.
Lock ins	- CO_2 has an atmospheric lifespan of around 50 years. In short to medium-term timeframes, atmospheric concentrations of CO_2 are cumulative and irreversible. - Investments by businesses typically take a 10-20 year timeframe.

Windows of opportunity are significant aspects of CO_2 market design and operation. CO_2 levels in the atmosphere are effectively cumulative, due to their long atmospheric lifetime. As discussed in section 2.5.2, projections of business as usual growth in CO_2 emissions lead to dangerous atmospheric levels of CO_2 within the next 20-30 years (Vaughan et al., 2009). CO_2 markets are ultimately designed to provide a means to incentivise businesses to reduce their CO_2 emissions in order to mitigate Climate Change. Therefore it follows that CO_2 market design and operation is subject to a 20-30 year window of opportunity. This aspect of CO_2 market design and operation is discussed in the literature, but is not apparent in the current operation of existing CO_2 markets.

Temporal aspects of CO_2 market design and operation are also lock ins. Lock ins are decisions which have an extended and irreversible impact. One lock in for CO_2 markets is due to the long atmospheric lifespan of CO_2 of around 50 years (Moser, 2010). This atmospheric lifespan makes CO_2 emissions effectively cumulative and irreversible when viewed within the 20-30 year timeframe for the mitigation of Climate Change. The lock in due to the atmospheric lifespan of CO_2 removes the opportunity for CO_2 markets to reverse Climate Change. CO_2 markets can only attempt to prevent Climate Change and each emission of CO_2 ratchets up atmospheric CO_2 concentrations to a new level that cannot be reversed. The second lock in is that investments by businesses typically take a 10-20 year timeframe. Once these long-term investment decisions are taken, businesses are extremely keen to avoid prematurely writing off their assets. For example, convincing a utilities company to shut down a 5 year old coal fired power station would be extremely difficult and expensive, as the typical operating life of a coal fired power station is around 40 years (Meinshausen & Hare, 2008). Acknowledging these lock ins is key to the development of CO_2 markets as an effort to mitigate Climate Change. The timeframes of the lock ins often extend beyond the window of opportunity for mitigation of Climate Change and will therefore lock in an outcome that will be extremely difficult to influence.

These temporal aspects of CO_2 market design and operation receive significant interest in the literature (Meinshausen & Hare, 2008; Moser, 2010; Teppo, 2006; Tsoutsos & Stamboulis, 2005; Vaughan et al., 2009), but were not prominent in the six cases. It would appear that the current modes of operation of CO_2 markets will struggle to acknowledge the windows of opportunity and lock ins that will play a significant role in CO_2 markets' success or failure in mitigating Climate Change.

Finally, the discussion now moves on to the role of uncertainty during the design and operation of CO_2 markets.

11.5.3 Uncertainty in CO_2 markets

Uncertainty-based aspects of CO_2 market design and operation are now analysed. This section answers research question 7, which asked *'How are uncertainty-based considerations affecting CO_2 market design and operation?'*. Uncertainty-based aspects of CO_2 market design and operation are now analysed as 'problem uncertainty' and 'cognitive biases'. Problem uncertainty is due to uncertainty regarding the best or most expedient way to cope with the problem that the market is designed to tackle (Ford & Mouzas, 2010). Cognitive biases are frailties embedded in the human learning and decision making process which distort our views of the world and are often subconscious (Bazerman et al., 2001; Bazerman, 2006; Kahneman et al., 1982). In many cases, cognitive biases are triggered or exacerbated by uncertainty and act to impede market design and operation. Uncertainty based aspects of market design and operation are summarised in Table 29 and then analysed in turn.

Problem uncertainty in CO_2 market design and operation relates to uncertainty regarding the best or most expedient way to cope with mitigating Climate Change (Ford & Mouzas, 2010). This problem uncertainty runs to the very core of CO_2 markets. For example, as discussed in section 2.5.3, the United Nations states that CO_2 markets are designed to stabilise CO_2 emissions at a level which prevents dangerous human interference with the climate system (Meze-Hausken, 2008; UNFCCC, 2005). The complexities of modelling Climate Change therefore result in problem uncertainty regarding Climate Change's future affects and the suitable level of CO_2 reductions to target.

Table 29: Uncertainty based aspects of CO_2 markets

	Uncertainty based aspects
Problem uncertainty	- Technical complexities of modelling Climate Change cause uncertainty regarding its future affects. - Future price of CO_2 is inherently uncertain within a market. - Regulatory uncertainty regarding the future developments in CO_2 markets beyond 3-8 year timeframe.
Cognitive biases	- Low availability: CO_2 is invisible, odourless and has no direct health impacts. - Distorted views of others: EU seeks global replacement for Kyoto Protocol before committing to the most stringent version of their 2020 CO_2 reduction target. The USA adopted a historically protectionist stance, refusing to ratify the Kyoto Protocol due to the absence of China and India. The developing world emphasises developed world responsibility for Climate Change as a reason to follow, rather than lead Climate Change mitigation efforts. - Negative framing: United Nations presents Climate Change as a threat at least equivalent to that posed to humanity by war. Leading Climate Change NGOs have names such as 'Stop Climate Chaos.org'.

Furthermore, from the perspective of business participants in CO_2 markets, another type of problem uncertainty is the challenge of building the future price of CO_2 into investment appraisals, these challenges were observed in all of the cases and in the literature (Conejero & Farina, 2003; Levy & Kolk, 2002; Okereke, 2007; Shi et al., 2008; Sutherland, 1991). Firstly, the future price of CO_2 is inherently uncertain within a market. Secondly, in 2010 the timeframes of CO_2 markets extended from between 3-8 years into the future, beyond which there was uncertainty whether the particular market would continue. These timeframes, combined with uncertainty regarding the price of CO_2, meant that CO_2 markets didn't give the certainty required for CO_2 costs to influence businesses' investment decisions.

Cognitive biases during CO_2 market design and operation are now discussed. Cognitive biases are frailties embedded in the human learning and decision making process which distort our views of the world and are often subconscious (Bazerman et al., 2001; Bazerman, 2006; Kahneman et al., 1982). In many cases, cognitive biases are triggered or exacerbated by uncertainty and act to impede market design and operation. Cognitive biases which are proposed as influencing CO_2 market design and operation are the availability heuristic, parochialism, egoism and negative framing. The availability heuristic suggests that people weigh risks by the ease with which examples of resulting harm can be visualised or recalled (Kahneman et al., 1982; Sunstein, 2006; Tversky & Kahneman, 1973). Therefore, the nature of CO_2 as being invisible, odourless and having no direct health impacts means that the low availability of problems caused by Climate Change may be impeding CO_2 market design and operation. The availability heuristic is flagged in the literature as being a cause of the lack of action on Climate Change. The empirical findings are consistent across the United States (Boykoff, 2008; Jamieson, 1991, 2006; Kellstedt et al., 2008); the European Union (Dunlap & Saad, 2001; Hersch & Viscusi, 2006; Poortinga & Pidgeon, 2003); and the developed world as a whole (Leiserowitz, 2006; Lorenzoni & Pidgeon, 2006; Oreskes, 2004). The availability heuristic could be part of the explanation that in all case studies the CO_2 markets were led by regulators, rather than by pressure from end customers and consumers.

The cognitive biases of parochialism and egoism lead to distorted views of others, affecting CO_2 market design and operation. Parochialism is a cognitive bias which leads actors to favour their group at the expense of outsiders (Baron, 2006; Schwartz-Shea & Simmons, 1991). Egoism is a cognitive bias which leads actors to prioritise their self interest over that of the wider range of stakeholders (Bazerman, 2006; Farber & Bazerman, 1987; Markovits, 2004). In the examination of negotiations to extend the Kyoto Protocol in case one, the descriptions given by the European Union, the United States of America and the developing world showed biases of parochialism and egoism. The European Union set two levels of target for CO_2 savings by 2020 and was only prepared to accept the more stringent target if a global replacement to the Kyoto Protocol was agreed. Furthermore, the United States of America had historically taken a protectionist stance that emphasised the potential of CO_2 markets to damage the economy. During the original negotiations over phase I of the Kyoto Protocol, the United States focussed upon India and China's failure to ratify the Kyoto Protocol as a reason not to ratify it themselves. This was despite the consideration that the United States was the largest emitter of CO_2 in the world. Furthermore, the developing world emphasised developed world responsibility for Climate Change as a reason to follow, rather than lead CO_2 reduction efforts. Even though all parties acknowledged the basic science that Climate Change is cheaper to mitigate than to adapt to, the cognitive biases of parochialism and egoism have been found to be impeding the design and operation of CO_2 markets.

Finally, the cognitive bias of negative framing is an important aspect of CO_2 market design and operation in a number of ways (Bazerman, 1984; Kahneman & Tversky, 1979; Tversky & Kahneman, 1986). Negative framing of decisions, regarding losses, prompts risk-seeking behaviour that avoids, rather than tackles, the issues at hand (Kahneman & Tversky, 1979). One example of negative framing in the case of CO_2 markets is the presentation of the United Nations of Climate Change as a threat at least equivalent to that posed to humanity by war. A second example is that leading Climate Change Non-Governmental Organisations have names such as 'Stop Climate Chaos.org' and 'Climate Crisis.net'. These negative frames impede CO_2 market design and operation, by encouraging participants to disengage from the CO_2 markets and manage them as a threat rather than as an opportunity.

Having examined the macro-level aspects of CO_2 market design and operation, the chapter now closes with a brief conclusion. The discussion then moves on to the conclusions and implications of the research in chapter twelve.

11.6 Summary

This chapter has confronted the six case studies with the conceptual framework for the study of market design and operation that was proposed at the end of the literature review. The first section reviewed the research questions posed. The second section presented the actors involved during CO_2 market design and operation. The third and fourth sections then analysed the network and macro-level aspects of CO_2 market design and operation. The discussion now moves on to examine the conclusions and implications of the research.

CHAPTER 12:

CONCLUSIONS AND IMPLICATIONS

12 CONCLUSIONS AND IMPLICATIONS

12.1 Introduction

This chapter discusses the conclusions and implications that can be drawn from the research presented in this dissertation. Section 12.2 provides a summary of the findings of the research. Section 12.3 discusses the theoretical contributions and implications of the research. The policy implications of the research are discussed in section 12.4. Managerial implications of the research are then discussed in section 12.5. Finally, section 12.6 reviews the limitations of the research and proposes some directions for future research.

12.2 Summary of findings: The failure of CO_2 markets to significantly influence businesses' behaviour

This section provides a summary of the findings of the present research. These findings explain why CO_2 markets have failed to significantly influence businesses' behaviour. The findings are based upon an examination of the design of CO_2 markets, as compared to their actual operation. The discussion in this section is structured using the proposed conceptual framework for the study of CO_2 market design and operation that can be found in Figure 4 on page 73. Network-level aspects of CO_2 markets were examined as exchange, representational and normalising practices, plus the translations which link them (Kjellberg & Helgesson, 2007a). Macro-level aspects of CO_2 markets were examined as technical, temporal and uncertainty based considerations. The remainder of this section summarises the research findings, following the structure and content of Figure 28.

Figure 28: CO_2 market design and operation- summary of findings

			CO_2 market regulators:		CO_2 market participants:
NETWORK-LEVEL ASPECTS	Exchange	Interests	- Absolute CO_2 emission reductions at least cost to society	vs.	- Profit maximisation - Managing reputational impacts - Achieving regulatory compliance
		Measurements	- Absolute cost of CO_2 (\$/t, €/t or £/t)	vs.	- Relative costs of CO_2 as a percentage of energy expenditure
	Representational	Results	- Kyoto Protocol: ~\$20/t CO_2 - EU ETS: ~€2 - /€15 t CO_2 - CRC: £12/t CO_2	vs.	- Kyoto Protocol: n/a to businesses - EU ETS: ~0.15 - 1.5% of energy costs - CRC: ~0.8% of energy costs
		Descriptions	- CO_2 as a strategic concern - CO_2 price incentivises capital efficient emission reductions	vs.	- CO_2 market as a compliance scheme - Low CO_2 costs as insufficient to drive strategic decisions
	Normalising	Rules & tools	- Rules and tools for participation, permit allocation, CO_2 reporting & trading, audits and penalties	vs.	- Obligations to maximise profit - Regulatory compliance is mandatory - Policies prohibiting speculation
		Measures & methods of measurement	- CO_2 price: \$, €, £ / t CO_2 - CO_2 volume: Standard CO_2 conversion factors for fuels	vs.	- Relative cost as % of energy expenditure - Reputational impacts
MACRO-LEVEL ASPECTS	Technical	Technological	- CO_2 emissions widely dispersed across economy and society - Heavy manufacturing processes inherently energy and CO_2 intensive - Lack of knowledge of CO_2 reduction opportunities - Lack of expertise for converting energy data into equivalent CO_2 emissions		
		Public goods & resource limits	- CO_2 is free to move within the atmosphere - Isolated local efforts to reduce CO_2 emissions are insufficient		
	Temporal	Windows of opportunity	- 20-30 year window of opportunity for the mitigation of Climate Change		
		Lock ins	- 50 year atmospheric lifespan of CO_2 means that CO_2 levels are cumulative and irreversible in short to medium-term timeframes - Large capital investments of businesses taking a 10-20 year timeframe		
	Uncertainty-based	Problem uncertainty	- Complexities of climate modelling cause uncertainty regarding future affects - Future price of CO_2 is inherently uncertain within a market - Regulatory uncertainty as to the future of CO_2 markets in 3-8 year timeframes		
		Cognitive biases	- Low availability: CO_2 is invisible, odourless and has no direct health impacts - Parochialism and egoism: Distorted views of others, e.g. USA's refusal to ratify the Kyoto Protocol unless China and India do too - Negative framing: United Nations presents Climate Change as a threat at least equivalent to that posed to humanity by war. Leading Climate Change NGOs named 'Stop Climate Chaos.org' or 'Climate Crisis.net'		

NB: EU ETS = European Emissions Trading Scheme CRC= Carbon Reduction Commitment

Exchange practices relate to the economic exchanges taking place within the market and their supporting activities. Exchange based aspects of markets were captured by translations of 'interests' and 'measurements'. Interests are stakes, or involvement in an undertaking, which drive exchange practices and inform efforts to influence a market's representational and normalising practices. This research identified conflict between the interests of CO_2 market regulators and participants. The primary interest of regulators was to achieve absolute reductions in CO_2 emissions at the least cost to society. In contrast, business participants in CO_2 markets saw their interests as being to maximise profit, manage the reputational impact of CO_2 markets and achieve CO_2 market compliance. These differences in interests became embedded in the measurements of CO_2 markets, which are now discussed. Measurements are descriptions of exchange which influence how actors see the market and respond to it. Regulators' measurements of CO_2 markets were found to be the absolute cost of CO_2 in $/tonne for the Kyoto Protocol, €/tonne for the European Emissions Trading Scheme and £/tonne for the United Kingdom's Carbon Reduction Commitment. Regulators' measurement of absolute CO_2 costs were aligned with their interests in achieving CO_2 reductions at the least cost to society. In contrast, business participants measured CO_2 costs as a percentage of their annual energy expenditure, with the result that businesses did not recognise CO_2 markets as a strategic concern. The reasons for this are explored below, in a discussion of findings which relate to representational aspects of CO_2 markets.

Representational practices aim to depict markets and how they work. Representational practices were captured by translations of 'results' and 'descriptions'. The results of measurements drive exchange practices by influencing how actors view the outcome of their exchanges. This research found that the results of regulators' measurements of

CO_2 markets were ~\$20/tonne CO_2 for the Kyoto Protocol, ~€2-15/tonne CO_2 in phases I and II of the European Emissions Trading Scheme, an unknown future price within phase III of the European Emissions Trading Scheme and £12/tonne CO_2 in phase I of the Carbon Reduction Commitment. In contrast, the results described by businesses expressed CO_2 costs relative to energy expenditure. Businesses' results were CO_2 costs of ~0.15% and ~1.1% of energy expenditure in phases I and II of the European Emissions Trading Scheme, an unknown percentage in the future phase III of the European Emissions Trading Scheme and 0.77% of energy expenditure in phase I of the Carbon Reduction Commitment. These results influenced descriptions of CO_2 markets in a number of ways. Descriptions drive normalising practices by informing participants' representations of markets. Regulators described CO_2 markets as introducing a price for CO_2 emissions which incentivised capital efficient CO_2 reductions and made CO_2 a strategic concern for businesses. In contrast, businesses described CO_2 costs as being insufficient to drive strategic decisions. CO_2 markets were described by businesses as a risk management and compliance issue. The following section now discusses the affects of these representations upon the normalising practices of CO_2 markets.

Normalising aspects of markets were captured by translations of 'rules and tools' and 'measures and methods of measurement'. Rules and tools are used to perform and influence exchange practices. The rules and tools set by regulators determined: which organisations should participate in CO_2 markets, how CO_2 permits were allocated, how CO_2 emissions were reported and traded, how participants' compliance was verified and enforced, and the fines incurred for noncompliance. Although businesses acknowledged and complied with the regulator's rules, these rules did not drive businesses' decisions. Businesses' responses treated CO_2 markets as a compliance issue and prioritised profit maximisation as the overarching rule. Furthermore, there were often corporate policies in place which prohibited speculation in non-core business activities. These anti-speculation policies forced businesses to simply buy the CO_2 permits required for compliance and undermined the intended operation of CO_2 markets. The second element of normalising practices in markets is measures and methods of measurement. Measures and methods of measurement influence representational practices by setting what aspects of markets are measured and how measurements are made. Measures and methods of measurement employed by regulators related to the CO_2 prices and volumes which market participants had to account for. In all CO_2 markets, except the practice phase of the Carbon Reduction Commitment, the CO_2 price was set by a market. The CO_2 volumes to be accounted for were calculated using each participant's energy consumption, plus the regulator's conversion factors which defined the CO_2 content of each fuel. Businesses acknowledged the measures and methods of measurement imposed by the regulator and calculated the relevant CO_2 prices and volumes. However, businesses' responses to CO_2 markets were primarily driven by measures which revealed CO_2 costs to represent a very low percentage of energy expenditure, plus measures of the reputational impacts of CO_2 markets. These measures meant that CO_2 markets failed to significantly influence businesses' behaviours and that businesses responded to CO_2 markets in the mode of compliance and risk management.

The previous discussion gave an overview of the network-level aspects of CO_2 markets that were identified by this research. The discussion now turns to an examination of findings which relate to macro-level aspects of CO_2 markets. Macro-level aspects of

CO_2 markets were examined as technical, temporal and uncertainty based considerations, each of which is now discussed.

Technical aspects of CO_2 markets are proposed as 'technological' considerations and those due to 'public goods and resource limits'. Technological aspects are immutable physical laws, or the limits of today's knowledge and capabilities. The first technological consideration is that CO_2 is a widely dispersed pollutant, having sources across many parts of the economy and society. The dispersed nature of CO_2 emissions was reflected by the broad coverage of CO_2 markets across industries ranging from aluminium production, the retail sector and electricity production. This dispersed nature of CO_2 emissions means there is no simple target for CO_2 reductions. Furthermore, many heavy manufacturing processes are inherently energy and CO_2 intensive and there are few substitutes for these processes. In addition, expertise regarding CO_2 reduction opportunities was often found to be weak inside organisations, reducing the ability of businesses to respond proactively to CO_2 markets. Technological considerations were also found to be impeding businesses' CO_2 reporting. The expertise required to convert raw energy data into equivalent CO_2 emissions was often unavailable in-house and many businesses initially lacked the data systems and records required for CO_2 reporting. The second category of technical aspects relates to environmental constraints upon CO_2 markets. Public goods were found to be important aspects of CO_2 markets, since any actor can release CO_2 into the atmosphere and doing so does not stop another from doing the same. Resource limits were important, due to the finite nature of the atmosphere and its inability to absorb increasing rates of CO_2 emissions. Regulators acknowledged CO_2 as a public good and the atmosphere as a scarce resource. Considerations of public goods and scarce resources were the drivers behind regulators' efforts to create and subsequently extend the coverage of the global CO_2 market of the Kyoto Protocol.

Temporal aspects were examined as 'windows of opportunity' and 'lock ins'. Windows of opportunity result from the consideration that markets are often responding to a problem or need which can only be met within a certain timeframe. In the case of CO_2 markets, projections of 'business as usual' growth in CO_2 emissions will lead to dangerous atmospheric levels of CO_2 within the next 20-30 years. Therefore CO_2 markets are subject to a 20-30 year window of opportunity within which to incentivise businesses to reduce their CO_2 emissions. This research emphasises that the development of CO_2 markets is a time bound challenge that is not open ended. This window of opportunity is not often discussed in other treatments of CO_2 markets, despite it being key to CO_2 markets' success or failure to mitigate Climate Change. The second temporal aspect relates to decisions which have long-term impacts due to the lock ins which they create. Lock ins are decisions which have an extended and irreversible impact. One lock in for CO_2 markets is the 50 year atmospheric lifespan of CO_2. This atmospheric lifespan makes CO_2 emissions cumulative and effectively irreversible when viewed within the 20-30 year window of opportunity for the mitigation of Climate Change. This lock in, due to the atmospheric lifespan of CO_2 emissions, removes the opportunity for CO_2 markets to reverse Climate Change. CO_2 markets can only mitigate Climate Change and each emission of CO_2 ratchets up atmospheric CO_2 concentrations to a new level that cannot be reversed. The second lock in is that CO_2 intensive capital investments typically take a 10-20 year timeframe. Once these long-term investment decisions are taken, businesses are keen to avoid writing off their assets prematurely. For example, convincing a utilities company to shut down a 5 year old coal fired power station would either be extremely difficult, or expensive. These temporal aspects of CO_2 markets mean that decisions taken today will have a significant impact on the outcome of the Climate Change mitigation efforts embodied by CO_2 markets. This research highlights that it is important to acknowledge windows of opportunity and lock ins during the design and operation of CO_2 markets, since these temporal aspects threaten to undermine the ability of CO_2 markets to mitigate Climate Change.

Uncertainty based aspects of CO_2 markets were examined through 'problem uncertainty' and 'cognitive biases'. Problem uncertainty relates to uncertainty as to the best way to cope with the problem that a market is designed to tackle. The study has examined the United Nations' statement that CO_2 markets are designed to stabilise CO_2 emissions at a level that prevents dangerous human interference with the climate system. The United Nation's approach faces uncertainty regarding the future affects of Climate Change, plus the uncertainty of a subjective judgement on the definition of 'dangerous human interference'. In addition, the inherently variable price of CO_2 is another type of problem uncertainty in CO_2 markets. Furthermore, there is also uncertainty regarding the political longevity of CO_2 markets. In 2010, regulators had failed to guarantee each CO_2 market's operation beyond 3-8 years into the future. The uncertainty surrounding the level and longevity of CO_2 costs was found in all cases to be hampering businesses' efforts to factor CO_2 costs into their investment decisions. The second uncertainty based aspect of CO_2 markets presented by this research is cognitive biases that distort our views of the world and are often subconscious. In many cases, cognitive biases are triggered or exacerbated by uncertainty and can act to impede market design and operation. Cognitive biases which were found to be influencing CO_2 market design and operation were the availability heuristic, parochialism, egoism and negative framing. The availability heuristic suggests that people weigh risks by the ease with which examples of resulting harm can be visualised or recalled. The low availability of problems caused by Climate Change may be impeding CO_2 market design and operation. This low availability is due to the nature of CO_2 as being invisible, odourless and having no direct health impacts. Furthermore, the cognitive biases of parochialism and egoism lead to distorted views of others, affecting CO_2 market design and operation. One example of the action of parochialism and egoism is the United States' refusal to ratify the Kyoto Protocol, due to it not including India or China. This was despite considerations that the United States was the largest emitter of CO_2 in the world and that Climate Change is cheaper to mitigate than to adapt to. Finally, the cognitive bias of negative framing was an important consideration during CO_2 market design and operation. Negative framing of decisions prompts risk-seeking behaviour that avoids the issue under discussion. Examples of negative framing relating to CO_2 markets were the presentation by the United Nations of Climate Change as a threat at least equivalent to that posed by war, and the names of Climate Change Non-Governmental Organisations, such as 'Stop Climate Chaos.org' and 'Climate Crisis.net'. It is argued that these negative frames encourage businesses to disengage from CO_2 markets and manage them as a threat, rather than an opportunity.

This section has provided an overview of the findings of the research, discussing why CO_2 markets have failed to significantly influence businesses' behaviour. The next section discusses the research's theoretical implications.

12.3 Theoretical implications for CO_2 market design

The primary theoretical contribution of this research has been to challenge traditional theories which underpin the design of CO_2 markets. These challenges arise from examinations of the actual operation of CO_2 markets, which show that CO_2 markets have so far failed to significantly influence businesses' behaviour. As such, this research raises doubts regarding the efficacy of CO_2 markets as a method of mitigating Climate Change. This section first reviews the traditional theoretical underpinnings of CO_2 market design. Next, the influence of a practice based perspective upon the present research is discussed. This leads into the location of the present research within an emerging body of work that challenges traditional theories of CO_2 market design. Finally, network-level and macro-level theoretical implications for CO_2 market design and operation are discussed.

The present research has shown that existing theories which are used to explain the design of CO_2 markets provide only a restricted understanding of the real world operation of CO_2 markets. Examples of such existing theories of CO_2 market design and operation can be found in the work of Barrett (2007), Bebbington and Larrinaga-Gonzalez (2008), Coase (1960; 1988), Cornes and Sandler (1986), Dales (1968), Demsetz (1966), Groves and Ledyard (1977), Hardin (1968), Kolk et al. (2008), Lohmann (2009), MacKenzie (2009), Olson (1965), and Stern (2006). A typical theoretical explanation of CO_2 markets focuses upon externalities, property rights, incentives and their economic design, for example: *'Facilities with high abatement costs buy pollution rights from facilities with lower abatement costs, saving themselves money. Facilities for whom reductions come cheaper could meanwhile make money by cutting pollution and selling the unused pollution rights they were thus enabled to stockpile. The system would reward both sellers and buyers* *and result in reductions being made where they were least expensive."* (Lohmann, 2009: 504). The present research challenges such economic theories which underpin CO_2 market design. While it is acknowledged that the economic reasoning behind the design of CO_2 markets is logically sound, the present research has shown that this economic logic is failing to translate into successful real world application. These challenges to theories of CO_2 market design were developed through the adoption of a practice based perspective that emphasised the examination of the actual operation of CO_2 markets.

The practice based perspective adopted by this research views CO_2 markets as networks of actors that are engaged in exchange, representational and normalising practices (Hagberg & Kjellberg, 2010; Kjellberg & Helgesson, 2006, 2007b, 2007a). This practice based perspective is useful because it advocates the description of real life practices in CO_2 markets as a means of providing insight into the efficacy of CO_2 market designs. The descriptions by this research of CO_2 markets in operation, or 'in vivo' as Callon refers to them (2009), provide a rich view of the challenges faced by CO_2 market designers. The six case studies developed by this research illustrate in detail how CO_2 markets are operating in the real world, as summarised in section 12.2, providing a contribution to knowledge by answering contemporary calls for more accurate descriptions of what is actually happening in CO_2 markets: *"Carbon markets are an exceptional field for furthering our understanding of the ... forms of ... economic, political and scientific activities [that constitute the market], their mutual relations and the challenges they are designed to meet"* (Callon, 2009: 546). As such, the case studies provided by this research aim to help answer a call to reconnect markets and marketing, providing a new perspective on CO_2 market design (Araujo, 2007; Araujo et al., 2010; Kjellberg & Helgesson, 2007a).

This research contributes to a body of literature that challenges traditional theories of CO_2 market design, by identifying a number of significant failures of CO_2 markets to influence business behaviour (Engels, 2009; Spash, 2010). Engels presents a case study showing that some companies ignored the European Emissions Trading Scheme all through the mandatory 2 year practice phase and entered phase II of the scheme with no strategy or structures in place to make decisions regarding CO_2 trading. These observations are consistent with the conclusion that: *"the reality of [CO_2] market operation is far removed from the assumptions of economic theory and the promise of saving resources by efficiently allocating emission reductions"* (Spash, 2010: 169). The findings of the present research provide further insights on the challenges faced by CO_2 markets.

The research was guided by the development of a conceptual framework for the study of CO_2 market design and operation which is shown in Figure 4 on page 73. This conceptual framework also provides the structure for the summary of research findings which is given in Figure 28 on page 318. The proposed conceptual framework for the study of CO_2 markets is based upon network-level and macro-level aspects of CO_2 market design and operation.

Network-level aspects of CO_2 market design and operation were captured by exchange, representational and normalising practices, plus the translations which link them. The network-level aspects of CO_2 markets discussed in this research build upon work by Kjellberg and Helgesson (2006; 2007b; 2007a). This approach was useful, as it offered a wider perspective of CO_2 markets than the narrow economic focus which is typically adopted. While economic aspects of CO_2 markets were found to be important, the examination of representational and normalising practices in CO_2 markets also delivered significant explanatory insights. Furthermore, the examination of the translations which linked the market practices provided a way of examining how the different practices influenced each other. Exchange based aspects of CO_2 markets are discussed throughout this section, as they correspond to the traditional theories of CO_2 markets. Theoretical implications of representational and normalising aspects of CO_2 markets are now discussed below.

Representational implications of this research arise from the finding that businesses do not share the regulators' representations of CO_2 markets. Regulators represent CO_2 markets as introducing a price for CO_2 emissions which incentivises capital efficient CO_2 reductions, making CO_2 a strategic concern. However, the present research has shown that results of businesses' measurements of CO_2 markets were CO_2 costs representing around 1% of annual energy costs. Businesses described CO_2 markets as introducing costs that were insufficient to drive strategic decisions. CO_2 markets were therefore described primarily as a risk management and compliance issue. These findings are aligned with theoretical findings that representations are not uniform or stable and that there are multiple versions of markets, due to different representations developed by different actors (Finch, 2007; Ford et al., 2003; Henneberg et al., 2006; Leek & Mason, 2010; Weick, 1993, 1995). Regulators and other CO_2 market designers must take into account that representations *"have a certain normative power"* (Henneberg et al., 2010: 358). CO_2 markets will not achieve their objective of incentivising reduced business CO_2 emissions before businesses have been convinced to change their representations of CO_2 markets.

Normalising aspects of CO_2 markets were also found to be important in explaining the operation of CO_2 markets. Regulators and other CO_2 market designers have defined detailed rules and tools which were designed to deliver CO_2 reductions at the least cost to society. However, within the business community these rules were subordinated to the over arching rule of profit maximisation as the driver of decision making. No businesses broke the rules of the CO_2 markets. Yet the CO_2 market objectives of Climate Change mitigation were not met, as the costs introduced by CO_2 markets were too low to significantly affect profits. These low costs meant that businesses saw no need to engage CO_2 markets on any level other than compliance and risk management. This research shows that examinations of CO_2 market design and operation should acknowledge the normalising aspects of CO_2 markets (Kjellberg & Helgesson, 2006; 2007b; 2007a), which are also called market constitution by Mouzas and Ford (2009). This is because the economic logic underpinning CO_2 market designs is currently being overridden by the rules which guide the decision making of profit seeking public companies.

Macro-level aspects of CO_2 markets are now discussed. This research highlights that attempts to improve upon current CO_2 market design and operation will need to acknowledge technical, temporal and uncertainty based aspects of CO_2 markets.

Technical aspects of CO_2 markets have been identified in this research as technological aspects and considerations relating to public goods and resource limits. There is a well developed literature which explores the technological challenges faced by CO_2 markets. For example, the technological challenges of accurately determining and reflecting the cost of environmental damage caused by CO_2 and other pollutants (Bond & Houston, 2003; Engels, 2005; Watts et al., 1999). Furthermore, other researchers have provided examples of the types of technological challenges which prevent the development of new technologies such as renewable electricity generation (Teppo, 2006; Tsoutsos &

Stamboulis, 2005; Walawalkar et al., 2007), cars powered by Liquid Petroleum Gas (Steenberghen & Lopez, 2008) and lower CO_2 technologies in general (Okereke, 2007; Shi et al., 2008). The other type of technical challenge faced by CO_2 markets relates to the elimination of externalities and the challenges of providing public goods (Barrett, 2007; Coase, 1960, 1988; Cornes & Sandler, 1986; Dales, 1968; Demsetz, 1966; Groves & Ledyard, 1977; Hardin, 1968; Olson, 1965; Peattie & Ratnayaka, 1992). These theories are at the core of the current design of CO_2 markets and were discussed by this research for completeness as they are still important considerations during CO_2 market design and operation.

Temporal aspects of CO_2 markets have been identified in this research as windows of opportunity and lock ins. CO_2 markets are subject to a 20-30 year window of opportunity within which to incentivise businesses to reduce their CO_2 emissions. The important consideration is that two lock ins which affect CO_2 markets are of comparable timeframes. CO_2 has an atmospheric lifespan of around 50 years and CO_2 intensive investments by businesses typically take a 10-20 year timeframe. As such, this research highlights that changes are required in the design and operation of CO_2 markets, in order to acknowledge the windows of opportunities and lock ins which threaten to undermine the ability of CO_2 markets to mitigate Climate Change. This makes Climate Change mitigation through CO_2 markets effectively a 'one shot' challenge. Theoretical developments of CO_2 market design must acknowledge that decisions taken in the next 5-10 years will most likely lock us into the final outcome of efforts to mitigate Climate Change.

Uncertainty-based aspects of CO_2 markets have been identified in this research as problem uncertainty and cognitive biases. Problem uncertainty has impeded the development of CO_2 markets due to uncertainty regarding the future affects of Climate Change, price uncertainty that is inherent in a market based approach and regulatory uncertainty whereby current CO_2 markets are only fixed in law for the next 3-8 years. These uncertainties make CO_2 difficult to build into businesses' economic decisions and also contribute to the action of a number of cognitive biases which bias and skew decision making processes, further impeding the development of CO_2 markets (Baron, 2006; Farber & Bazerman, 1987; Hopwood, 2009; Kahneman & Tversky, 1979; Kahneman et al., 1982; Schwartz-Shea & Simmons, 1991; Sunstein, 2006; Tversky & Kahneman, 1973).

Certain elements of CO_2 market design and operation which are discussed above may seem alien to business research. For example, public goods and resource limits sound more like environmental concerns than issues for business. However, the research community is starting to recognise that such issues are central to businesses' long-term sustainability. These developments in research agenda are observable in recent and upcoming special issues on Climate Change and Sustainability. The first example is a 2009 special issue on 'Accounting and Carbon Markets' in the journal of 'Accounting, Organizations and Society' (Braun, 2009; Callon, 2009; Cook, 2009; Engels, 2009; Hopwood, 2009; Lohmann, 2009; MacKenzie, 2009). The second example is an upcoming special issue in the 'Journal of Management Studies' on 'The Foundations of Sustainability' (Floyd et al., Forthcoming). Furthermore, there is also an upcoming special issue in 'Organization Studies' on 'Climate Change and the Emergence of New Organizational Landscapes' (Wittneben et al., forthcoming). The research presented in this dissertation has contributed to these new developments by showing that CO_2 market design and operation is best understood when viewed as a challenge that not only encompasses economic aspects, but also representational, normalising, technical, temporal and uncertainty based considerations. Furthermore, this research has shown that the championed benefits of CO_2 markets, namely capital efficiency through market flexibility, are not being achieved by current CO_2 markets and may not even represent the most important concerns with regards to Climate Change mitigation. This research supports the argument that a CO_2 tax would bring more benefits in terms of certainty than would be lost in terms of market efficiency, especially when the desired market efficiency has not been achieved in the real world operation of CO_2 markets (Wittneben, 2009). An argument could also be made for a CO_2 tax to be supported by mandated targets for CO_2 performance that would acknowledge the short window of opportunity for Climate Change mitigation and the need to avoid lock ins caused by decisions taken today (Apaiwongse, 1993). Furthermore, it has been shown that a more balanced perspective on CO_2 market design is required. Current theoretical underpinnings of CO_2 market designs portray the regulator as being the primary, perhaps the only, decision maker. It is recommended that future work on CO_2 markets acknowledges the interdependence of regulators upon market participants and vice versa, for example, by acknowledging the insights of the Industrial Marketing and Purchasing (IMP) Group who would argue that regulators cannot assume the role of arranging the incentives faced by passive CO_2 market participants. (Håkansson & Johanson, 1992; Håkansson & Snehota, 1995; Håkansson & Ford, 2002; Håkansson et al., 2009). Finally, the division between CO_2 market design and operation adopted by this research was used to highlight that CO_2 markets have a life beyond the drawing board. This is where the practice based perspective has demonstrated the need to take an empirical view of what is happening to CO_2 markets in the real world. It is argued that this approach could further help to bridge the gap between CO_2 market design and operation, while at the same time answering calls to reconnect markets and marketing, providing a new perspective on CO_2 market design (Araujo, 2007; Araujo et al., 2010; Kjellberg & Helgesson, 2007a).

Having discussed the theoretical implications of this research, the following section discusses the research's policy implications.

12.4 Policy implications: CO_2 markets versus CO_2 taxes or mandates

This section examines the policy implications of the present research. The discussion challenges the efficacy of a market based response to Climate Change by comparing it with the alternatives of CO_2 taxes or mandates.

The traditional justifications for the preference of CO_2 markets over taxes or mandates are summarised in Table 30. CO_2 markets are typically presented as the most suitable policy measure for Climate Change mitigation for two reasons. Firstly, CO_2 markets offer the theoretical potential to minimise the costs borne by industry during Climate Change mitigation efforts. Secondly, the design of CO_2 markets allows regulators to set quantifiable targets for CO_2 reductions from the outset (DEFRA, 2007; MacKenzie, 2009).

In contrast, a tax on CO_2 can neither minimise the costs borne by industry, nor fix a target level of CO_2 reductions. A mandate can fix a CO_2 reduction target, but still fails to minimise the costs borne by industry. The ability of CO_2 markets to achieve cost efficiency and enable target setting are the standard explanations as to why CO_2 markets are the most suitable policy response to Climate Change. These ideas were discussed in more detail in section 4.6. Accordingly, CO_2 markets have been defined as *"markets in permits to emit CO_2 gases or in credits earned by not emitting them"* (MacKenzie, 2009: 440). The previous definition leaves implicit that the ability of the regulator to set targeted CO_2 reductions arises from their control over the number of CO_2 permits which are allocated each year.

Table 30: Traditional justification for design of CO_2 markets

(summarised version of Table 8 on page 130)

	Cost borne by industry	Tonnes CO_2 saved
1) TAX	> min possible	cannot be predicted
2) MANDATE	> min possible	fixed by regulation
3) CO_2 MARKET	min possible	fixed by regulation

The present research's examination of CO_2 markets challenges the conventional CO_2 market designs discussed above in two ways. Firstly, the examination of network-level aspects of CO_2 markets has shown that they are not yet significantly influencing the decisions of CO_2 market participants. As such, CO_2 markets are failing to deliver CO_2 reductions, meaning that ambitions to minimise the costs borne by industry and to set CO_2 reduction targets at the outset are undermined. Secondly, the examination of macro-level aspects of CO_2 markets has exposed significant weaknesses which relate to the influences of time and uncertainty. These challenges are summarised in Table 31, which revises Table 30. The findings presented in Table 31 are discussed below, where

CO_2 markets are again compared to their alternatives of a tax or mandate, but in light of the findings of this research.

Table 31: CO_2 markets in practice

(Revised version of Table 8 and Table 30 in light of findings of present research)

	Cost borne by industry	Tonnes CO_2 saved	Time	Uncertainty
1) TAX	**> min possible**	**cannot be predicted**	Fast	Low
2) MANDATE	**> min possible**	**fixed by regulation**	Fast	Low
3) CO_2 MARKET	**> min possible (in practice)**	**cannot be predicted (in practice)**	Slow	**High**

Reference to columns two and three in Table 31 shows that the present research has challenged the ability of CO_2 markets to minimise the costs borne by industry and to set targeted CO_2 emission reductions from the outset. CO_2 markets have so far failed to significantly influence businesses' behaviour. For example, businesses do not recognise the costs introduced by CO_2 markets as material. At 2010 prices, CO_2 costs represented approximately 0.5% to just over 1% of the annual energy expenditure of CO_2 market participants. Accordingly, it was found that businesses' interactions with CO_2 markets were driven by risk management and compliance concerns. Furthermore, large businesses often have corporate policies which prohibit speculation on non core business activities. To a certain extent, these policies prohibit the possibility of businesses making CO_2 reductions beyond what is required for compliance and selling the surplus into the CO_2 market. The low costs of CO_2 when compared to energy costs and businesses' anti-speculation policies provide significant challenges to the intended capital efficiency of CO_2 markets through market mechanisms. These findings have influenced the scoring of the first two columns in Table 31. Taking just these two columns into account, in light of the present research, CO_2 markets are joint with taxes as the least attractive policy measures for Climate Change mitigation. Mandates are more attractive, due to their ability to target specific levels of CO_2 reduction from the outset. As such, the present research has shown that the prioritisation of CO_2 markets due to their theoretical capability to minimise the costs borne by industry and to set targets upfront cannot be justified by the present examination of CO_2 markets in operation. In addition, as discussed below, an examination of macro-level aspects of CO_2 market design and operation raises further concerns regarding the prioritisation of CO_2 markets over the alternatives of taxes or mandates.

Reference to the last two columns in Table 31 shows that temporal and uncertainty-based considerations provide further challenges regarding the efficacy of CO_2 markets in mitigating Climate Change. This research has shown that that the temporal and uncertainty-based aspects of CO_2 markets are important factors for Climate Change policy. In terms of time, it was discussed in section 12.2 how policies designed to mitigate Climate Change must take into account the 20-30 year window of opportunity within which Climate Change mitigation is possible; plus lock ins due to the 50 year atmospheric lifespan of CO_2 and typical business investment timeframes of 10-20 years. In other words CO_2 markets face a tight window of opportunity within which to influence business decisions and decisions taken today may lock us into outcomes which are hard to undo later. CO_2 markets are relatively slow when compared to taxes or mandates, because CO_2 markets introduce incentives which follow a complex chain of events before an incentive is realised. This chain of events runs through target setting, market development and CO_2 trading before a business sees an incentive to change their behaviour. In contrast, a mandated reduction, such as to match the United Kingdom's ambition to cut CO_2 emissions by 80% by 2050, can be implemented immediately, as can a CO_2 tax of £50 per tonne CO_2 for example. It is for these reasons that CO_2 markets are ranked below taxes and mandates in terms of their ability to respond to Climate Change mitigation within the timeframes required. Furthermore, this research has shown that uncertainty-based aspects of CO_2 market design and operation have important implications for Climate Change policy. As discussed in section 12.2, regulators' 3-8 year timeframes for CO_2 markets were not long enough to influence businesses' investment decisions, which typically take a 10-20 year timeframe. This long-term uncertainty regarding the future of CO_2 markets was further compounded by the uncertainty built into a market based approach to CO_2 regulation. Businesses struggled to recognise future costs of CO_2 in their investment appraisals, since the market price of CO_2 is inherently unpredictable. Uncertainty was found to be high in CO_2 markets, while a mandate gives certainty regarding the target which must be hit and a tax gives price certainty for CO_2 emissions. Because of this, a CO_2 tax and mandate were shown in Table 31 to be associated with less uncertainty than a CO_2 market. Again, these findings suggest that a tax or a mandate may be better placed than a CO_2 market to foster efforts to mitigate Climate Change.

The present research highlights significant policy implications by questioning the near universal reliance upon CO_2 markets as the primary policy mechanism for mitigating Climate Change. These research findings have acknowledged how CO_2 markets are operating in practice and have examined the challenges of cost minimisation, target setting, meeting the short timeframes of Climate Change mitigation and the need to avoid uncertainty, as summarised in Table 31. At an incremental level, if Climate Change mitigation efforts continue to prioritise a market based policy response, then future policies will need to tackle the challenges of low CO_2 prices, corporate policies banning speculation and macro-level aspects of time and uncertainty. At a more fundamental level, this research challenges the rationale that is traditionally used to justify a market based response to Climate Change mitigation. This research concludes that, in order of preference, mandated CO_2 reductions may be the best placed policy mechanism to deal with Climate Change mitigation, followed next by CO_2 taxes and finally by CO_2 markets. These conclusions are of relevance to the upcoming replacement of the CO_2 market of the Kyoto Protocol in 2012 and decisions by national governments as to how to regulate for Climate Change mitigation. Having discussed the policy implications of the research, the following section examines the managerial implications of the research.

12.5 Managerial implications

This research has attempted to achieve high standards of academic rigour, while maintaining relevance to the practitioner community. This balance of objectives has been managed in two ways. Firstly, the researcher has attempted to maintain a highly empirical approach to the research, describing what was happening, rather than what should, or could, have been happening. This ought to mean that the empirical findings are recognisable and relevant to practitioners. Secondly, the proposed conceptual framework, shown in Figure 4 on page 73, gives practitioners a checklist which is intended to be a form of shorthand for the range of concepts and empirical examples which were discussed in the research. It is hoped that the comprehensive nature of the conceptual framework will help practitioners to develop more complete analyses of CO_2

market design and operation than would otherwise have been achieved. The insights as to the challenges currently faced by CO_2 markets are now presented for CO_2 market participants.

From the point of view of businesses, CO_2 markets represent an emerging regime which is currently closest to a compliance type of activity. At 2010 prices, CO_2 costs represented approximately 0.5% to just over 1% of annual energy expenditure. So CO_2 markets are not yet delivering the cost incentives which would be required to significantly change the behaviour of businesses. However, CO_2 markets have been found to be an important business matter for four reasons. Firstly, CO_2 markets are backed up by ambitious longer-term government targets for CO_2 reductions. One example is the European Union's ambition to achieve an 80% reduction in CO_2 emissions by 2050. Secondly, the reach of CO_2 markets is spreading. Phases I and II of the European Emissions Trading Scheme covered approximately 10,500 sites, the third phase will extend this to an estimated 12,000 - 15,000 sites and the United Kingdom's Carbon Reduction Commitment brings another CO_2 market to an estimated further 5,000 smaller organisations, or 25,000 -150,000 sites. Furthermore, there are significant fines which reinforce the need to comply with CO_2 markets, especially when combined with the reputational impact of failing to comply. Finally, although current CO_2 costs are low, the general trend is that they are rising. Phase I of the European Emissions Trading Scheme traded at an average price of around €2/tonne CO_2, this rose to around €15/tonne CO_2 in the second phase of the European Emissions Trading Scheme. Early stages of CO_2 markets, such as phases I and II of the European Emissions Trading Scheme, worked by allocating the majority of CO_2 permits for free and leaving participants only to buy any shortfalls on the CO_2 markets. Phase III of the European

Emissions Trading Scheme introduces the auctioning of permits, so that over time, participants will have to buy 100% of their CO_2 permits. This 100% auctioning of CO_2 permits will also be employed by the upcoming Carbon Reduction Commitment. These developments point to CO_2 markets becoming increasingly important for businesses in a 5-10 year timeframe. There is a case to be made for the development of CO_2 accounting and reporting tools which ensure compliance with the current forms of CO_2 markets and provide a platform that could underpin a robust response to future developments.

The discussion of implications of CO_2 markets for businesses should also acknowledge two further considerations. Firstly, unless businesses choose to take a proactive role, the future of CO_2 markets really lies with regulators, Non-Governmental Organisations and Consumers. This is because business objectives of profit maximisation are at best indifferent to whether CO_2 markets will emerge or not. Secondly, there is a growing community of practitioners within the business world who believe that a proactive response to Climate Change will be good for long-term business sustainability. The proposed conceptual framework for the analysis of market design and operation may help this proactive community to understand and tackle the very real and significant challenges faced by CO_2 markets.

Having discussed the managerial implications of the research, the following section describes limitations of the research and proposes directions for future research.

12.6 *Limitations and directions for future research*

This research has proposed a conceptual framework for the study of CO_2 market design and operation and developed six case studies which describe business responses during CO_2 market design and operation. The limitations of this conceptual framework and some further sources of data are now suggested as potential avenues of further research.

Firstly, the geographical scope of this research could be extended. This research has drawn upon the discussion and analysis of six case studies which describe business responses during the design and operation of the CO_2 markets of the Kyoto Protocol, the European Emissions Trading Scheme and the United Kingdom's Carbon Reduction Commitment. Collectively, these represented over 98% of the 2009 CO_2 market by value (Kossoy & Ambrosi, 2010). This research was European-centric, as CO_2 markets have their origins in Europe. However, as CO_2 markets become more global, it would be sensible to extend the coverage of the cases to Australia and the United States of America. A case study could be developed to examine the development of the United States' Regional Greenhouse Gas Initiative (RGGI). The Regional Greenhouse Gas Initiative is a pilot CO_2 market between ten states that caps the CO_2 emissions of the electricity generation industry (RGGI, 2010). The Regional Greenhouse Gas Initiative accounted for 1.6% of the global value traded on CO_2 markets in 2009 (Kossoy & Ambrosi, 2010). A second case study could also be developed to examine the Greenhouse Gas Reduction Scheme that was developed by the state of New South Wales in Australia (GGAS, 2010). The Greenhouse Gas Reduction Scheme represented 0.1% of the global value traded on CO_2 markets in 2009 (Kossoy & Ambrosi, 2010). These two markets are small in scale and local, rather than national, CO_2 markets. As such, they were comparable in scale to the United Kingdom's Carbon Reduction

Commitment, which was covered by this research. For reasons of data access and scale of importance it was decided to focus the case studies upon the Kyoto Protocol, the European Emissions Trading Scheme and the Carbon Reduction Commitment. However, examining these two extra CO_2 markets would give a broader perspective of CO_2 market design and operation.

Secondly, a number of the case studies could be extended to reflect recent developments. There is potential to provide an update for case one, which examined early negotiations to extend the Kyoto Protocol beyond 2012. As phase I of the Kyoto Protocol draws to a close, there is the opportunity to examine the current efforts to extend the Kyoto Protocol into a second phase. Furthermore, the United Kingdom's Carbon Reduction Commitment has recently been converted into a tax which represents CO_2 costs of approximately 8% of energy costs. This announcement was made in October 2010 and the changes will be enacted in the second phase of the Carbon Reduction Commitment which starts in 2013. This change to the Carbon Reduction Commitment seems to tackle some of the challenges faced by CO_2 markets which were identified in this research. A new case study could explore the rationale behind the changes and businesses' responses to the updated Carbon Reduction Commitment.

Furthermore, the wider applicability of the proposed conceptual framework could be tested through its application to the analysis of the design and operation of other markets. The conceptual framework for the study of market design and operation has been developed within the empirical domain of CO_2 markets. Potential areas of application include the development of markets for other environmental goods such as fishing quotas, biodiversity trading or a historical review of sulphur dioxide trading. In wider terms, the conceptual framework could possibly also be extended to the analysis of the design and operation of markets outside of the environmental sphere. As previously discussed, there is already research on market design and operation for the provision of: parking spaces during planning applications, radio frequency bandwidths, kidney transplants, and even school places (Barter, 2010; Carmona et al., 2010; Coase, 1960, 1988; Conejero & Farina, 2003; Dales, 1968; Demsetz, 1966; Engels, 2005; Hurwicz, 1973; Levy & Kolk, 2002; MacKenzie, 2009; McMillan, 2003; Meinshausen & Hare, 2008; Moser, 2010; Myerson, 1979, 1983; Okereke, 2007; Roth, 2008; Sultanian & Van beukering, 2008; Vaughan et al., 2009). The conceptual framework could be developed by investigating some of these markets, or historical cases presented in the literature listed above.

Finally, due to the contemporary nature of CO_2 markets, this research has drawn upon a diverse set of literature. There is still other literature to explore and incorporate. One field is that of network pictures and cognitive views. This literature could help in the development of representational aspects of the conceptual framework (Geiger & Finch, 2010; Henneberg et al., 2006; Henneberg et al., 2010; Leek & Mason, 2010; Mouzas et al., 2008). Furthermore, a brief treatment of a number of theories of environmental governance was given. These seem to map onto the exchange, representational and normalising aspects of markets which were examined. However, future developments of this research will draw upon a more detailed examination of research on international markets for environmental governance. This research describes a 'war of position' based upon 'material', 'discursive' and 'organisational' pillars (Levy & Newell, 2002; Levy & Egan, 2003); 'regimes' as persistent and connected sets of rules and practices that prescribe behavioural roles, constrain activity and shape expectations (Keohane et al., 1993) and 'clusters of norms, rules, principles and decision-making procedures' (Krasner, 1983). This literature would most likely bring another perspective that would help to challenge and develop the conceptual framework for the study of CO_2 market design and operation.

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APPENDIX 1:

SAMPLE RESEARCH AGREEMENT

APPENDIX 1: Sample research agreement

RESEARCH AGREEMENT

Manufacturer Alpha and the research led by PhD Candidate Gareth Veal of Lancaster University Management School, agree to the following in the conduct of the research project with Manufacturer Alpha. Gareth Veal and his PhD supervisor Dr Stefanos Mouzas will conduct research with the management and staff of Manufacturer Alpha, focusing upon how CO_2 markets are influencing the strategic planning activities and processes (hereafter referred to as 'the process') of Manufacturer Alpha. This will involve conducting multiple interviews, attending team meetings, observing team members, being given copies of documentation relating to the teams' activities, and administering questionnaires, together with other procedures, during the period from January to June 2009 inclusive. The research period will be extended if deemed necessary through agreement by both parties.

Data collection

Data will be collected through participant observation, interviews and document collection as follows:

Company participants

People to be interviewed will be management and staff of Manufacturer Alpha, including:

- General Managing Director
- Other senior and middle managers
- Other team members at production sites

All respondents will be asked to sign a Statement of Informed Consent at the beginning of their onsite interviews.

The research team will have ongoing telephone access to interview respondents in order to:

- confirm the accuracy of the transcript and /or interpretations
- clear up puzzling aspects of the interviews
- test their general interpretations and findings by soliciting respondent feedback.

Document sharing

Company respondents will be encouraged to provide the research team with any documents pertaining to or illuminating the process, including:

- documents that outline the plans for, conduct and anticipated outcomes of, the process
- documents that communicate thoughts, actions, effects and outcomes related to the process
- flipcharts, notes and/or transcripts from the meetings
- any documents generated by respondents that are pertinent to the process, including letters, memoranda, e-mails, reports, speeches, meeting agendas and personal notes.

Data ownership
The research team will retain all data, including transcripts and documents. In the case of documents, those designated with 'read and return' status will be returned (including any copies) to the company no later than the presentation of the final report.

Assurance of participant anonymity and confidentiality of commercial and security-sensitive information
All interviews will be rendered strictly anonymous in order to protect the identity of individuals and groups and, where necessary, quotations taken from individual interviews will be deliberately disguised in order to fulfil this objective.

Manufacturer Alpha will be given the opportunity to vet all publications from the research, in order to screen out any commercial or security-sensitive information. However, the research team will retain full editorial control of all other aspects of the form and content of each publication. A maximum of two weeks from the date of submission to the organization will be given for approval in the case of each article.
In addition, the research team will not identify the Company or respondents on recorded, transcribed, or other data; instead, they will use a pseudonym for the Company and assigned numbers for each of the individual respondents.

After the research is completed, the research team will provide Manufacturer Alpha with the following:

- An Interim Report of insights to date
- A Full report and verbal presentation detailing the research findings
- In addition, respondents will be provided with a single copy of transcripts of their own interviews upon request, they may share these with others at their own discretion

Research timeframe
Manufacturer Alpha agrees that their participation in the data collection phase will be concluded by approximately the end of June 2009, a period that may be extended, if it is regarded that this will be of benefit to both parties.

Interviews will be scheduled in accordance with the timeframe of the process as planned and implemented by Manufacturer Alpha.

Agreed and approved:

______________	______________
Research focal point's name	Gareth Veal
Manufacturer Alpha	Lancaster University
Date:	Date:

APPENDIX 2:

SAMPLE STATEMENT OF INFORMED CONSENT

APPENDIX 2: Sample statement of informed consent

STATEMENT OF INFORMED CONSENT

Dear Participant:

Thank you for agreeing to participate in this study of how CO_2 markets are influencing strategic planning activities and processes. The research will focus upon how company actions have been influenced by your recent Carbon Trust Energy Efficiency report and the influence of European and National CO_2 markets. The aim is to draft a paper to present at the 25th Industrial Marketing and Purchasing Conference in September 2009. This research will also form a case study for Gareth Veal's PhD thesis and will eventually be published, in a suitably anonymised form, in management research journals.

At the end of the study, I will share general observations with the management of Manufacturer Alpha, your business area and with other study participants. These observations will be general in nature and not specific to any individual or team.

As a participant, you may be asked to engage in several informal interviews over the course of the study. In addition, I will observe and record meetings in which you may be a participant. At some future time, I may also ask if you would be willing to respond to a survey or instrument that will help us further understand your thinking about the response to CO_2 markets at Manufacturer Alpha.

Your participation is entirely voluntary and you may terminate your involvement at any time. All data from your participation will be kept anonymous and confidential. I am happy to provide you with a transcript of any of your interviews upon your request.

If you have questions about the research or wish to discuss your participation in the study, you are encouraged to contact the research team at any time, as follows:

Gareth Veal
01225 580 256
07896713058
g.veal@Lancaster.ac.uk
garethjv@hotmail.com

I understand the above and agree to participate in this study.

Date____________________

Participant's Signature ________________________________

Researcher's Signature________________________________

APPENDIX 3:

SUMMARY OF EXPLORATORY LITERATURE SEARCH

APPENDIX 3: Summary of exploratory literature search

	'Market design'	'Market operation'	'Mechanism design'	'Market creation'	'Market formation'	'Market barriers'	'Carbon' 'CO2' 'Carbon Market'	'Climate Change' 'Global warming'	'Kyoto'	'European Emissions Trading Scheme' 'EU ETS'	'Carbon Reduction Commitment' 'CRC'	'Climate Change Agreement' 'CCA'
1) GOOGLE SCHOLAR NB: Search was for 'exact match' in title of articles, excluding patents and citations. Two searches for context: 'Market' = 239,000 and 'Relationship' = 393,000												
	408	**169**	**1550**	**61**	**51**	**90**	(Not searched, since too broad a topic for this source)					
2) 'BUSINESS SOURCE PREMIER' DATABASE NB: Search was for peer reviewed journals only and exact matches in title or abstract. Two searches for context: 'Market' = 40,668 and 'Relationship' = 23,959												
	193	**73**	**283**	**43**	**29**	**49**	**8,413**	**3,910**	**987**	**61**	**137** (**6** for full name, 'CRC' is a common acronym in unrelated fields)	**283** (**9** for full name, 'CCA' is a common acronym in unrelated fields)
2) BUSINESS AND MARKETING JOURNALS NB: Search cascade was: – All Association of Business Schools (ABS) 4* ranking journals – All ABS 3* marketing journals												
Journal of Environmental Economics & Management	-	-	**1**	-	-	-	**33**	**29**	**6**	**2**	-	-
American	**2**	**5**	**7**	-	-	-	**19**	**31**	**4**	-	-	**1**

Economic Review												
Risk Analysis	-	-	-	-	-	-	8	44	1	-	-	-
Environment and Planning A	-	-	-	1	-	-	12	32	2	1	-	-
Economic Journal	2	1		1	-	-	5	20	2	-	-	-
Journal of Business & Industrial Marketing	3	-	-	-	-	-	-	-	-	-	-	-
Econometrica	1	-	22									
Journal of Economic Perspectives	-	1	-	-	-	-	8	10	2	-	-	-
Journal of Financial Economics	1	-	-	-	-	-	-	-	-	-	-	-
Journal of Finance	4	1	-	-	-	-	-	-	-	-	-	
Journal of Financial & Quantitative Analysis	1	1	-	-	-	-	-	-	-	-	-	-
Review of Financial Studies	2	-	-	-	-	-	-	-	-	-	-	-
Harvard business review	1	-	-	-	-	-	-	19	-	-	-	-
Accounting, Organizations & Society	1	-	-	-	-	-	6	2	3	2	-	-
Environment and Planning D: Society and Space	-	-	-	-	-	-	5	7	1	-	-	-
Journal of the American Statistical Association	-	-	-	-	-	-	4	7	1	-	-	-
Accounting Review	-	-	1	-	-	-	4	5	1	-	-	-
Economic Geography	-	-	-	-	-	-	4	3	1	-	-	-

Review of Economics & Statistics	-	-	-	-	-	-	2	5	-	-	-	-
Journal of Political Economy	-	4	2	-	-	-	1	4	-	-	-	-
Journal of the European Economic Association	-	-	3	-	-	-	1	3	-	1	-	-
Journal of Monetary Economics	-	1	2	-	-	-	-	-	-	-	-	-
Journal of Economic Theory	-	-	26	-	-	-	-	-	-	-	-	-
Management Science	1	-	9	-	-	-	4	-	-	-	-	-
Public Administration Review	-	-	-	-	-	-	1	3	-	-	-	-
Journal of marketing	-	2	-	1	-	-	-	2	-	-	-	-
Organization studies	-	-	-	1	-	-	-	1	1	-	-	-
Administrative Science Quarterly	-	-	-	1	-	-	-	-	1	-	-	-
American Sociological Review	-	-	-	-	1	-	-	-	1	-	-	-
Journal of Applied Psychology	-	-	-	-	-	-	2	-	-	-	-	-
Journal of Economic Geography	-	-	-	-	-	-	1	1	-	-	-	-
Journal of International Business Studies	-	-	-	-	-	-	-	2	-	-	-	-

Journal of Management Studies	-	-	-	-	-	-	-	2	-	-	-	-
Journal of Marketing Management	-	-	-	-	-	-	-	2	-	-	-	-
Strategic Management Journal	-	-	-	-	-	-	1	1	-	-	-	-
Business History	-	-	-	-	-	-	1	-	-	-	-	-
Economic History Review	-	-	-	-	-	-	-	1	-	-	-	-
European Journal of Marketing	-	-	1	-	-	1	-	-	-	-	-	-
Human Relations	-	-	-	-	1	-	-	-	-	-	-	-
Human Resource Management	-	-	-	-	-	-	-	1	-	-	-	-
Industrial Marketing Management	-	-	-	-	1	-	-	-	-	-	-	-
Industrial Relations	-	-	-	-	-	-	-	1	-	-	-	-
International Economic Review	-	-	-	-	-	-	1	-	-	-	-	-
International Marketing Review	4	-	-	-	-	-	-	-	-	-	-	-
Journal of the Royal Statistical Society: Series B (Statistical Methodology)	-	-	-	-	-	-	-	1	-	-	-	-
Operations Research	2	-	7	-	-	-	-	-	-	-	-	-
Quarterly Journal of Economics	-	1	1	-	-	-	1	-	-	-	-	-
Marketing Science	-	-	1	-	-	-	-	-	-	-	-	-
MIS Quarterly	1	-	-	-	-	-	-	-	-	-	-	-

Information Systems Research	-	-	**4**	-	-	-	-	-	-	-	-	-
Research Policy	-	-	-	-	-	-	-	**1**	-	-	-	-
Review of Economic Studies	**1**	-	**5**	-	-	-	**1**	-	-	-	-	-
3) DISSERTATIONS SEARCH												
www.theses.com (Theses database covering back to 1716)	**10**	**5**	**11**	**3**	**4**	**4**	**9101**	**573**	**79**	**1**	**0**	**0**
www.impgroup.org /dissertations.php	No specific results for search topics, but three are of particular relevance: – 'The emergence of a new mechanical pulp technology' (Waluszewski, 1990) – 'Strategic response to predicted events: The case of the banning of CFCs' (Harrison, 1998) – 'A Bumper? An empirical investigation of the relationship between the economy and the environment' (Brekke, 2009)											
4) ENERGY AND CLIMATE POLICY JOURNALS NB: Selected journals dealing with energy and climate policy.												
Energy Policy	**10**	**4**	**2**	**2**	**1**	**7**	(Not searched, since too broad a topic for this source)					
Climate Policy	**-**	**1**	**2**	**23**	**13**	**38**						
Climatic Change	**1**	**1**	**-**	**70**	**66**	**107**						
Journal of Cleaner Production	**7**	**1**	**-**	**1**	**-**	**2**						
Wiley interdisciplinary reviews - Climate Change	A single special issue with two relevant papers: – Communicating Climate Change: history, challenges, process & future directions (Moser, 2010) – The EU emissions trading scheme (Bailey, 2010)											
The following journals were not searched extensively, since they deal solely with physical and technical research into Climate Change processes:	– Journal of Applied Meteorology and Climatology – Journal of Climate – Climate Research – Climate Dynamics – International Journal of Climatology – Theoretical and Applied Climatology											

APPENDIX 4:

SAMPLE DATA SOURCES (DATA FOR CASE 6)

APPENDIX 4: Sample data sources (data for case six)

DATA SOURCE	EXAMPLE
1. DOCUMENTATION	a) **REGULATORY GUIDANCE** **Environment Agency reports (34)** Each available as a PDF at: www.environment-agency.gov.uk/crc 1. A short introduction to the CRC Energy Efficiency Scheme. 2. Am I in? A guide to qualification and structure. 3. Carbon Reduction Commitment Energy Efficiency Scheme Case study- Local Authority 4. Changing your contact details in the CRC registry 5. CRC and private equity funds 6. CRC Case study- Overseas organisation 7. CRC guidance on trusts 8. CRC organisational case study- Automotive example 9. CRC organisational case study- Public sector organisation 10. Frequently Asked Questions 11. Guidance for CRC: Glossary of terms 12. Guidance for CRC: Making an information disclosure 13. Guidance on the CRC energy efficiency scheme: Annual reports 14. Guidance on the CRC energy efficiency scheme: Changes to CCA's 15. Guidance on the CRC energy efficiency scheme: Changes to organisational structure- public sector 16. Guidance on the CRC energy efficiency scheme: Changes to organisational structure- private sector 17. Guidance on the CRC energy efficiency scheme: Changes to organisational structure- government departments 18. Guidance on the CRC energy efficiency scheme: Conversion & emission factors 19. Guidance on the CRC energy efficiency scheme: Electricity generation 20. Guidance on the CRC energy efficiency scheme: Estimation techniques 21. Guidance on the CRC energy efficiency scheme: EU Emissions Trading System (EU ETS) and Climate Change Agreements (CCA) 22. Guidance on the CRC energy efficiency scheme: Evidence pack guidance 23. Guidance on the CRC energy efficiency scheme: Footprint reports 24. Guidance on the CRC energy efficiency scheme: Meters and metering 25. Guidance on the CRC energy efficiency scheme: Residual measurement list 26. Guidance on the CRC energy efficiency scheme: Supply rules 27. Guidance on the CRC energy efficiency scheme: The Carbon Trust Standard & equivalent schemes

28. Guidance on the CRC energy efficiency scheme: Timelines for CRC
29. Guidance on the CRC energy efficiency scheme: Treatment of Private Finance Initiatives (PFI)
30. List of registered participants
31. Registering as a CRC participant: A guide for those organisations that have to register as a participant in the CRC
32. Scheme administration and regulation
33. Summary of steps needed to determine if I qualify.
34. The CRC and Insolvency, Administration, Winding Up and Cessation of Business

Department of Energy and Climate Change reports (9)
Each available as a PDF at: www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx
1. Consultation on the Draft Order to Implement the Carbon Reduction Commitment: Combined Consultation Workshop Report
2. Carbon Reduction Commitment quarterly stakeholder update
3. Consultation on the draft order to implement the Carbon Reduction Commitment (CRC): analysis of consultation responses
4. Addendum to the Consultation response
5. Office of Public Sector Information: CRC Energy Efficiency Scheme Order 2010
6. The CRC Energy Efficiency Scheme User Guide
7. Corrigendum to CRC Energy Efficiency Scheme User Guide
8. The CRC Energy Efficiency Scheme (Allocation of Allowances for Payment) Regulations 2010
9. Policy note on the Draft Allocation regulations for the CRC Energy Efficiency Scheme

Carbon Trust reports (2)
1. Carbon Trust page introducing the CRC:
   www.carbontrust.co.uk/policy-legislation/business-public-sector/pages/carbon-reduction-commitment.aspx
2. Carbon Trust Standard webpage for CRC Early Action Metrics:
   www.carbontruststandard.com/pages/Carbon-Reduction-Commitment

b) EMAILS AND OTHER WRITTEN CORRESPONDENCE
Environment Agency email helpline clarification requests (6)
Help line can be accessed at crchelp@environment-agency.gov.uk
1. Clarification sought regarding CRC timelines (20/05/2010)
2. Request for unlocked version of Evidence Pack guidance document (07/04/2010)
3. Request to check treatment of turnover in Early Action Metrics (02/09/2009)
4. Request to check Manufacturer Beta's Standard Industry Classification (SIC) code interpretation (08/02/2010)
5. Checking half hourly meter details held by Environment Agency for Manufacturer Beta (20/01/2010)

	6. Request to receive each site's CRC information pack for registration at one central location (17/08/2009) **Emails with Manufacturer Beta's Carbon Reduction Commitment project team (1,082)** 1. Manufacturer Beta: a) Head of Environment in Corporate Sustainability team (173) b) Head of Property within Corporate Legal team (144) c) Heads of Sustainable Development at business unit level (92) d) Associate in Corporate Sustainability team (44) e) UK Central Energy Procurement Manager (29) f) Associate within Corporate Legal team (25) g) Trading specialist from Corporate Treasury team (17) h) Manager of UK real estate database (8) i) UK Finance Director (6) j) Member of Corporate Legal team (5) k) UK Company Secretariat (5) l) Group Property Director (4) m) Director of Government Relations (2) 2. Carbon Consultancy: a) Project Data Analyst (350) b) Project Director (146) 3. Environment Agency: a) CRC mailing list (7) b) Help line email address (6) 4. Energy suppliers: a) Manufacturer Beta's key account manager (15) a) Energy supplier's sales representative (4) 5. Bureau provider- no direct email contact, but data was supplied through Carbon Consultancy Project Data Analyst. **c) PROPOSALS AND STRATEGY DOCUMENTS (2)** 1. Manufacturer Beta's corporate real estate management policies 2. Manufacturer Beta's corporate governance policies **d) AUDIT REPORTS AND TRADING STATEMENTS (2)**

	1. Historic records of European Emissions Trading Scheme management, used to establish Carbon Reduction Commitment Exemptions. 2. Historic records of Climate Change Agreement management, used to establish Carbon Reduction Commitment Exemptions. **e) GOVERNMENT AND INDUSTRY TRAINING EVENTS AND MAILING LISTS** **Environment Agency CRC mailing list updates (7)** Mailing list can be joined here: http://dmtrk.co.uk/AYH-2U0/s2.aspx 1. Latest developments and news about the CRC scheme (29/07/2010) 2. Latest developments and news about the CRC scheme (03/06/2010) 3. New CRC Energy Efficiency Scheme guidance now available (27/03/2010) 4. CRC Energy Efficiency Scheme Stakeholder Update (09/11/2009) 5. Carbon Reduction Commitment Quarterly Stakeholder Update (07/10/2009) 6. The Carbon Reduction Commitment (CRC): Interim update for stakeholders (04/08/2009) 7. Invitation to Carbon Reduction Commitment consultation workshops (01/04/2009) **Training events (3)** 1. Environment Agency's 1 day CRC training Seminar, Cardiff, Wales, (29/04/2009) 2. ENVEC 2009: Energy Management conference- Speeches from Forum for the Future, EDF Energy, Energy Saving Trust, UK Climate Impacts Programme, EDF Energy and the Environment Agency. Weston-Super-Mare, (08/10/2009) Presentations at http://www.oursouthwest.com/envec/archive/index.htm 3. Avon and Somerset Energy Efficiency Manager's Group: Carbon Reduction Commitment briefing session, Bristol, (19/11/2009)
2. ARCHIVAL RECORDS	– European Emissions Trading Scheme and Climate Change Agreement compliance records.
3. INTERVIEWS	– Semi-structured interview to review confidentiality or accuracy issues in case study drafts (15/02/2010, 19/07/2010).
4. DIRECT OBSERVATION	– Not applicable. All observation was through participant observation, rather than direct observation.
5. PARTICIPANT OBSERVATION	**Steering team meetings with Manufacturer Beta's Carbon Reduction Commitment steering team (7)** – NB: steering team consisted of Head of Environment in Corporate Sustainability team, Heads of Sustainable Development at business unit level, Member of Corporate Legal Team, UK Company Secretariat, Manager of UK real estate database, UK Central Energy Procurement Manager, Trading specialist from Corporate Treasury team. Plus Carbon Consultancy Project Director and Data Analyst. – Steering team meetings held [06/05/2009, 12/05/2009, 10/06/2009, 16/07/2009, 27/08/2009, 29/10/2009, 08/12/2009]

	Additional meetings with Manufacturer Beta's Carbon Reduction Commitment project team (39) 1. Manufacturer Beta: a) Head of Environment in Corporate Sustainability team (24) [08/04/2009, 15/04/2009, 02/06/2009-am, 02/06/2009-pm, 09/06/2009, 16/06/2009, 14/07/2009, 16/07/2009, 24/07/2009, 24/08/2009, 5-6/10/2009, 16/10/2009, 26/11/2009, 13/01/2010, 22/01/2010, 27/01/2010, 10/02/2010, 19/03/2010, 31/03/2010, 13/04/2010, 22/04/2010, 30/04/2010, 03/06/2010, 09/06/2010] b) Associate in Corporate Sustainability team (6) [26/05/2010, 02/06/2010, 03/06/2010, 09/06/2010, 15/06/2010, 24/06/2010] c) Heads of Sustainable Development at business unit level (10) [05/03/2009, 09/06/2009, 17/06/2009, 14/07/2009, 24/08/2009, 25/08/2009, 5-6/10/2009, 16/10/2009, 10/11/2009, 23/11/2009] d) Group Property Director (4) [09/06/2009, 16/07/2009, 10/02/2010, 31/03/2010 e) UK Finance Director (2) [31/03/2010, 22/04/2010] f) UK Managing Director (1) [22/04/2010] g) UK Central Energy Procurement Manager (7) [04/03/2009, 09/06/2009, 15/06/2009, 14/07/2009, 22/07/2009, 11/08/2009, 24/08/2009] h) Manager of UK real estate database (3) [14/07/2009, 24/08/2009] i) Head of Property within Corporate Legal team (12) [02/06/2009-am, 02/06/2009-pm, 16/06/2009, 24/07/2009, 16/10/2009, 26/11/2009, 13/01/2010, 22/01/2010, 27/01/2010, 10/02/2010, 16/02/2010, 19/03/2010] j) Associate within Corporate Legal team (3) [02/06/2009-am, 16/06/2009, 24/07/2009] k) Trading specialist from Corporate Treasury team (1) [04/06/2009] 2. Carbon Consultancy: c) Project Director: Weekly project meeting, Jan 2009- June 2011. d) Project Data Analyst Weekly project meeting plus approximately 2 hours joint project work per week, Jan 2009- June 2011. 3. Bureau provider. a) Manufacturer Beta's key account manager (6) [05/05/2009, 11/08/2009, 14/01/2010, 19/01/2010, 21/01/2010, 22/01/2010]

6. **PHYSICAL ARTEFACTS**	**Online regulatory compliance accounts (1)** 1. Online CRC Registry, example can be viewed at: https://crc.environment-agency.gov.uk/crcregistry/web/login?execution=e1s1 **Business intranet based CO_2 management and reporting systems (3)** 1. Manufacturer Beta's real estate management database (confidential, internal access only) 2. Manufacturer Beta's real time energy management database (confidential, internal access only) 3. Manufacturer Beta's Health, Safety and Environmental corporate reporting database (confidential, internal access only) **Spreadsheet based CO_2 calculation tools (4)** 1. Environment Agency CRC energy efficiency scheme source list tool, available at: www.environment-agency.gov.uk/static/documents/Business/Carbon_Reduction_Commitment_guidance_map.pdf 2. Carbon consultancy spreadsheets: a) Site survey questionnaires b) Half hourly meter data template c) Carbon Reduction Commitment registration template

APPENDIX 5:

PUBLICATIONS AND CONFERENCE PAPERS

APPENDIX 5: Publications and conference papers

Material from this dissertation has been published in two journal papers and presented at a number of conferences. This work and any assignments of copyright as part of the publication process are summarised below.

Journal publications

	Title	Journal	Relevant sections of dissertation	Status
Accepted	1. Learning to collaborate: A study of business networks (Veal & Mouzas, 2010b)	Journal of Business and Industrial Marketing	• Figure 13 • Section 2.5.3 • Case 1 / Chapter 5	• Accepted July 2009 • Copyright transferred
	2. Changing the rules of the game: Business responses to new regulation (Veal & Mouzas, 2011)	Industrial Marketing Management	• Figure 18 • Table 8 • Figure 19 • Case 3 / Chapter 7	• Accepted Sept. 2010 • Copyright transferred

Conference papers

Title	Involvement	Location	Date
1. Doctoral Consortium: IMP 2007	– Presentation of research questions and methods.	University of Manchester	28-29/08/2007
2. Conference: IMP 2007	– 'Barriers to collaboration: The problem of Climate Change' (Veal & Mouzas, 2007)	University of Manchester	30/08/2007 to 01/09/2007
3. IMP Journal Seminar: Managing in Business Networks	– 'Mechanism Design as a Response to the Problem of Climate Change' (Veal & Mouzas, 2008b)	Lancaster University	15-17/05/2008
4. Conference:	– 'Mechanism Design as a	Uppsala	4-6/09/2008

IMP 2008	Response to the Problem of Climate Change' (Veal & Mouzas, 2008a)	University	
5. Conference: Action research to promote the social stewardship of Ecosystem Services	– Attended as delegate	University of Bath	19/02/2009
6. Conference: IMP 2009	– 'Business network development under legislated change' (Veal & Mouzas, 2009)	Euromed Management School	3-5/09/2009
7. Conference: ENVEC- Making sustainability happen	– Attended as delegate	Weston Supermare	08/10/2009
8. Conference: ISBM Harvard	– 'Barriers to market formation: A study of emerging markets for CO_2' (Veal & Mouzas, 2010d)	Harvard University	11-12/08/2010
9. Conference: IMP 2010	– 'Barriers to market formation' (Veal & Mouzas, 2010a)	University of Budapest	2-4/09/2010
10. Doctoral consortium: JMS / SAMs	– Bursary awarded to attend doctoral consortium	Loughborough University	27/09/2010
11. Conference: JMS / SAMs 'The foundations of sustainability'	– 'Market-based responses to sustainability: A study of barriers to CO_2 market formation' (Veal & Mouzas, 2010c)	Loughborough University	28-29/09/2010
12. Presentation to the Institute for Sustainable Energy and the Environment	– Barriers to Market Formation: A Study of CO_2 Markets	University of Bath	07/12/2010