Accounting for carbon in the FTSE100: Numbers, narratives and credibility

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Numbers, narratives and credibility

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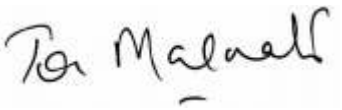
Signature: 

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Details of collaboration and publications:

The carbon risk software toolkit described in Chapter 9 is a collaborative venture under the organisation of RVA Consulting (http://rvaconsulting.se). The Ph.D. candidate has contributed by sharing the FTSE62carbon dataset prepared for this thesis, which the software incorporates into the calculation of its carbon-financial metrics.

In addition, the Ph.D. candidate has collaborated in writing a peer-reviewed paper (Haslam *et al*., 2014b) and a summary of a small research project published in the Institute of Chartered Accountants of Scotland (ICAS) research newsletter (Haslam *et al*., 2014a)

Dedication

To my parents, John George and Patricia Ann Malamatenios

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Albert Einstein once observed that if he knew what he was doing, it would not be called research. Perhaps for this reason, it is essential that a Ph.D. researcher can call upon the wisdom and insight of their supervisory team. I owe a huge debt of gratitude to Professor Colin Haslam, not just for his expertise but also for his patient and kind support through my moments of intensity. I would also like to thank Dr. Nicholas Tsitsianis who provided invaluable specialist counsel in the role of second supervisor.

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Abstract

The United Kingdom Government has mandated ambitious carbon objectives, requiring an 80% reduction in emissions by 2050, and a 20% interim reduction by 2020. Their achievement will require government and large companies to work together, and for each to be assured of the other's strategic intent. An emergent carbon accounting can provide reassurance if it produces credible information that supports the claims made by each party.

This thesis investigates the extent to which carbon reduction narratives are supported or contradicted by actual carbon emissions disclosed in corporate accounting reports. It also investigates whether large corporations have delivered absolute carbon reductions in support of the government's legally binding objectives. As a result of these and other investigations, the thesis contributes to the carbon accounting literature by critiquing the method of framing emissions employed by the Greenhouse Gas Protocol, the extent to which carbon reduction is supported by meaningful managerial incentives and the means by which analysts might rebalance financial return with carbon risk in portfolio construction.

Following a middle ground approach, the research employs a numbers and narratives analysis in which critical alternative narratives are created at national, sectoral and firm levels. The analysis disaggregates macro carbon emissions data, and considers carbon emissions at a corporate meso and micro level. Narratives constituted out of these numbers, together with counter-narratives generated from corporate disclosures, are then evaluated to assess their credibility.

The thesis adopts a practical approach, utilising multiple framing devices. In addition to reporting scopes 1, 2 and 3 carbon emissions, it describes a business model framework in which firms are expected to disclose their carbon-material stakeholder relations. Further recommendations are aimed at aligning the interests of corporate managers, investors and financial analysts with government carbon policy in order to modify behaviour and reduce emissions trajectories towards a lower carbon future.

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List of abbreviations used in this thesis

AAA	American Accounting Association
ABS	Association of Business Schools
AICPA	American Institute of Certified Public Accountants
ANC	Autorité des Normes Comptables
ASGC	Accounting Standards Committee of Germany
ASOBAT	A Statement of Basic Accounting Theory
ASSC	Accounting Standards Steering Committee
CCGT	Combined cycle gas turbine
CDP	Carbon Disclosure Project
CDSB	Climate Disclosure Standards Board
CFA	Chartered Financial Analyst
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent (tonnes)
CSR	Corporate Social Responsibility
CUSUM	CUmulative SUM deviation
DECC	United Kingdom Department of Energy and Climate Change.
DEFRA	United Kingdom Department for the Environment, Food and Rural Affairs
EBIT	Earnings Before Interest and Taxation
EBITDA	Earnings Before Interest, Taxation, Depreciation and Amortisation
EFRAG	European Financial Reporting Advisory Group
EVA™	Economic Value Added
FTSE62	The FTSE62 sample of carbon disclosing large corporations
FTSE100	The FTSE 100 Index of shares listed on the London Stock Exchange
FTSE350	The FTSE350 Index of shares listed on the London Stock Exchange (FTSE100 + FTSE250)
FRC	United Kingdom Financial Reporting Council
GHG	Greenhouse gas
GRI	Global Reporting Initiative
GWP	Global Warming Potential
HFC	Hydrofluorocarbons
HMRC	Her Majesty's Revenue and Customs (United Kingdom)
HS2	High-speed Rail 2
IAS	International Accounting Standard
IASB	International Accounting Standards Board
ICAEW	Institute of Chartered Accountants in England and Wales

ICAS	Institute of Chartered Accountants of Scotland
IFRS	International Financial Reporting Standards
IIRC	International Integrated Reporting Committee
IPCC	Intergovernmental Panel on Climate Change
<IR>	Integrated Reporting
KPI	Key Performance Indicator
M&A	Merger and acquisition
MKT VAL	Market Valuation
MWe	Megawatt electrical
NASA	National Aeronautics and Space Administration
N_2O	Nitrous oxide
OECD	Organisation for Economic Co-Operation and Development
OIC	Organismo Italiano di Contabilità
OFR	Operating and Financial Review
ONS	United Kingdom Office for National Statistics
PFC	Perfluorocarbons
RBV	Resource-based view
SASB	Sustainability Accounting Standards Board
SEC	Securities and Exchange Commission (United States)
SF_6	Sulphur hexafluoride
SRI	Stanford Research Institute
TTL INC	Total Income
UN	United Nations
UNEP	United Nations Environment Programme
UNEP FI	United Nations Environment Programme Finance Initiative
UNFCCC	United Nations Framework Convention on Climate Change
VAR	Value Added Retained
WBCSD	World Business Council for Sustainable Development
WRAP	Waste Resources Action Programme
WRI	World Resources Institute

Chapter One

Introduction to the thesis

> "The public must decide whether it wishes to continue on the present road, and it can do so only when in full possession of the facts. In the words of Jean Rostand, 'The obligation to endure gives us the right to know' " (Carson, 1962: p.30).
>
> "But the day will come, when people so clearly 'see' pollution as part of the organization, that we will have to include it in the picture. And there will be consequences …" (Hines, 1988: p.255).

1.0 Introduction

This research is predicated on the belief that large companies will be required to make substantial contributions towards the collective reduction in greenhouse gas emissions demanded of society, if the harmful impacts of global warming are to be minimised. The belief is justified by the arguments that economic activity is inextricably linked to the consumption of carbon-generating fossil fuels (Chapman, 1975; Morgan, 2010, 2013), that business tends to externalise pollution costs so that these are borne by society (Bakan, 2004); and that business is granted a revocable license to operate, provided its goals are considered congruent with those of broader society (Lindblom, 1994).

Additional to these arguments, it can be shown that the business sector is the source of a considerable proportion of total greenhouse emissions in developed economies. In the United Kingdom, for example, business sector emissions account for approximately 74% of the national greenhouse inventory (Office for National Statistics, 2012a). Customers increasingly expect socially-responsible firms to use their expertise and resources to meet certain social responsibilities on their behalf (Giddens, 1994), including recycling and decarbonisation of supply. Moreover, due to scale effects, collaboration between government and large companies offers the advantage of maximum policy reach achieved through a manageable number of participating stakeholders. Institutions and regulatory structures already govern numerous aspects of corporate activity, and these can be adapted to accommodate additional responsibilities undertaken by the business sector.

If national carbon reduction policy depends upon the productive collaboration of large companies with active responsible government, it may be helpful to consider what is required to make such collaboration 'work', and how the necessary 'ingredients' can be evaluated, monitored, managed, supported and incentivised. This thesis is concerned with the extent to which corporate carbon

reduction supports national climate change objectives, and the credibility of carbon reduction narratives constituted out of corporate carbon accounting and disclosure.

1.2 Aims of the thesis

The broad aims of this thesis are to investigate whether large corporations are reducing their carbon emissions in line with national government carbon objectives in the United Kingdom, and the extent to which accounting enables users to evaluate the credibility of carbon reduction narratives obtained from the accounting and sustainability reports of these companies. As a corollary, it will investigate how accounting frameworks may be amended to enhance the credibility of carbon accounting and disclosure, and whether accounting tools might be used to appraise the carbon risks of focal organisations.

These objectives can be subdivided as follows:

The thesis will derive carbon reduction narratives at the national (macro), sectoral (meso) and firm (micro) levels. The credibility of these narratives will be evaluated against the 'numbers' in terms of greenhouse emissions data applicable at that level, with the intention of either confirming the original, or creating an alternative critical narrative using these numbers. Numbers and narratives form the basis for the creation of dialogue and broad stakeholder inclusion in corporate carbon reduction.

By collating data from the corporate reports and company websites of the FTSE100 list of leading companies, this research will determine whether it is possible to create an original meso dataset comprising the greenhouse emissions of the United Kingdom's largest companies. Initially it will be necessary to review these corporate sources to determine how much data is disclosed, how it is organised and the breadth of disclosure among FTSE100 companies. To the best of the researcher's knowledge, this data is not comprehensively available to the public at present.

Following the creation of the meso carbon dataset, the research will determine whether the large corporations represented in the FTSE100 group have collectively maintained, reduced or increased their emissions since 2006 which will be taken as a base year. A similar exercise will be conducted for a case study using the mixed-retail sector group of firms represented in the FTSE100 group, to reflect the trend in firm-level carbon emissions and to provide the basis for a more detailed and granular investigation of carbon emissions reduction. Using the corporate reports for the FTSE100 mixed-retail firms, the thesis will extract and review disclosures to determine whether it is possible to use

narrative statements to reveal differences in carbon reduction credibility among firms in the same industry.

Lastly, this thesis will consider whether the present accounting framework may be amended, and complemented by the innovative application of physical and financial metrics to increase the visibility of carbon emissions and carbon risk; thereby enhancing accountability and the decision-making capacity of stakeholders with interests in reducing carbon emissions. It is intended that the recommendations of this thesis will help policymakers to devise critical interventions and frame new policy initiatives.

1.3 Accounting for carbon emissions

Accounting is a calculative technology through which economic agents establish the possible states of the world and rank these states in order of preferences before identifying and describing actions that allow for these states (Callon, 1998). At the same time, accounting faces outwards towards other stakeholders for whom it represents the conduit of accountability. The potential for conflict between these positions means that accounting cannot be neutral, because the disclosures in accounting reports have a range of potential consequences for different classes of stakeholders, and it can be difficult to reconcile these positions with the self-interests of owners and investors. Callon's vision of a 'calculative' and optimising technology is organised around the needs of investors. Yet as Carson (1962) argues, in the opening quotation to this chapter, accountability serves democracy when it provides information to those who are entitled to receive it, and where it consequently creates a public reaction to injustice. Hines (1988) confirms how this entitlement creates a pressure for disclosure which, in turn, provokes a reaction among recipients. The ability of accounting to create reality, and the tensions between conflicting stakeholder interests are not new areas of knowledge. Because they are widely understood among managers and accountants, they are likely to pre-empt a strategic approach to sustainability and carbon accounting on behalf of the accounting entity.

Meanwhile, accounting for carbon emissions is an emerging discipline, and still in its 'evaluation phase'. Hopwood (1987) describes how accounting is becoming increasingly used in areas for which it was not originally intended, evolving to meet the needs of a changing society. As accounting expands from the domain of money measurement to incorporate physical phenomena, it faces fresh challenges as it attempts to capture and measure those carbon emissions that can be reasonably attributed to the reporting entity. In short, as a frontier technology, carbon accounting can reasonably be expected to experience growing pains.

Reporting boundaries are a defining element of this new framework of carbon accounting. Callon (1998) describes the determination of boundaries as 'framing'. Framing establishes the criteria by which reporting boundaries are defined thereby determining the scope of carbon capture in company reports, and the extent to which these faithfully represent corporate emissions. Framing encapsulates many of the technical challenges encountered at the frontier of accounting, and will be extensively critiqued throughout this thesis.

1.4 Credibility

This thesis argues that, by increasing the visibility of emissions and disclosing strategic intent towards carbon reduction, accounting and disclosure can help modify the behaviour of a reporting firm and its stakeholders in ways that can help to reduce carbon trajectories. It is further argued that the reduction of national greenhouse inventories is a collaborative venture between government, corporate firms and other stakeholders; that trust is a fundamental characteristic of productive relationships and that rational stakeholders must make an active decision whether or not to trust those with whom they are required to collaborate.

Under these conditions, this thesis argues that stakeholders will wish to evaluate available information, including reported carbon emissions data and declarations of intent, to help them to make the decision to trust, or otherwise. In this respect, carbon accounting and disclosure will only be used if they are credible. Where this applies, carbon accounting and disclosure can be considered decision-useful when applied to the 'trust/ do not trust' decision.

Accordingly this thesis is interested in the notion of 'external credibility' which represents the extent to which information may be assessed as being 'believable', with respect to a stakeholder's decision whether to trust (and how to collaborate with) the reporting firm. For the most part, 'external credibility' is abbreviated as 'credibility' throughout the thesis, in the interests of economy, and references made to one of these two terms may be taken as being synonymous with the other.

In practice, there are a multitude of potential stakeholders that may engage with the firm in collaborative carbon reduction, and for whom the credibility of carbon accounting and disclosure are influential considerations. In the analysis contained in this thesis, particular regard is given to whether corporate accounting and disclosure can be considered to be credible; and how these data may affect the carbon collaboration specifically between the reporting firm, government, policymakers and financial analysts operating on behalf of investor clients.

1.5 Approach to the research

The research will adopt a middle ground approach, juxtaposing the numbers and narrative statements of accounting reports to create critical alternative narratives (Froud *et al*., 2006). The intention is to create the impetus for further investigation and dialogue, which open up the complexity of corporate carbon reduction as a means to collaborative success; rather than using discussion to 'close down' and limit stakeholder engagement (Senge, 1990).

The numbers and narratives approach will be conducted at three levels of analysis – national (macro), sectoral (meso) and firm (micro). Where narrative claims set out statements of intent that are not supported by subsequent delivery, their credibility is called into question. This research will evaluate the credibility of carbon reduction narratives at each level of analysis, and will explore how this affects the willingness of other stakeholders to engage in collaborative carbon reduction. By drawing attention to the credibility of carbon accounting and disclosure, and the collaborative nature of carbon reduction, this analysis will set up the basis for recommendations aimed at improving the current carbon accounting framework.

As a corollary to the evaluation of the carbon accounting framework, this thesis will consider how accounting may be used to modify behaviour and help frame policy interventions aimed at lowering carbon trajectories over time. This research will consider how carbon and financial information could be integrated within software applications designed to increase the visibility of organisational carbon risk. This strategy is based on the presumption that carbon risk is relatively under-appreciated by investors and their advisors, which limits its current impact on share selection and portfolio construction. If analysts are assisted in evaluating the carbon risk profile of their recommendations, and obtaining desired returns at a lower exposure to carbon risk, then it makes sense for them to make investment decisions that optimise value creation relative to carbon-intensity.

The focus of the research is both practical and experimental. It is inspired by Hopwood (2009) and Gray (2010) who call for a movement beyond the merely conceptual to articulate practical recommendations of what sustainability (and by implication, carbon) accounting might look like. At the same time, the resulting recommendations are likely to offer prototypes rather than final solutions. In time, it is hoped that future researchers will join the author of this thesis in trialling and developing its recommendations into mainstream accounting practice.

1.6 Outline of the thesis

Chapter Two conducts a systematic census of environmental and carbon-related articles appearing in journals throughout the five-year period preceding the commencement of the study. These journals comprise titles from the major business disciplines including accountancy, economics, sociology and strategy. They are relevant because the thesis is grounded in accounting; a discipline which is socially-constructed and informed by the perspectives of other social scientists. In addition to identifying papers, the chapter sets out to count and classify relevant articles according to journal title and academic discipline.

The purpose of this survey is twofold. First, the search is intended to locate high-quality, current articles from which to map out the terrain of academic argument, opinion and research and, in so doing, to locate this thesis within the context of contemporary scholarship. Second, it aims to quantify and classify papers to appreciate the extent of commitment shown by accounting academics to incorporating and developing environmental and climate-related themes within their field of study.

Chapter Three details the methodology adopted in furtherance of the research. The thesis assumes a middle-ground approach, which incorporates elements of quantitative and qualitative methodologies and which privileges methods that work to solve particular problems over strict confinement within tight philosophical technical and assumptive parameters. By way of method, the research investigates and analyses estimated time-series of physical emissions over three contrasting levels of analysis: the national (macro), sectoral (meso) and firm (micro) levels, to determine the extent to which these encourage supporting or contradictory alternative narratives of carbon reduction. The objects of study are located in the United Kingdom and the period of study comprises 2006-2011.

In addition to the numerical analysis of carbon footprint across the three levels, comparison is made between the physical carbon numbers reported and narratives disclosures in company reports, in order to evaluate the credibility of intentions stated by managers on behalf of the reporting entity, through the medium of accounting.

Chapter Four addresses the macro level of carbon accounting, and is interested in appraising the credibility of the government's stated position on carbon reduction. Using data obtained from the Office for National Statistics Environmental Accounts, the United Kingdom business sector emissions for the period are disaggregated into individual constituent greenhouse gases. These data series are

then statistically analysed using the innovative CUSUM[1] technique to identify change points which coincide with significant carbon-relevant events. On completion, the findings are interpreted alongside narratives inferred from the Climate Change Act 2008 to evaluate the credibility of the United Kingdom Government's carbon reduction policy.

Chapter Five aims to build on the first level of analysis by adding a second, meso, level. It seeks to achieve two objectives; first to act as a benchmark against which to evaluate the credibility and effectiveness of the government's carbon reduction policy. Second, it serves as a platform on which to appraise the credibility of collective intent of the corporate sector to reduce its carbon emissions.

The FTSE100 group comprises the largest companies listed on the London Stock Exchange, when ranked by market capitalisation. It therefore represents a substantial proportion of listed equity, along with commensurate sales revenue and employment. Using corporate reports and websites of the FTSE100 companies, the chapter sets out to compile a meso dataset of aggregated carbon emissions for the period 2006-2011. As well as comparing the meso and macro profiles, the chapter describes and reflects on the various challenges associated with the construction of the meso emissions dataset. In closing, the chapter infers a corporate carbon reduction narrative which it then evaluates against the physical outcomes reflected in the meso dataset.

Chapter Six presents a micro case study of four supermarket firms comprising the FTSE100 mixed-retail sector, which completes the analysis of carbon footprint time series by levels. This chapter considers a specific industrial sector in its socioeconomic context and extracts firm-level data to determine whether firms in the supermarket industry have reduced their emissions since 2006. By drilling down to firm level, the chapter considers whether numerical, graphical and verbal disclosures used in accounting reports confirm or distort the carbon reduction narrative that can be inferred from the trend in absolute physical emissions.

Chapter Seven reviews the narrative content of corporate reports of the mixed-retail case study firms. In particular, it considers whether carbon reduction intentions are registered consistently from one year to the next with regard to disclosed objectives and outcomes, or the extent to which the exercise amounts to an ad hoc approach. A taxonomy of narratives is created for this part of the research, and is used in conjunction with a keyword search to track and evaluate the credibility of disclosures between firms and over time.

[1] CUSUM is an abbreviated form of CUmulative SUM deviation; a statistical technique used for measuring bias in equal interval sequential data (Harris, 1994).

This chapter also evaluates the engagement of shareholders and managers with carbon reduction by comparing the objectives and rewards set out in numbers and narrative statements that describe the carbon performance requirements of executive compensation schemes.

Chapter Eight collates the finding of earlier chapters and considers how accounting tools and frameworks might be used to open up the visibility of carbon emissions, in order to provide financial intermediaries and investors with greater insight into carbon emissions and carbon risk.

Chapter Nine contains a broad range of proposals arising out of the thesis together with recommendations for future research.

Chapter Ten concludes the thesis by presenting its findings in context and reflecting on the limitations of the study.

Chapter Two

Literature Review

2.1 Introduction

This chapter starts with a consideration of the aspects and challenges subsumed within the broad organising framework of 'sustainable development'. It then moves to consider the literature describing greenhouse emissions, as an important subcategory of sustainable development, before concentrating its focus on the specific aspect of corporate carbon emissions. From this point, the literature review considers the ways in which corporate carbon emissions can be made visible by accounting in ways that inform stakeholders about carbon risk, and help modify corporate behaviour in ways that may contribute to carbon footprint reduction.

The broader sustainable development literature informs, organises and provides a context in which to locate the literature review on carbon emissions. Here, the work of Beck (1992) is instructive because it opens up the framing of sustainable development into a science of risk measurement and an associated 'reflexive' response, in terms of social and political dimensions which could include using measurement systems to inform regulation and intervention policy. Thus the issue of how greenhouse emissions are commensurated into 'carbon dioxide equivalents' is dependent upon the scientific conversion factors that transform individual greenhouse gases, for example methane, into carbon dioxide equivalents. This process of 'commensuration', or 'making things the same' (MacKenzie, 2009), provides a means of bringing physical phenomena in the form of greenhouse emissions into social and policymaking discourse, and facilitating carbon accounting at the international, national and organisational levels. However, measuring and attributing responsibility for carbon emissions is a contested space in which there are conflicts, contradictions, methodological challenges surrounding measurement and difficulties in establishing boundaries of responsibility.

The literature review then focuses on Beck's notion of 'reflexive modernisation' that social and political entities can be organised to 'manage' carbon emissions; or - as Elkington (2012) observes - how society and its supporting mechanisms could trigger changes in mind-sets, behaviours, cultures and the emergence of a new paradigm.

The focus of the chapter rests on the role that accounting can play in generating numbers and narratives that can be used to test the credibility of policies and initiatives designed to reduce

carbon emissions in the corporate sector, which accounts for over 70 per cent of total carbon emissions (Office for National Statistics, 2012a). Accounting is a socially constructed process that records financial flows as income and expenditures and balance sheet stocks. These numbers can be recorded for the individual firm, and at the levels of industry and the national economy, because aggregations are possible.

It has been argued elsewhere that incentives geared to financial targets can influence corporate behaviour and strategy towards trying to modify the financial numbers (Jensen, 1986; Lazonick & O'Sullivan, 2000). Accounting numbers extracted from financial reports can also be employed to construct narratives and critical commentaries about the extent to which outcomes align with expectations and can be used, in this way, to test the credibility of declarations of intention made by corporate managers (Froud *et al.,* 2006). In other words, the numbers disclosed in corporate annual reports can be reformatted into imaginative representations that test and reveal the credibility of corporate commitment to carbon emissions reduction.

There is also the potential that, because accounting numbers are socially constructed, it might be possible to reorganise and reframe the numbers used to describe corporate carbon emissions in corporate annual reports in such a way that may contribute towards modifying corporate behaviour in relation to organisational carbon dependency. Here, the literature on stakeholder theory is reviewed in the context of how it might be incorporated into a business model framework of analysis; in which 'the firm' is replaced as the boundary for collecting carbon data with a mapping of firm-stakeholder relations that are more, or less, carbon-intensive.

2.2 From sustainable development towards carbon emissions

Climate change policy and the reduction of carbon emissions are aspects of sustainable development, which is defined by the World Commission on Environment and Development (alternatively described as the Brundtland Commission) as being development:

> "that … meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987: para 27).

Thus, sustainable development and all of its components, including climate change policy, must be recognised for their social as well as environmental significance. Beck (1992) argues that problems like global pollution are direct consequences arising out of the knowledge gained as society moves from confronting basic problems, such as hunger, towards manifesting its mastery of nature through the progress of modernity:

> "While all earlier cultures and phases of social development confronted threats in various ways, society today is confronted by itself through its dealings with risks. Risks are the reflection of human actions and omissions, the expression of highly developed productive forces. That means that the sources of danger are no longer ignorance but knowledge; not a deficient but a perfected mastery over nature; not that which eludes the human grasp but the system of norms and objective constraints established with the industrial epoch. Modernity has even taken over the role of its counterpart – the tradition to be overcome, the natural constraint to be mastered. It has become the threat and the promise of emancipation from the threat that creates itself (Beck, 1992: p.183).

Thus Beck reveals two importance insights. The first is the emergence of the 'risk society', characterised by the risks of modernisation and typified by (though not limited to) global environmental degradation. Second, Beck introduces the notion of 'reflexive modernisation', which is manifested through sustainable development, *inter alia*. Knowledge, and disputes about knowledge, are foregrounded in reflexive modernisation; where scientific knowledge of risks is moderated by social and political dimensions, and this opens up a connection to accounting – and to plural forms of accounting, after Gray (1997, 2010) - which are explored later in this literature review.

Elkington (2012) is also consistent with this notion of risk society, where he argues that the stress on society and its supporting mechanisms could trigger changes in mind-sets, behaviours, cultures and the emergence of a new paradigm. The way to this end, according to Elkington, is to engage in 'thought experiments' which seek to reduce all adverse footprints (see also Brundtland, 1987) 'towards zero', and in so doing to fundamentally reform capitalism. In this way, sustainable development and corporate sustainability can be considered to be reflexive.

> "Properly understood, sustainability is not the same as corporate social responsibility (CSR) – nor can it be reduced to achieving an acceptable balance across economic, social and environmental bottom lines. Instead, it is about the fundamental task of winding down the dysfunctional economic and business models of the nineteenth and twentieth centuries, and the evolution of new ones fit for a human population headed towards nine billion people, living on a small planet which is already in 'ecological overshoot'" (Elkington, 2012: p.8).

The impact of Beck's 'reflexive modernity' and Elkington's 'thought experiments' has the potential to exert fundamental consequences upon economics and accounting, as these fields of academia and practice are forced to adapt in order to incorporate social and environmental functions:

> "… over time it has been much clearer that there are fundamental changes that we need to tackle in the coming decades, whose solution requires changes in the economy's basic operating system. These include rebooting the fields of economics, accounting, and company valuation to take account of the wider impacts of pollution" (Elkington, 2012: p.205).

This literature review begins by acknowledging Beck's 'reflexive' articulation of sustainable development in the context of how the social and political entities can be better organised to manage carbon emissions. In the foreground, the physical sciences are concerned with the measurement of greenhouse gases, their impact upon climate change and their commensuration into carbon dioxide equivalents, in order to render physical emissions amenable to social, political and economic integration. Supporting this literature, there are other studies concerned with accounting for carbon and modifying behaviour. The remainder of this thesis is principally concerned with carbon accounting but it does not ignore the fact that the framing of this literature can be used to inform the broader academic literature on sustainability. As Dyllick and Hockerts (2002) observe, the objective of sustainability includes bringing 'stakeholders' into the framing so that interventions at the corporate level must now pay attention to their present and future needs.

> "Sustainability grounds the development on a global framework, within which a continuous satisfaction of human needs constitute the ultimate goal (Brundtland, 1987). When transposing the idea to the business level, corporate sustainability can accordingly be defined as meeting the needs of a firm's direct and indirect stakeholders … without compromising its ability to meet the needs of future stakeholders as well. Towards this goal, firms have to maintain and grow their economic, social and environmental capital base while actively contributing to sustainability in the political domain" (Dyllick & Hockerts, 2002: pp.131-132).

Thus the sustainability literature carries three central framing elements: first the notion of 'risk society' where scientific knowledge of risks are 'moderated' by social and political interventions; second, that accounting has a role to play in terms of generating numbers and narratives that can help test the credibility of declared intentions to reduce carbon; and third, managing the environment requires stakeholder engagement and appropriate incentives to change behaviour.

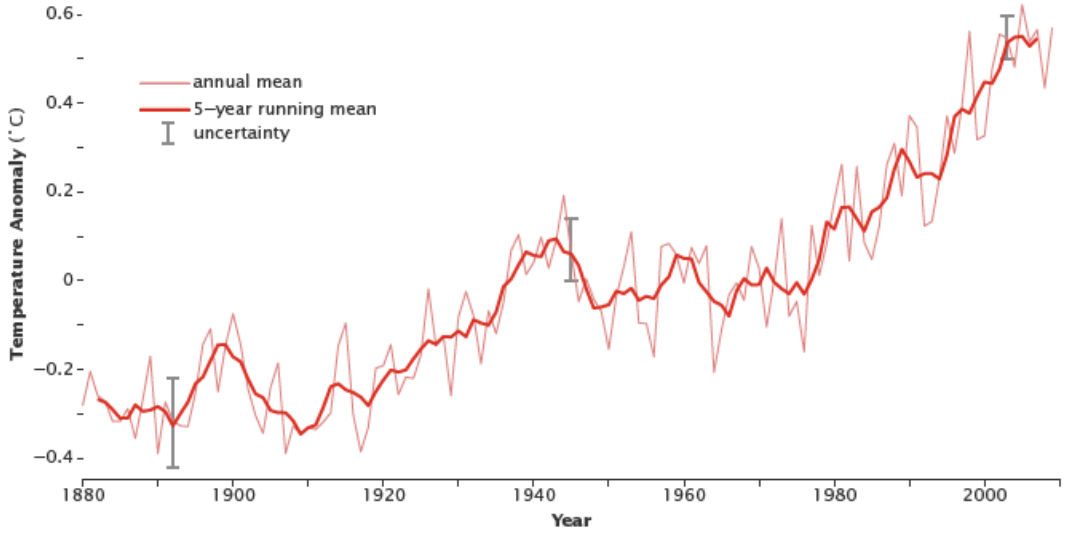
The next section of this literature review turns briefly to the science of climate change and greenhouse emissions; including a review of how these greenhouse emissions are commensurated into carbon dioxide equivalents.

2.3 The science of climate change and the commensuration of greenhouse emissions

The 'greenhouse effect' occurs when greenhouse gases absorb and then re-radiate thermal infrared radiation towards the earth's surface, trapping heat in the lower atmosphere. Regulated greenhouse gases comprise carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and the 'refrigerant gases'; namely hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Anthropogenic greenhouse emissions are released into the atmosphere as a consequence of human activity, mostly through the combustion of fuels and land-use change.

'Global warming' refers to the intensification of the greenhouse effect when caused by human activity (IPCC, 2007a). Figure 1 reveals how global mean surface temperature has increased over the period 1880 - 2010.

Figure 1. Global mean surface temperature



Source: Reproduced from NASA (2013)

The key feature of Figure 1 is that the rate of increase in temperature has increased from 1.1 degrees Celsius per 100 years in the first quarter of the 20th Century to 2.4 degrees per 100 years in the last quarter, and there are fears that this could make the current way of life on earth unsustainable in many ways, due to adverse impacts on food and water supply and habitation.

> "The IPCC has warned that our current trajectory will lead to warming estimated to range from 3.7 – 4.8°C over the 21st century. It anticipates severe adverse impacts on people and ecosystems through water stress, food security threats, coastal inundation, extreme weather events, ecosystem shifts and species extinction on land and sea. At the higher levels of warming, the IPCC states that these impacts are likely to be pervasive, systemic, and irreversible" (Pricewaterhouse Coopers, 2014: p.2).

Individual greenhouse gases vary according to their physical characteristics, including the time taken to decay in the atmosphere. The harmful impact of each gas, relative to carbon dioxide, is expressed as a global warming potential (GWP). GWP is estimated by 'commensuration', which converts the physical quantities of each gas into 'tonnes of carbon dioxide equivalent' (CO_2e), allowing different gases to be aggregated by virtue of a common property (Espeland & Stevens, 1998). Commensuration is therefore the conflation of a physical entity into a social one, in which the accountant replaces physical properties with an economic meaning (see Dillard *et al*., 2005). It is essentially a reconstruction of disparate physical greenhouse emissions into one 'carbon footprint'.

The following equation simplifies the commensuration of gases into carbon footprint:

$$\text{Carbon Footprint (tonnes } CO_2e) = \Sigma^{all\ i} G_i M_i$$

Where G = GWP, M = mass of emissions (tonnes), and i is all of the gases, CO_2, CH_4, N_2O, PFCs, HFCs and SFCs.

Table 1 reveals the proportion of each gas comprising the United Kingdom greenhouse gas inventory, together with individual GWP estimates.

Table 1: The mix and GWP of greenhouse gases in the United Kingdom inventory

Greenhouse Gas	% Carbon Footprint (2008)	Global Warming Potential (GWP)
Carbon Dioxide (CO_2)	87	1
Methane (CH_4)	5	25
Nitrous Oxide (N_2O)	7	300
Refrigerant Gases	1	11,700 *

* For the purpose of simplicity, the GWP of HFC-23 is included as a representative of refrigerant gases (See MacKenzie, 2009).

Sources: Author, using data provided by Office for National Statistics (2010); Berners-Lee & Clark (2010)

Despite the fact that natural events contribute to the greenhouse effect, the Intergovernmental Panel on Climate Change (IPCC) – an international scientific review body established by the United Nations - concludes that: "most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations" (IPCC, 2007b).

It is helpful here to distinguish between global warming, and climate change where the latter term collectively describes various indirect and long-term consequences of global warming:

> "Climate change' refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC, 2007b).

Climate change is therefore a 'global problem', in which "changes at a local scale, in turn, contribute to global changes as well as being affected by them" (Wilbanks & Kates, 1999: p.601). This contrasts with 'local problems' such as effluent spills, where those responsible for offending behaviour are also directly and personally affected by it. The impact of climate change upon human life is predicted

to vary between regions. For example, global warming may bring agricultural benefits to some countries and harm to others (see Ashenfelter & Storchmann, 2010; Felkner, Tazhibayeva & Townsend, 2009; Olesen & Bindi, 2002; Schlenker *et al.,* 2006). However, the more harmful consequences could include extreme weather events, reduction in ice sheets and loss of biodiversity. Low-lying countries, like Bangladesh, are especially vulnerable because rising sea-levels could threaten food security and trigger displacement of the population. A significant element within the debate on climate change and global warming is the concern with the use of carbon and emissions of carbon dioxide. This thesis will focus on the issue of carbon emissions and how and to what extent carbon reduction targets can be accounted for and behaviour modified. The following sections focus on the arrangements for reducing global carbon emissions before turning to review the literature on carbon emissions and accounting for carbon.

2.4 Reducing carbon: numbers and targets set by the Kyoto Protocol

Science confers legitimacy on calls to mitigate and adapt to the impact of climate change and examples of past successes include the discovery that Chlorofluorocarbons (CFCs) threatened the ozone layer, and the subsequent enactment of the Montreal Protocol (Farman *et al*., 1985; Pyle & Harris, 2013), and the removal of lead tetraethyl additives from gasoline to combat the effects of toxicity on public health (Kovarik, 2005). Scientific methodologies employ numbers and measurement to helping to explain, predict and formulate recommendations:

> "I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind. If you cannot measure it, you cannot improve it" (Kelvin, 1883[23], in Kaplan, 2010: p.3).

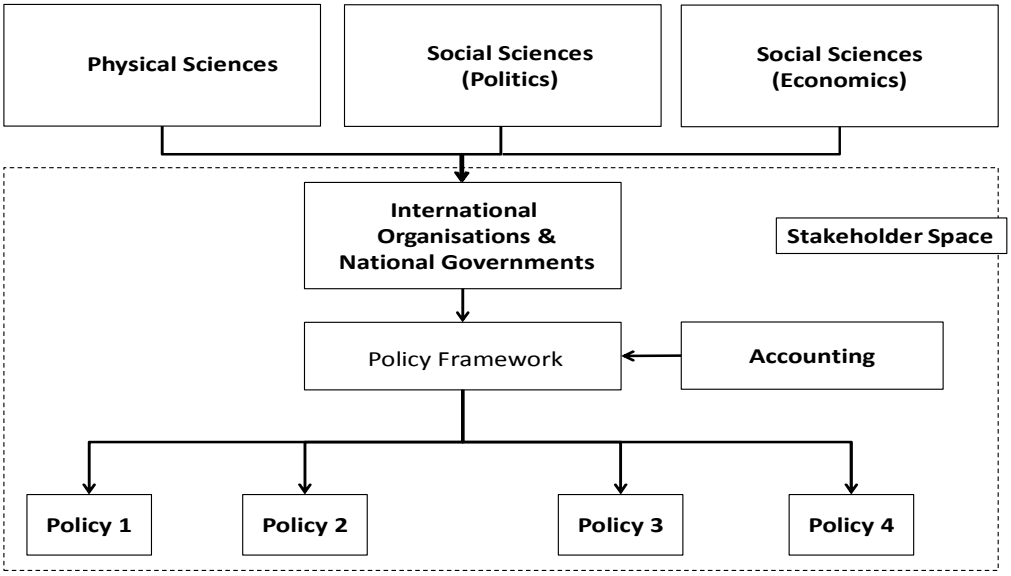
Scientific numbers, measurement and quantitative analysis have entered the domain of international climate change policy. According to Liverman (2009), policymakers have inferred from scientific opinion that the avoidance of harm is consistent with climate stabilisation at an atmospheric concentration of 450-550 parts greenhouse gas per million (ppm). While significantly higher than the present 393.66 ppm (Earth System Research Laboratory, 2013), scientists predict that increases in global mean temperatures should not exceed 2˚C above pre-industrial levels, if concentrations are to be held within this range (IPCC, 1995). This requires action to be effective within the career span of any individual starting work now.

[2] The original quotation can be found on page 72 of Thomson (1899) *Popular lectures and addresses. Vol 1*. London: Macmillan and Co. This is reproduced in facsimile online by the Internet Archive (2007) with funding from Microsoft Corporation and can be accessed on: https://archive.org/stream/popularlecturesa01kelvuoft#page/n3/mode/2up

[3] Kelvin, here, is William Thomson, Lord Kelvin, the physicist known for his work on thermodynamics, and after whom the unit of temperature is named.

The transition of scientific consensus into policy is difficult because science needs to influence a diversity of stakeholders if it is to infiltrate and change the political narrative. In addition, separate arguments must be used to win over stakeholders if science is to penetrate the economic narrative. Both tests must be satisfied in order to create science-driven policy. Figure 2 illustrates these dynamics. The United Nations (UN) has assumed political responsibility for international climate change policy. In 1997, the UN secured the agreement of 191 states to the Kyoto Protocol, which imposes legally-binding carbon-reduction targets on developed countries. These countries are then required to implement these obligations into domestic legislation.

Figure 2: From science into policy across the stakeholder space



Source: Author

Appendix A contains a timeline documenting significant developments in the science, politics and regulation of climate change. Helm (2008) argues that science and international climate change policy are disconnected because they fail to incorporate the economic and population growth of China and India, and the consequential increases in energy consumption and emissions. Helm places these factors at the 'core' of any credible international decarbonisation strategy. In its recent assessment, the Government of Canada (2011) concluded that Kyoto regulates less than 30% of the world's emissions.

The Kyoto Protocol allocates legally-binding emissions targets among Annex 1 countries. During the initial five-year commitment period (2008 – 2012), the European Union (EU) agreed to reduce its emissions by 8.5% relative to the 1990 baseline (UNFCCC, 1998). For its share of the EU target, the

United Kingdom agreed to 12.5% and 20% reductions over the first and second commitment periods (European Commission, 2013).

2.5 Reducing carbon and UK adoption of the Kyoto Protocol

To implement the Kyoto Protocol, the United Kingdom enacted the Climate Change Act 2008, establishing legally-binding national targets: an 80% reduction in greenhouse emissions over the period 1990 – 2050 and an interim target of 34% by 2020 (United Kingdom Parliament, 2008). The Act also provided for five-year carbon budgets and the publication of a Carbon Plan to be laid before Parliament, detailing the means of delivering these reductions. If it is to work, this 'top-down' policy will depend on a 'bottom-up' response from corporate stakeholders who will be expected to deliver absolute reductions in carbon emissions.

The United Kingdom Government commissioned Sir Nicholas (now Lord) Stern to report on the impact of global warming on the world economy. Stern was Chairman of the Grantham Institute on Climate Change and the Environment at the London School of Economics, and The Stern Review on the Economics of Climate Change was presented to the government in October 2006 (See Timeline – Appendix A). The reception given to the Stern Review demonstrates that it is more difficult to blend scientific opinion into the economic narrative than proved to be the case when science was assimilated into the political narrative.

The timing of the Stern Review was curious because the United Kingdom had already ratified the Kyoto Protocol and had incurred obligations under international law. Therefore, if the intention was to legitimise policies enshrined in the (subsequent) Climate Change Act, it would have been unfortunate if the *Review* had contained inconvenient conclusions. As it transpired, the *Review* provided an economic justification for the ambitious national carbon reduction targets mandated in the Act. The *Review* was immediately both influential and controversial. Two prominent and authoritatively stated themes emerge from its 700 pages:

> "The benefits of strong, early action on climate change outweigh the cost" (Stern, 2007: p.i)
>
> "resource cost estimates suggest that an upper bound for the expected annual cost of emissions reductions consistent with a trajectory leading to stabilisation at 550 ppm CO2e is likely to be around 1% of GDP by 2050" (Stern, 2007: p.xiii) (Later revised to 2% - see Jowitt & Wintour, 2008).

Nordhaus (2007) and Weitzman (2007) argue that the report is as political in nature as it is economic, and that moral concerns, such as intergenerational equity, outweigh economics in its choice of discount rates. The Stern Review is relevant to this thesis because instead of settling the issue, closing it down and legitimising the government's climate change strategy; it stimulated a dialogue, which exposed the unresolved complexity of the economics of climate change. Stern's unintended achievement was to provoke other academics into contributing to the methodology of economic climate change assessment, where the resulting dialogue reveals a tension between political intentions, as enshrined in the Climate Change Act, and their likely economic consequences. Stern was unable to persuade the academic and business communities that immediate mitigation is cheaper mitigation.

International and national carbon targets have become a significant component of a broader 'sustainability agenda' and these incorporate the measurement and recording of carbon emissions as a significant development. The following section considers the challenges associated with measuring and accounting for carbon.

2.6 Accounting for carbon: the challenge of measurement

While carbon accounting can help evaluate the credibility of statements of intent made by another, it is functionally impaired where the goals and expectations of the various actors who have created it are incongruent (Bowen & Wittneben, 2011; Dillard *et al*., 2005). Differences exist because scientists, governments, economists and accountants incorporate different standards of accuracy, consistency and certainty into their preferred measures of carbon emissions. Moreover, unlike natural systems, social systems abstract information and manipulate it to apply meaning, using a network of rules, values, assumptions and protocols. The essence of accounting is to privilege the impact of phenomena on human interests rather than natural systems (Dillard *et al*., 2005). As a result, carbon accounting does not necessarily represent physical emissions, becoming instead a "way of telling a carbon performance story" (Bowen and Wittneben, 2011: p.1032). The same characterisation applies equally to corporate and national carbon accounting.

The field of capture of UK carbon emissions data is defined by a process of framing. At a macro and aggregate level this distinguishes those emissions that will be counted from those that will be disregarded when compiling the national inventory. As Callon (1988: p.16) explains:

> "In short, a clear and precise boundary must be drawn between the relations which the agents will take into account and which will serve in their calculations and those that will be thrown out of the calculation as such".

The National Accounting boundary captures those emissions arising within the territorial borders of United Kingdom, together with those generated by the combustion of fuel purchased by United Kingdom residents abroad (including those used in shipping and aviation). However, the settling of boundaries inevitably creates 'overflows', which defy framing (Callon, 1998). For example, national accounting captures emissions from production and excludes emissions embedded in imported goods and services (as consumption). The impact of these overflows is far from trivial: Helm *et al*., (2007) calculate that the claimed 12.5% reduction in overall United Kingdom greenhouse emissions over the period 1990-2005 would need to be restated as a 19% increase, if 'imported' emissions were taken into account.

The national accounting methodology uses a 'top-down' approach to estimate greenhouse emissions attributable to each industrial sector by Standard Industrial Classification. Carbon data are allocated to different sectors according to activity statistics obtained from other sources. Once calculated, the national emissions are organised into various formats; the United Kingdom National Accounts (see Chapter 4) and versions adapted for the IPCC and UN Economic Commission for Europe. These allocations can be based on 'emissions at source' or by 'estimating' the amounts using other variables to determine the quantum of carbon emissions.

> "Greenhouse gases can be measured by recording emissions at source by continuous emissions monitoring or by estimating the amount emitted using activity data (such as the amount of fuel used) and applying relevant conversion factors (e.g. calorific values, emission factors, etc.)" (DEFRA, 2013a: p.1).

These estimates' are subject to a continuous process of adaptation and adjustment as methodologies and allocation mechanisms change over time. Even over short periods of time these estimates may be subject to substantial revisions in the order of plus or minus 10% from one year to the next.

> "Additional information is also provided in Appendix 2 of this report on major changes to the values of specific emission factors (i.e. +-10% since the 2012 GHG Conversion Factors). Some of these changes are due to the methodological adjustments outlined above and in the later sections of this methodology paper, whist others are due to changes in the underlying source datasets" (DEFRA, 2013a: p.3).

These conversion factors are also used to inform individual organisations how to calculate estimates of greenhouse gas emissions from a range of activities, including energy use, water consumption, waste disposal, recycling and transport activities; for example, a conversion factor can be used to calculate the amount of greenhouse gases emitted as a result of burning a particular quantity of oil in a heating boiler (DEFRA, 2013: p.1). At the organisational level of the individual firm, the GHG Protocol defines direct and indirect emissions of firms as follows:

> "Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity. …Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity" (WRI & WBCSD, 2012).

The Greenhouse Gas Protocol (GHG Protocol) nominates direct emissions within a single category, and subdivides indirect emissions into two subcategories determined by the source of those indirect emissions. The categories and sub-categories are referred to as 'scopes':

- Scope 1: All direct GHG emissions.

- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.

- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. Transmissions and Distribution losses) not covered in Scope 2, outsourced activities, waste disposal).

Furthermore, the GHG Protocol 'frames' carbon emissions by locating emissions by scope within organisational boundaries which purport to represent responsibility for and control over these emissions, as detailed in Table 2.

Table 2: Framing by scopes and boundaries under the Greenhouse Gas Protocol

Scopes (Emissions)		Boundaries (Reporting)
1	Direct Emissions – from sources owned or controlled by the company. Typically arising from combustion	Scopes 1 and 2 emissions are recognised and reported where occurring within the Organisational Boundary – defined according to criteria of ownership or control (equity share or financial control) Equity share – A firm accounts for 100% of its own scope 1 and 2 emissions. Where it has a stake in another firm, it accounts for a proportion of the invested firm's emissions equivalent to its percentage shareholding. Financial Control - A firm accounts for 100% of its own scope 1 and 2 emissions. Where it exercises financial control over another firm (51% or more voting capital) it will also account for 100% of that firm's emissions.
2	Indirect Emissions – from purchased electricity, where the emissions are incurred on behalf of the firm by an external energy company.	
3	Other Indirect Emissions – other emissions incurred by other organisations on behalf of the firm. An optional reporting category.	

Source: Author, using definitions obtained from the Greenhouse Gas Protocol (WRI & WBCSD, 2001)

2.7 Carbon accounting in academic literature and professional protocols

Carbon accounting enters the domain of corporate reporting because the accountability for organisational greenhouse emissions requires a process of estimation (measurement) and disclosure. An alternative school recognises the potential for accounting to create rather than merely reflect reality. Hines (1989) states that: "Reality is created and sustained by the ceaseless reflexive use of accounts, by social actors in constant interaction with each other" (see also Hines, 1988). Following a similar theme, Hopwood (1987: p.213) observes:

> "Accounting … is not a passive instrument of technical administration, a neutral means for merely revealing the pre-given aspects of organisational functioning. Instead its origins are seen to reside in the exercising of social power both within and without the organisation. It is seen as being implicated in the forging, indeed the active creation, of a particular regime of economic calculation within the organisation in order to make real and powerful quite particular conceptions of economic and social ends".

A radical school of accounting urges that accountants should 'take sides' and act as agents of social change (Tinker *et al*., 1991); to "expose, enhance and develop social relationships through a re-examination and expansion of established rights to information" (Gray, 1992: p. 413; Dillard *et al*., 2005).

Despite the emergence of frameworks governing carbon accounting and disclosure (such as the GHG Protocol), very few academic carbon accounting articles have been published in the major business and accounting journals. As part of the literature review, this researcher has conducted a systematic literature survey to gauge the business academic research community's commitment to sustainability, environmental and carbon accounting. The survey interrogated journal titles listed within the Association of Business Schools (ABS) Academic Journal Quality Guide, which identifies the relevant '4-rated' journals. The survey findings do not represent the entire research output. Rather, they indicate the degree of academic commitment to selected themes, reflected in the publication criteria of an externally-selected reference group of elite social science journals.

Seven relevant disciplines, comprising 51 journal titles, feature in the survey (see Appendix B), which covered the period 2005-2010. Relevant articles were identified from their titles and abstracts, counted and collated. Table 3 summarises the survey results, which are contained in greater detail in Appendix B.

Table 3 reveals a low frequency of environment and climate change articles from which the majority of 'relevant' articles were published in the Economics and Social Science categories. When combined, these account for 57% of titles (see Appendix B). In the field of Economics, which has the

greatest exposure, climate change featured only once in every hundred articles. The Accountancy category comprises 5 journal titles that have published just 5 climate change articles between them over the six-year period. Goodall (2008) searched the keywords 'climate change' and 'global warming' in her survey of articles appearing in a 'top-30' list of management journals covering the period 1970–2006. From a population of approximately 31,000 articles, only 9 examples featured global warming or climate change.

Table 3: Article frequency (environment and climate change): ABS '4-rated' Journals (2005-2010)

ABS Subject Category	Total Article Count	No. Environment Articles	No. Climate Change Articles[4]
Economics	7,015	243	73
Social Science	6,657	206	46
General Management	3,104	45	25
Accountancy	1,142	18	5
Strategic Management	428	9	3
Organization Studies	1,410	4	0
Finance	2,178	1	0
TOTAL	21,934	526	152
Percentage	100%	2.4%	0.7%

Source: Author

The analysis of the extant literature within this survey reveals there is no consistent academic definition for 'carbon footprint'. It is likely that 'carbon footprint' evolved from Rees' 'ecological footprint', which quantifies the land area required to sustain per capita consumption in one region, and which permits inter-regional comparison (Rees, 1992; Rees, 2006; Rees, 2011; see also Ascui & Lovell, 2011). Accordingly, a suitable definition should describe the essential qualities of the carbon footprint with respect to its intended use: A definition suggested here is:

> *Carbon footprint is a metaphor used to describe an estimation of the harmful impact of an entity (country, industrial or social grouping or an organisation) on global warming, caused by that entity's anthropogenic greenhouse gas emissions. As with any footprint, the carbon footprint contains information, which may be used to describe, characterise and identify the entity to which it belongs.*

[4] Note that the 526 environment articles include the 152 climate change articles.

The accounting literature on sustainability and carbon footprint takes the position that economic development is antagonistic to environmental sustainability. In other words, as the world's consumption pattern (measured as gross domestic product) continues to grow, this also generates and inflates its collective carbon footprint. Thus modernity is challenged, amid calls for "paving the way for a reorganisation of society along more humane and ecologically sensitive parameters" (Spence, 2009: p.207), and a vision of the future that demands economic growth align with a broader public good, in a world not driven by carbon consumption (Nair, 2011). This involves 'reshap[ing] capitalism and its relationship to society' and a recalibration of markets to respond to social as well as economic drivers (Porter & Kramer, 2011, p.64; Elkington, 2012). At the practical level, accounting has "the potential to privilege economic considerations, natural considerations or both": where it embraces multiple stakeholder engagement, accounting "has the potential to retard the momentum of the currently irresponsible and exploitative trajectory" (Dillard *et al.*, 2005: pp. 97 & 98). In a world that is becoming reconciled to carbon footprint reduction, the challenge is to redefine the notion of progress along less carbon-intensive lines. By adopting an inclusive framework, which engages with broad stakeholders around the internalisation of environmental costs, accounting becomes instrumental in creating a new reality for a post-carbon age (Hines, 1988; Dillard *et al.*, 2005; Knox-Hayes, 2010).

This positive framing of the role of accounting for carbon can be set against a literature that that is more critically informed and this can be classified into four groups which correspond with recurring themes:

- The sheer scale of economic development to be inexorable and carbon emissions will continue to rise.
- Carbon emissions should be brought into the domain of accounting and regulated via the market mechanism.
- Carbon accounting is problematic because it is difficult to frame reporting boundaries.
- Carbon disclosures to institutional investors are not influencing and modifying behaviour.

Milne and Grubnic (2011) examine the challenges of achieving international carbon reduction commitments at the levels of the corporation and the national economy. Taking the example of Air New Zealand, the authors explain how carbon savings from a 40% increase in fuel-burn efficiency have been outstripped by the tripling of operating capacity; therefore accounting can be used to shift the attention of stakeholders towards efficiency rather than effectiveness (see also Dyllick & Hockerts, 2002). Moreover, if New Zealand was to achieve a 40% reduction in its national emissions,

as urged by Greenpeace, this would require elimination of all transport emissions, and an additional equivalent reduction from other sources. This literature therefore offers multi-level perspectives that illustrate how the scale of the carbon reduction challenge facing modern societies brings economic progress into direct conflict with the achievement of the scale of carbon reduction demanded by science-driven environmental policies.

With regards to bringing carbon into a regulated market mechanism, Lohmann (2009: p.499) disagrees with attempts to internalise greenhouse emissions within the market sphere, noting the "conflicts, contradictions and resistances engendered by environmental accounting". Bringing the environment into the 'calculative space' and monetising carbon emissions requires that rational decision makers actively consider the undesirable behaviours that the carbon trading markets were intended to deter. Companies that have purchased emission allowances to offset carbon emissions have made a cost-benefit calculation that legitimises their actions. Thus a 'fine' has become a 'price' (Gneezy & Rustichini, 2000).

There is also the challenge associated with 'framing'. This is concerned with how the financial boundaries of the firm are aligned with the physical boundaries on carbon use. Kolk *et al*. (2008) observe that scope 3 emissions are ill-defined, because firms are free to decide how far they wish to track emissions along their supply chain. For example, some firms attempt to capture employee business travel while routinely omitting other elements, such as "purchased materials and fuels, transport-related activities, outsourced activities, use of sold products and services, and waste disposal" (Kolk *et al*., 2008). Matthews *et al.* (2008: p.5842) conclude that "these protocols will, in general, lead the organizations to [claim] footprint estimates that are relatively small in comparison with their total life-cycle footprints". For example, 90% of Kraft Foods greenhouse emissions are designated within scope 3 (WRI & WBCSD, 2011b).

The practical manifestation of framing is represented by the allocation of operational boundaries into three 'scopes' (see table 2). The first two scopes comprise direct emissions (scope 1) from combustion-based activities, and indirect emissions (scope 2) from purchased electricity. Scope 3 or other indirect emissions - described by the Greenhouse Gas Protocol as an optional category – are embedded in purchased supplies (WRI & WBCSD, 2001). Thus the challenge facing organisations is that of allocating their carbon footprint into the scope 1, 2 and 3 categories. A specific example serves to illustrate the malleability associated with this classification and accounting process. It is possible for reporting entities to modify the structure of their balance sheets, for example, the sale and leaseback of non-current assets. In the United Kingdom, the Kingfisher plc retail group has undertaken sale and leaseback deals of its B & Q DIY retail warehouses. These financially-motivated

manoeuvres can also impact upon the location of carbon within scopes 1, 2 and 3, determining whether these are counted as being 'inside', or disregarded as remaining 'outside' of an entity's reporting boundary. Emissions from leased facilities and vehicles may be classified as Scope 1, Scope 2, or Scope 3, depending on the source of emissions; the approach used by a company to establish its organisational boundary, and the type of leasing arrangement in place. Leased assets that fall within a company's organisational boundary should be classified as Scope 1 or 2 (depending on whether they are direct emissions, or indirect emissions from purchased electricity), while those falling outside the company's organisational boundary should be classified as Scope 3 (WRI & WBCSD, 2012). Thus the framing of carbon emissions and their consequent disclosure in corporate reports is both complex and malleable. As Lohmann observes, every attempt to bring something 'inside' creates new 'outsides'; resulting in porous, malleable and unstable boundaries because the spaces of calculation and non-calculation cannot be walled off in rigid, mutually-exclusive spheres (Lohmann, 2009, p. 502)

A fourth dimension of the literature evaluates the usefulness of sustainability and carbon information to institutional investors via their advisors (Campbell & Slack, 2011). Other studies evaluate carbon disclosures made outside mainstream corporate reports via the Carbon Disclosure Project (CDP) (Andrew & Cortese, 2011; Kolk *et al*., 2008). CDP is an "international not-for-profit organization" (CDP, 2013) which compiles and reports voluntary carbon emissions disclosures submitted by corporate subscribers. CDP incorporates these disclosures into reports and league tables that inform institutional investors about sustainability risks within their portfolios (CDP, 2013). This literature can be sub-divided into two positions on disclosure. First, sustainability and carbon disclosures appear to have made a limited impact on investor stakeholder groups. Second, CDP disclosure is not a direct substitute for mainstream disclosure using the more established stream of individual corporate reports. Campbell and Slack (2011), for example, interview bank sell-side analysts to determine their interest in corporate environmental reporting disclosures. They discovered that analysts tend to consider these disclosures 'irrelevant and immaterial', and that they fail to align with their incentive structures and institutional cultures. Campbell and Slack concluded that these disclosures would only become relevant if adapted to fit the analysts' forecasting models, and modified to emphasise their financial orientation.

CDP has the "largest collection globally of self-reported climate change, water and forest-risk data". At the present time, it receives voluntary carbon data submissions from "thousands of companies" and provides information to 722 institutional investors with an estimated $87 trillion of assets under management (CDP, 2013). Yet despite these achievements, Kolk *et al.* (2008) conclude that the level

and detail of disclosure is not particularly valuable for investors and other stakeholders, for reasons associated with commensuration, comprehensibility, completeness and reliability. Andrew and Cortese (2011) find that corporate CDP disclosures employ diverse methodologies that frustrate comparability, and they question the quality of CDP's independence. While acknowledging the diversity of CDP's corporate funders, Andrew and Cortese (2011: p.133) demand greater scrutiny of the scale of corporate backing, if it has the potential to "further entrench the current economic status quo as the only path to a more environmentally responsible future".

In common with Campbell and Slack, Kolk *et al.* (2008: p.28) conclude that "there is no real evidence that the information is helpful and is being used by investors in their decision-making processes". This thesis aims to contribute to disclosure practice that encourages carbon reduction; therefore it must consider whether disclosure is more aptly progressed within corporate reporting or through collective, third-party initiatives. Ascui and Lovell (2011: p.990) state that CDP responses are "not necessarily complete, nor necessarily made public". Moreover, CDP's claimed independence – questioned by Andrew and Cortese (2011) - may legitimise corporate reporting, while simultaneously masking the shortcomings alleged in literature. Collective reporting, which collates data into reports and league tables, privileges aggregation and ranking over the visibility of granular information about emissions and the interactions that produce them.

This review of how companies can account for carbon and the usefulness of these disclosures reveals a number of challenges, which centre on how accounting for carbon might help to increase the visibility of carbon-risk to society and contribute towards modifying behaviour. This thesis is motivated by Hopwood's (2009) call to incorporate existing knowledge into the creation of *practical* methods and systems that increase the importance of sustainability within corporations:

> "the research traditions now established in the area of the organisational and social analysis of accounting provide a good basis for looking beyond abstract schemes for change and improvement to explore the actuality of their functioning and operations, and to use this knowledge for the more realistic design of approaches to changing both the significance which environmental and sustainability considerations play in the corporate sphere and our ways of gaining insights into the adequacy or otherwise of these" (Hopwood, 2009, p. 439).

Hopwood implies that the 'design of approaches' is at an early stage, and that development and evaluation should proceed in tandem. Gray calls this 'experimenting':

> "The key, it seems will therefore be to re-habilitate the experiments considered in 'What does accounting for sustainability look like?' as potential sources of counter-narratives, as part of a multiple and expression of sustainability in organisations" (Gray, 2010: p.59).

In this thesis, the objective is to focus on what 'carbon accounting' might look like; its potential to become an integral part of corporate governance, and incentives that change the field of the visible

and modify behaviour towards the achievement of meaningful carbon footprint reduction in large corporations.

2.8 Evaluating the credibility of intention by reframing carbon accounting

In order to explore the possibility of 'experimentation' with carbon disclosure numbers, this section draws upon three notions: first, carbon reporting is conducted at different levels of aggregation; second, there is a need to reframe existing numbers into new formats; and third, these accounting numbers then be used to generate alternative narratives and insights that can be employed to test the credibility of declared intention to reduce carbon footprints.

Froud *et al.* (2006) reveal how different analyses can be performed at macro, meso and micro levels of aggregation to frame critically engaged narratives and to test the credibility of management declarations. It is important, for example, to understand how macro aggregate trends of national accounting data are moving in order to appreciate trajectory. Thus the macro emissions data extracted from the United Kingdom Environmental Accounts, produced by the Office for National Statistics, are an important resource from which to articulate narratives about carbon emissions. However even at this level there are, as already noted in this literature review, methodological challenges and different ways of accounting for national carbon emissions, which can either be based on measures of territorial economic output or consumption. A numbers and narratives approach used to generate critically engaged narratives would suggest that both output and consumption data are needed to consider the extent to which macro carbon emissions are on a downwards trajectory (see Froud *et al*., 2006; Gray, 1997, 2010). This could take the form of type of 'shadow accounting' which reveals contradictions as a basis from which to test credibility:

> "Shadow accounting can be viewed as a technology that measures, creates, makes visible, represents, and communicates evidence in contested arenas characterised by multiple (often contradictory) reports, prepared according to different institutional and ideological rules, Any evaluation of shadow accounting should recognise this context for power and the intention to influence decisions" (Dey *et al.,* 2011: p.64).

Gray (1997, 2010) justifies the juxtaposition of multiple accounts drafted from competing methodologies using the argument that:

> "… there is clearly no single ''sustainability" that can be known and accounted for. What there can be, in all probability however, are more tangible ways of knowing about unsustainability under differing assumptions" (Gray, 2010: p.56).

At a meso - or industrial grouping – level, it is also important to understand the extent to which carbon emissions are increasing or reducing. The United Kingdom corporate sector accounts for over 70 per cent of national carbon emissions (Office for National Statistics, 2012a) and thus an

understanding of the trajectory of carbon emissions within the FTSE100 group of companies would contribute additional valuable insight into the nature of absolute carbon emissions and carbon intensities; and also help to test the credibility of the declared national carbon reduction strategy by comparing the effectiveness with which corporate stakeholders are engaging with the national plan. This type of meso-level data could also provide a useful resource within which to review one firm's performance against that of the FTSE100 as a whole, so that a narrative about relative performance could be generated. Problems may arise with this form of analysis where not all FTSE100 firms have consistently disclosed their historic carbon emissions, and it is only from October 2013 that all companies in the London Stock Exchange Main Listing have been required to make carbon disclosures in their annual reports, under the Companies Act 2006 (Strategic and Directors' Reports: Regulations 2013). These mandatory disclosures include the absolute annual greenhouse emissions (in tonnes CO_2e) from activities for which the company is responsible, and at least one carbon intensity ratio.

In addition, financial metrics and physical carbon emissions data for individual large firms could be combined to reveal the trade-off between the financial performance of the reporting firm and its carbon usage. It is this type of information that investors and pension funds will require as they progressively seek to reduce carbon risk exposure in their investment portfolios, to add credibility to their capital stack allocations as the perception of corporate carbon risk becomes more established in the financial community. Furthermore, embedding relative carbon-intensity performance metrics into executive remuneration packages would help to strengthen the alignment between investor interests and corporate use of resources and to transition to less carbon-intensive business models.

Executive remuneration packages already include bonuses linked to boosting Earnings per Share (EPS), Return on Capital Employed, and Economic Value Added (EVA™) relative to peers or to a benchmark index. These might reasonably – and feasibly – be extended to include carbon emissions per employee, carbon emissions generated from revenue, cash earnings or profit relative to other investable companies from the same index. These metrics could also be incorporated into senior executive remuneration packages and weighted towards transforming medium to long-term carbon emissions reduction. There is significant evidence to show that where the incentive has a considerable weighting in the overall bonus package this can help to modify corporate governance. Jensen (1986) observed how the use of debt finance would help to modify managerial motivations and Lazonick and O'Sullivan (2000) consider how the rise of shareholder value metrics modify corporate governance towards maximising returns to shareholders, so that their cash bonuses and stock options are triggered as part of their remuneration packages. Thus there may be scope to

incorporate relative carbon emissions metrics into the remuneration packages that govern executive compensation, with the intention of modifying corporate commitment to carbon reductions.

At the level of the reporting entity there is also scope for experimentation in terms of the way in which disclosures are made within the annual financial statements. International Accounting Standard 1 (IAS1) is concerned with the presentation of a reporting entity's financial statements and relevant information to be disclosed. Insofar as statements of comprehensive income are concerned, the normal practice is for companies to report their comprehensive income using the 'function of expense format', which aggregates expense lines into functional categories such as cost of sales, selling and administration expenses and research and development expenses. However, IAS1 also stipulates that if a reporting entity chooses to report expenses by function, it should also disclose sufficient information to enable the user of the financial statements to convert a functional comprehensive income statement into one that is formatted to reveal the 'nature of expenses' (Deloitte, 2013).

In 2007, the Chartered Financial Analysts (CFA) Institute called for the disclosure of financial information by its nature because this would enhance comparability and because aggregating expenses by function congealed information with variable properties thus limiting its interpretative and decision-making quality:

> "By 'nature', we mean that items should be reported by the type of resource consumed, such as labor or raw materials, rather than by the function or purpose for which it is used, for example, cost of goods sold or selling, general, and administrative expense. Categorization according to nature can greatly enhance comparability across companies and consistency within the statements of a single company" (CFA Institute, 2007: p.14).

Disclosing financial information using the 'nature of expenses' approach more closely aligns with a stakeholder account of the use of resources. Traditionally the disclosure of information in a firm's financial statements has been directed towards the need of 'investors' and 'decision usefulness'. Zeff (2013) observes that in 1966 the American Accounting Association (AAA) published a pioneering monograph entitled 'A Statement of Basic Accounting Theory (ASOBAT). ASOBAT defined accounting as "the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by users of the information" (AAA, 1966, p.1), and its focus was directed upon ASOBAT the information needs of investors, specifically earnings; upon which predictions and valuations might be made The American Institute *Trueblood Committee Report: Objectives of Financial Statements* (1973) carried forward the issue of decision-usefulness announcing that the "objective of financial statements is to provide information useful to investors and creditors" (AICPA, 1973: p.20).

However, The Trueblood Committee report was also concerned with the use of multiple values to describe performance to a range of user groups and also proposed that social goals are no less important than economic goals. Zeff (2013) summarises the reflections of Burton and Fairfield (1981) upon the Trueblood report, who observed that:

> "What may turn out to be the most significant points of the report … are the two observations that may point the way toward the future of financial accounting. The first is that earnings forecasts are useful for the predictive process, thus opening the door for their inclusion in financial statements. The second is the suggestion that companies may be expected to report on aspects of their business that affect the goals of society in addition to the goals of their specific stockholders. The definition of user groups would be broadened considerably if and when this view becomes an accepted objective (Zeff, 2013: p.284).

In subsequent years, the accounting profession has struggled to redefine its conceptual framework. While this is still focused on disclosure for decision usefulness, the latest draft of the conceptual framework is more narrowly focused on the disclosure of information for investors. The International Accounting Standards Board (IASB) exposure draft on the conceptual framework in 2010 discloses that:

> "A reporting entity is a circumscribed area of economic activities whose financial information has the potential to be useful to existing and potential equity investors, lenders and other creditors who cannot obtain the information they need in making decisions about providing resources to the entity" (IASB , 2010: para RE2).

This narrow view of the function and purpose of accounting disclosure is subject to ongoing challenge. The International Integrated Reporting Council (IIRC) consultation draft on integrated reporting (<IR>) observes that:

> "Although providers of financial capital are the primary intended report users, an integrated report and other communications resulting from <IR> will be of benefit to all stakeholders interested in an organization's ability to create value over time, including employees, customers, suppliers, business partners, local communities, legislators, regulators, and policy-makers" (IIRC, 2013b: p8).

The IIRC report calls on the accounting profession and regulators to demand that reporting firms disclose information to a broader group of stakeholders and for the disclosure of physical as well as financial data. This could include the presentation of carbon data within the annual financial statements. However, as noted earlier in this literature review, such disclosure would still be in the form set out by the GHG Protocol scopes 1, 2 and 3; where there are contested methodological and practical issues that may frustrate the reliability of carbon disclosure when the firm's boundary of responsibility and control is malleable.

However, the IIRC report does open up the issue of stakeholders and also the concept of the reporting entitiy's business model. The report suggests that the firm is located in a network of stakeholders, who are collectively integrated within a 'business model' that is designed to create and capture value from products and services sold. Under the recommendations of the report, the firm should provide disclosures about its business model strategy which sets out how key stakeholders are involved in the process of creating and capturing value for 'investors'.

A common thread running through stakeholder theory, as applied to corporations, is the role and contribution of management towards satisfying and reconciling the needs of a variety of stakeholders that have a legitimate interest in the organisation. This responsibility of management can be then more broadly specified as 'stakeholder-agency' rather than 'shareholder-agency'. Evan and Freeman (1993) observe that:

> "A stakeholder theory of the firm must redefine the purpose of the firm. The very purpose of the firm is, in our view, to serve as a vehicle for coordinating stakeholder interests" (Evan and Freeman, 1993: p.102-3).

Freeman attributes the term 'stakeholder' to the Stanford Research Institute (SRI) (Freeman, 1984). SRI defined stakeholders as "those groups without whose support the organization would cease to exist" (SRI, 1963 in Freeman, 1984: p.31)[5] . Freeman adapted SRI's definition as follows:

> "any group or individual who can affect or is affected by the achievement of an organization's purpose" (Freeman, 1984: p.53).

Corporate emissions and value creation are generated out of collaborative enterprise between a firm and its stakeholders. This interpretation invokes stakeholder agency and the accountability that flows between parties in relationships (Gray *et al.,* 2014) and the notion that commitment and trust are at the heart of productive relationships (Morgan & Hunt, 1994). These conditions favour strategies that stimulate dialogue, rather than discussion:

> "In a discussion, decisions are made. In a dialogue, complex issues are explored. When a team must reach agreement and decisions must be taken, some discussion is needed. On the basis of a commonly agreed analysis, alternative views need to be weighed and a preferred view selected (which may be one of the original alternatives or a new view that emerges from the discussion). When they are productive, discussions converge on a conclusion or course of action. On the other hand, dialogues are diverging; they do not seek agreement, but a richer grasp of complex issues" (Senge, 1990: p.247).

Haslam *et al.* (2012) reinforce the significance of disclosing stakeholder relations and how these impact upon corporate reported financial numbers (see also EFRAG, 2013). Haslam *et al.* argue that

[5] It has not been possible to trace a copy of the original SRI memorandum, which the author believes to be a non-public document. Freeman, in a footnote to his 1984 book (p.49), intimates that he had sight of the memorandum during a visit to SRI in 1980.

the reporting entity is interacting with a multiplicity of stakeholders which have an impact upon reported financial metrics. This line of thinking is new and useful, because it twists the concept of stakeholder reporting from '*reporting to'* stakeholders, to '*reporting about'* stakeholders. The objective of corporate disclosure is to capture information *about* these stakeholder relations and to disclose *how* they are impacting upon the reported financials of the firm. This alternative approach to firm level disclosure could be employed, as Callon observes to 'provoke reactions' and, as Dillard *et al*. note, to 'map the action space'. According to Callon (1998) accounting functions within calculative spaces that provoke reactions, influence strategies and change goals. If carbon disclosures are to be incorporated into an accounting conceptual framework, then physical and financial accounting must possess compatible objectives that must be reflected in the framing of the calculative space. Dillard *et al.,* (2005: p.85) formalise this connection as the 'environmental action space', where "mapping the action space is an initial step in conceptualizing the linkages between organizational actions and their implications for the natural system and vice versa".

Accounting numbers and their presentation and construction are this variably constituted across and within levels of analysis. This variability could suggest that accounting systems are weak and malleable and that this also limits the value of carbon reporting and its capacity to change the world. In this thesis the objective is to explore how this variability in the numbers reported about carbon emissions can be converted into a critical investigative toolkit because numbers can be used to generate a variety of 'accounts' that test credibility. This literature review has revealed that the credibility of declared intentions, policies and initiatives can be assessed by comparing numbers and narratives obtained from within the corporate accounting reports of a reporting entity; by examining 'plural' accounts of carbon reduction prepared according to multiple methodologies; by comparing and contrasting carbon trajectories articulated at different levels of aggregation within an economy and by comparing numbers and narratives of a reporting entity with other information that describes the structure and purpose of its business model as constituted by stakeholder relationships.

The credibility of carbon accounting matters where the provision of credible information about the intention to reduce carbon emissions is central to trust; where trust is key to productive carbon reduction partnerships at different levels, such as between government and large companies, and between large companies and their stakeholders within individual business models. In this thesis the use of variable calculative approaches within levels and across levels of analysis is explored with regard to its potential to generate critically informed narratives about the credibility of policy framing and the modification of behaviour consistent with reducing corporate carbon emissions

2.9 Conclusions and implications for the research

The aim of this thesis is to consider whether carbon accounting can contribute to the reduction of corporate carbon footprints, by making emission more visible and helping to modify behaviour that generates carbon emissions. In so doing, the thesis acknowledges that carbon reduction is a single aspect within the broad remit of sustainability and sustainable development, where the potential exists for actions undertaken within particular 'silos' to have implications for - and effects over - other, equally important aspects of sustainability.

During the literature review, this researcher undertook a unique and extensive survey of papers published in leading business academic journals which revealed that, while there is some literature devoted to broad sustainability, the issue of climate change has received negligible attention in the recent volumes of top-rated accounting and business journals identified by the Association of Business Schools. While this scarcity of coverage presents an opportunity to undertake original research in a field of considerable topical relevance, it became clear that the thesis must consider the following problems that arise from the literature review:

- Debate persists over whether society's need for economic growth can be reconciled with the sustainability imperative of carbon reduction; and whether the incorporation of carbon within accounting reports might be beneficial or potentially harmful to sustainability.
- Conversion and commensuration factors that enable physical emissions to be estimated and integrated within markets and social systems like accounting, are unstable; and more representative of relative performance than of changes in physical greenhouse inventories.
- There are problems associated with framing carbon emissions within accounting systems, where boundaries representing the limits of responsibility and control are malleable and ambiguous, and where significant categories of emissions are excluded from reported footprints.
- There is evidence that key stakeholders in the investment community find sustainability reports to 'immaterial', 'irrelevant' and out of alignment with their personal incentives and institutional cultures.

Rather than rejecting existing carbon accounting protocols, or attempting to reconceptualise carbon accounting, this thesis is motivated Hopwood's (2009) call to focus research on the development of practical ways of increasing the significance of sustainability on corporate affairs; and is encouraged by Gray's (2010) suggestion to *experiment* with 'what does accounting for sustainability look like?'.

Accordingly, the literature review will inform the subsequent research phases of the thesis in the following four ways.

First, the thesis will set out to evaluate the credibility of carbon accounting; acknowledging that its general aspiration is to consider whether accounting might be constructively employed in the reduction of carbon trajectories and footprints. This objective operates from the base presumption that national carbon reduction is a collaborative venture operating across at least three levels; namely the macro (national), meso (industrial sector) and micro (individual firm) levels of aggregation. Collaboration has been shown by Morgan and Hunt (1994) to rely upon commitment and trust, and this thesis attributes trustworthiness between partners at least partially to the credibility of declared intentions relating to aspects of shared endeavour. The assessment of credibility will be informed by the numbers and narratives approach originated by Froud *et al*. (2006) which will be oriented to provide comparison and cross check between:

- The carbon reduction outcomes reported at the macro level when prepared using multiple methodologies (output vs, consumption).
- The intentions declared, and the outcomes achieved by entities *within* each of the macro, meso and micro levels of aggregation. This exercise will be predicated on the production of suitable carbon emissions datasets by the researcher, providing the numbers required for cross comparison.
- The intentions declared at the macro level, and outcomes achieved at the meso and micro levels.
- The consistency of carbon reduction outcomes reported by the firm and the carbon reduction activities undertaken by the firm in concert with the major stakeholders integrated within its business model.

Second, being mindful of the problems associated with framing emissions within boundaries, the thesis will explore an alternative – but complementary – approach in which the firm undertakes to report 'about' stakeholders by disclosing the structure and purpose of its business model, and by making supplementary disclosures relating to carbon-material aspects of operations shared between the firm and these substantial stakeholders. This approach borrows from the important consolidation and extension of the business models literature by Haslam *et al*. (2012), and from the call by Gray (2010: p.59) for accounting to offer "a plurality of narratives of un-sustainability – rather than futile attempts at sustainability". Plurality offers the opportunity to encourage dialogue, which Senge (1990) argues permits the exposure and exploration of complexity. This, in itself provides a

further opportunity to test the credibility of carbon accounting as previously articulated in this review.

Third, the literature reveals an opportunity to make carbon accounting more amenable to the needs of stakeholders in the investment community. This represents a practical means of directing carbon accounting towards behaviour modification, where these stakeholders provide the input to investment decisions affecting the shares of large corporations. This is the area of carbon risk, which is expected to assume greater significance in future investment decisions as the link between carbon emissions and liabilities is made clearer. The literature review has identified the opportunity to combine financial metrics with physical carbon emissions data for individual large firms, to enable 'static' in-firm assessment and inter-firm/ peer group comparisons. However, this researcher notes that no suitable publicly-available dataset of FTSE100 reported carbon emissions existed prior to this research; therefore it will be necessary to construct a bespoke dataset of FTSE100 emissions for this thesis. This will provide the necessary inputs to reframe carbon emissions data in a format suited to the needs of investment analysts, who may then use this information to make relative assessments of carbon risk between one investable firm and others. From here, the thesis will consider whether reformatting carbon disclosures in this way might contribute towards managerial behaviour modification; where the reframing of carbon accounting facilitates the pricing of carbon risk with consequences for realignment of the capital stack.

Fourth, the thesis will investigate whether accounting information is currently being used to modify executive behaviour, in ways that favour the achievement of carbon reduction, though the process of informing managerial incentive schemes. Where appropriate, the thesis will consider the opportunity to employ carbon accounting information in the structure of incentive programmes.

The approach recommended by the findings of the literature review provides an additional useful mechanism with which to ground the finished research. By adopting a plural accounting approach, which juxtaposes carbon accounting derived from different methodologies, dialogue is encouraged – as previously noted – and this provides a platform on which to expose the complexity of carbon reduction within large companies and across their business models. It also has the potential to reveal impacts and trade-offs with other equally important aspects of sustainable development; helping to avoid the tendency to manage a carbon reduction 'silo', and encouraging other stakeholders to engage in the struggle for broad sustainability outcomes.

The next chapter proceeds to consider the nature and purpose of research methods, and to set out the broad approach and detailed methods employed in the thesis. The chapter will close with a summary of the five research questions underpinning the thesis.

Chapter Three

Research Methodology

3.1 Introduction

This chapter is divided into three broad sections. The first reviews the research methods available to researchers and their associated logics. In the second, the choice of research approach for this thesis is outlined and justified. The final section considers the information that will be required to construct the research investigation and how this engages with the research questions of the thesis.

3.2 The nature and purpose of research methods

This research is grounded in accounting which is originated and developed through normal science. It finds expression through numbers, which reflect the 'grammar' of accounting standards. The 'logic' of accounting – why accountants do (or do not do) things – is a social construction revealed through numbers and associated narratives. Thus, through the grammar and logic of numbers are found elements of overlap between positivism and constructivism[6], which form the foundations of epistemology and ontology (Ryle, 1949; Glynos & Howarth, 2007). The research approach taken in this thesis adopts a 'middle ground' approach which provides flexibility because it permits both narratives and numbers to be present; without attempting to test causality. To set this up, the chapter considers the possible research approaches that could be grounded in accounting to conduct the investigation.

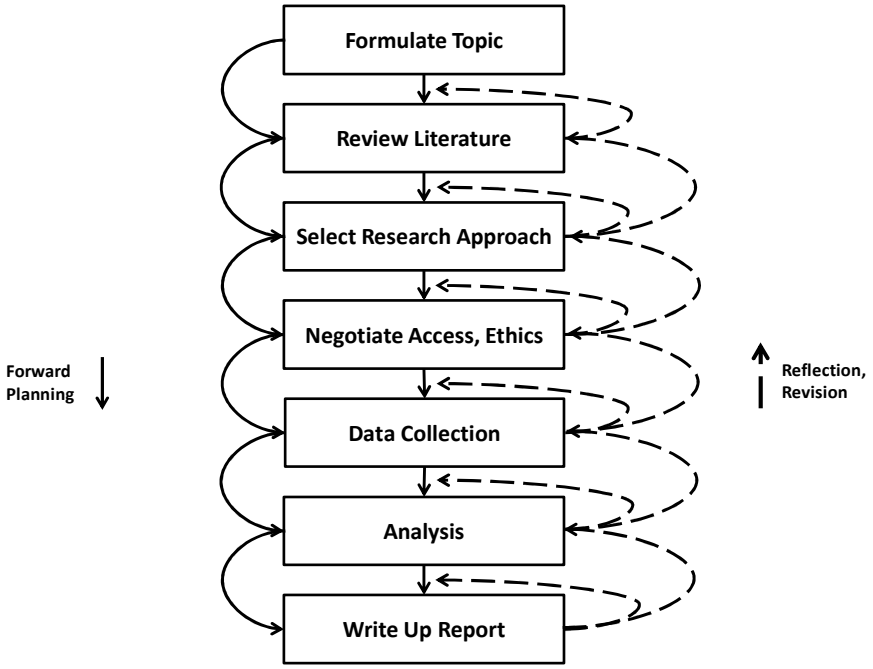
> "Research is formalised curiosity. It is poking and prying with a purpose. It is a seeking that he who wishes may know the cosmic secrets of the world and they that dwell therein" (Hurston, 1942: p.143)

Research is a systematic and methodical process of enquiry and investigation, by which people create and augment knowledge (Jankowicz, 1995; Collis & Hussey, 2003). Knowledge, according to the Royal Society (2012: p.12), represents "non-trivial, true claims about a phenomenon". It is the determination of 'truth' that requires research to be "open to critique and evaluation" (Long &

[6] Constructivism here refers to the philosophy that abstractions can be used to explain the experience and measurement of phenomena present in the natural world.

Johnson, 2000: p.30). While there are diverse opinions on what constitutes knowledge; argument has traditionally concentrated on whether the research has been conducted according to appropriate principles for the particular branch of science (Bryman, 2001). This is the domain of epistemology: the 'theory of knowledge'. The process of research is typically categorised within clearly identified stages which progress in a linked fashion. Ideas are often reworked as the researcher becomes more familiar with the terrain of inquiry and as others publish new material during the course of the research. Hence research is a structured, sequential and iterative process punctuated by reflection and revision as shown in Figure 1.

Figure 1. The research process



Source: Adapted from Saunders *et al.* (2000: p.5)

Epistemology has been defined as "the study of the nature of knowledge" and "what it is possible to discover by research" (Fisher, 2004: p.12). Ryle (1949: p.299) suggests that epistemology "might be used to stand for the theory of the sciences, i.e. the systematic study of the structures of built theories … or it might be used to stand for the theory of learning, discovery and invention". More recently Heron and Reason (2001) juxtapose a compatible typology of knowledge with four mutually-dependent ways of knowing, as shown in Table 1.

Table 1. A typology of knowledge and knowing

Type of Knowledge	Description
Experiential	Knowledge gained though interaction with people and situations
Presentational	Deriving from expression, including storytelling
Propositional	Conceptual and theoretical
Practical	Instrumental skills used to bring experiential, presentational and propositional knowledge into use

Source: Heron & Reason (2001)

According to Heron and Reason 'experiential knowledge' is acquired through direct perception, immersion in practice and collaboration with others; and 'presentational knowledge' from different means of interpreting experience, including narratives and stories. 'Propositional knowledge' is embedded in theories and concepts, while 'practical knowledge' describes the skills and know-how required to conduct practice:

> "In co-operative inquiry we say that knowing will be more valid if these four ways of knowing are congruent with each other" (Heron & Reason, 2001: p.183).

However, a key epistemological question concerns the role of the researcher within the research process. Because the social science researcher does not exist independently of the world, his or her interpretations of the world can never be considered to be completely impartial and objective. Research that claims to create knowledge is open to challenge in respect of the manner in which it minimises researcher bias. Becker (1996) uses the term 'error of attribution' that may arise when the researcher's point of view forces argument and position.

Understanding the remit of research and boundaries of epistemology establishes parameters governing what may be accomplished by research, and lays down conditions by which knowledge is accorded legitimacy. These provide significant guidance for the construction and elaboration of appropriate research questions on which to base the thesis.

3.3 Paradigms – the sociology of science

If research is to progress beyond an understanding of what constitutes 'knowledge' and 'knowing' the researcher must become conversant with the 'way in which science is done'. Kuhn ([1962] 1970)

and Becker (1996) describe this phenomenon as the 'sociology of science'. Research outputs only acquire the status of knowledge upon persuasion of the academic community (Glynos & Howarth, 2007), which typically requires observance of its conventions (Becker, 1996). This section examines the significance of paradigms generally and in the context of this research.

Prior to 1962, 'paradigm' was defined along functional lines as a purely structural mechanism that gives shape to knowledge. Paradigms were presented as models which present knowledge and extend it through further study:

> "The first and foremost purpose [of the paradigm] is to supply a provisional codified guide for adequate and fruitful functional analyses. This objective evidently implies that the paradigm contains the minimum set of concepts with which the sociologist must operate in order to carry through an adequate functional analysis and, as a corollary, that it can be used here and now as a guide for the critical study of existing analyses" (Merton, 1957: p.55).

However, the contemporary meaning of 'paradigm' incurred a sociological dimension when it was adapted by Kuhn ([1962] 1970) to represent a landmark within the progress of science. According to Kuhn, paradigms share two important characteristics. Their achievements are sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously they are sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve (Kuhn, [1962] 1970: p.10). Kuhn associates paradigms with 'normal science', which he defines as: "research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a while as supplying the foundation for its further practice" (Kuhn, [1962] 1970: p.10).

Thus paradigms became the way in which the academic community views the world, providing a context within which scientific activity is contained. Conceptually, the paradigm may be compared with *Weltanschauung*, or 'world-view', as explained by Freud (1933): "When one believes in such a thing, one feels secure in life, one knows what one ought to strive after, and how one ought to organise one's emotions and interests to the best purpose". Paradigms and world-view are conjoined by the concept of ontology, which describes the nature of reality accepted by the researcher. The positivist paradigm holds that reality is objective and exists independently of social actors. Positivism stands in contrast with constructivism, in which reality is held to be social constructed: brought into being through the perceptions of social actors.

The coexistence of differing world-views within given academic disciplines explains the persistence of multiple paradigms at any given moment. Within social sciences, the positivist paradigm arguably dominates: its adherents aspiring to a form of scientism based on the natural sciences and mathematics, from which to predict using causal laws (Merton, 1957; Glynos & Howarth, 2007). The positivist domination is supported by the publication criteria of leading US journals, and the consequential impact on research through university league tables and rankings (Merchant, 2009).

3.4 Accounting research: disclosure

Within accounting, there has been an ongoing debate about whether financial disclosure exists to inform a narrow group of stakeholders (investors) or broader users of accounting information. Zeff observes that in 1966 the American Accounting Association (AAA) published a pioneering monograph entitled 'A Statement of Basic Accounting Theory' (ASOBAT). It defined accounting as "the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by users of the information" (AAA, 1966, p.1). ASOBAT focused on the information needs of investors specifically earnings upon which predictions and valuations might be made:

> "such predictions are most crucial in the case of present and prospective equity investors and their representatives—considered by many to be the most important of the user groups". (AAA: 1966,p.23)

Yet Zeff observes that ASOBAT opened up the possibility for firms to record a variety of information with, for example, assets valued at historic or current cost depending upon the needs of the user(s) who may not simply be investors but employees and managers.

The American Institute *Trueblood Committee Report: Objectives of Financial Statements* (1973) carried forward the issue of decision usefulness announcing that the "objective of financial statements is to provide information useful to investors and creditors for predicting, comparing, and evaluating potential cash flows to them in terms of amount, timing, and related uncertainty" (AICPA, 1973, p. 20). However, The Trueblood report again discussed the use of multiple values to describe performance to a range of user groups; proposing that social goals are no less important than economic goals. Zeff (2013) summarises the reflections of Burton and Fairfield (1981) upon the Trueblood report:

> "What may turn out to be the most significant points of the report … are the two observations that may point the way toward the future of financial accounting. The first is that earnings forecasts are useful for the predictive process, thus opening the door for their inclusion in financial statements. The second is the suggestion that companies may be expected to report on aspects of their business that affect the goals of society in addition to the goals of their specific stockholders. The definition of user groups would be broadened considerably if and when this view becomes an accepted objective" (Zeff, 2013, p.284).

In subsequent years the accounting profession has struggled to redefine its conceptual framework and whilst this is still focused on disclosure for decision usefulness, the latest draft of the conceptual framework is more narrowly focused on the disclosure of information for investors. The International Accounting Standards Board (IASB) exposure draft on the conceptual framework discloses that:

> "a reporting entity is a circumscribed area of economic activities whose financial information has the potential to be useful to existing and potential equity investors, lenders and other creditors who cannot obtain the information they need in making decisions about providing resources to the entity" (IASB, 2010: para. RE2).

The IASB remains focused on formulating a conceptual framework in which the financial statements are reporting information primarily to investors as decision makers. However, as outlined earlier in the literature review, it remains necessary to broaden information disclosure in financial statements for a wider group of stakeholders. The International Integrated Reporting Council consultation draft on integrated reporting (<IR>) observes:

> "Although providers of financial capital are the primary intended report users, an integrated report and other communications resulting from <IR> will be of benefit to all stakeholders interested in an organization's ability to create value over time, including employees, customers, suppliers, business partners, local communities, legislators, regulators, and policy-makers" (IIRC, 2013b: p.8).

Thus while accounting is a process of recording and disclosing information, its purpose has been contested over time regarding the scope of disclosure and the intended 'users' of this information. The literature review viewed the disclosure debate through the lens of framing, where agents employ accounting to create a calculative space in which accounting performs optimising calculations that provoke reaction and change. Framing is directly relevant to disclosure because it distinguishes what lies within the boundaries of accounting from what is omitted from reporting and decision-making. In combination, framing and disclosure will be central to the determination of carbon footprint accounting in the context of its practical social purpose: the reduction of physical

emissions. The thesis will adopt a broad stakeholder perspective from which to evaluate the impact of different framings and modes of disclosure on information usefulness.

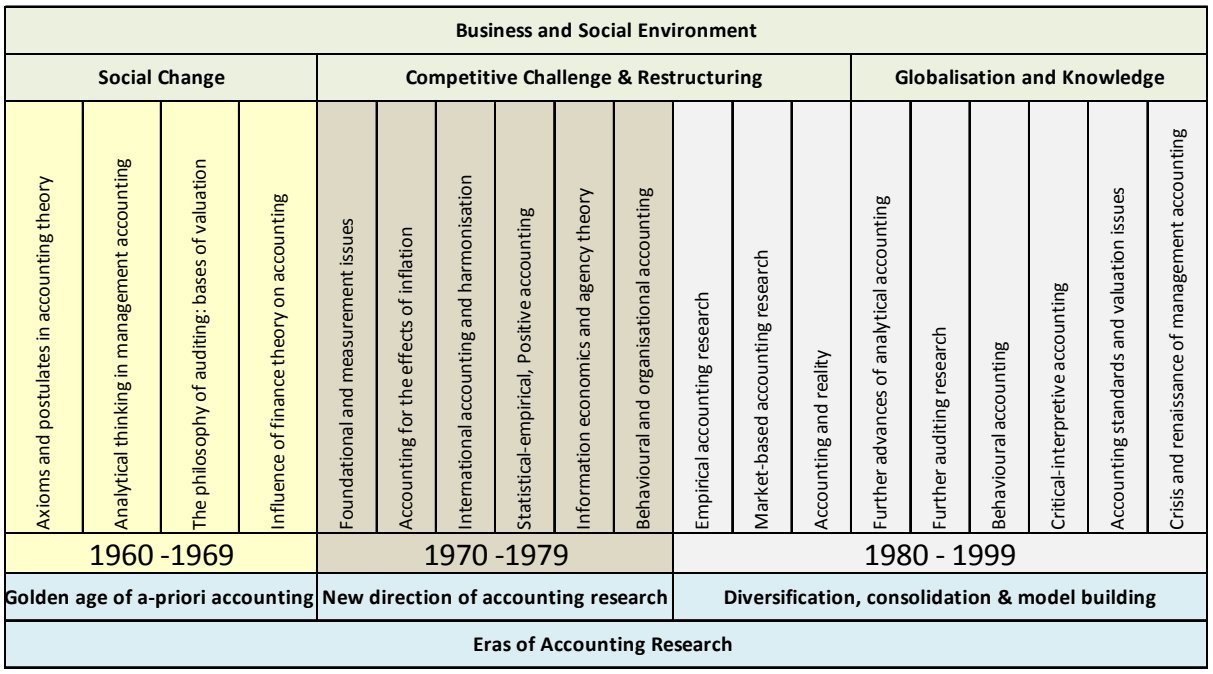
Corporate disclosures therefore provide the information resource for this thesis. These are obtained from annual financial reports and also supplemental disclosures in, for example, sustainability reports that also disclose information on the firm's carbon emissions and narrative statements about its carbon reduction strategy.

3.5 Framing accounting theory

Davis *et al*. (1982: p.310) argue that: "Accounting research … for the most part follows practice, with theory serving as part of a reflexive exercise to justify or debate the merits of current procedure". Theory justifies what accountants do, while lending a logical basis for further development as the demands made on accounting change. As Llewelyn (2003) observes, the scope of theory extends beyond generalising 'grand theories' to include frameworks enabling one to make sense of the world and provide structure for the understanding of social experiences.

This has not always applied because the notion of 'accounting theory' is relatively recent. Deegan and Unerman (2006) state that before 1960, the development of accounting was practitioner-led, rather than researcher-led, emphasising the codification of actual accounting practices. In 1963 Robert Kuhn Mautz noted the near-absence of research activity, in the following remarkable statement: "So far as I know, we do not have a single research professor of accounting in this country [the United States]… In the last twenty years or more, very little has been accomplished by the academic side of accounting as a field of knowledge" (Mautz, 1963). In subsequent decades accounting research increased substantially. Figure 2 presents a timeline of accounting research during 1960-2000; aligning the main themes with periods of social and economic change.

Figure 2. A thematic accounting research timeline: 1960-2000



Source: Author, after Sibbett (1997) and Mattessich (2008).

According to Deegan & Unerman (2006), 1960s accounting research focused on the prescription of accounting procedures, and the departure from a practice-driven agenda. In the 1970s, accounting research moved away from being descriptive, instead seeking to predict and explain accounting practices. From the 1980s to the end of the twentieth century, accounting research entered an era of reflection and rebuilding as it began to address the neglect of management accounting (Johnson & Kaplan, 1987), the transition to a globalised knowledge economy and concerns with normative aspects of accounting.

Chua (1986) neatly summarises the framing of accounting research and the possibilities available to researchers, by segregating the assumptions and the use of accounting information into 'mainstream', 'interpretive' and 'critical' approaches. In this way, Chua demonstrates how paradigms may not be mutually exclusive, instead being 'fuzzy around the edges'. Table 2 illustrates the working of this idea, by aligning different combinations of Chua's three approaches with beliefs about knowledge, physical and social reality, and the relationship between theory and practice.

Table 2. **Classification and assumptions of accounting paradigms**

	Mainstream	**Interpretive**	**Critical**
Beliefs about Knowledge	Theory and observations are separate. Quantitative methods are favoured as theory seeks to generalise	Seeks to make sense of human intentions by studying actors in their environment	Context and time are relevant for judging theory
Beliefs about Physical & Social Reality	Reality is objective and exists outside of the subject. Humans do not create reality	Social reality is transient, subjective, and manifested in human action	Reality is objective, yet moderated through subjective evaluation. Conflict characterises society, through injustice and ideology which permeates the structures of institutions
Relationship of Theory and Practice	The status quo is accepted and theory seeks solutions that operate within existing structures	Theory restricted to the explanation of human action and the mechanism of social order	Theory exists to identify and remove domination and ideology.

Source: Author, after Chua (1986)

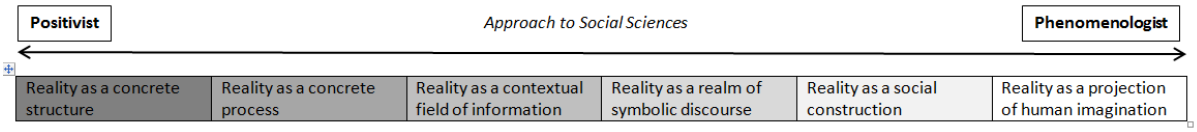
A new line of argument suggests that rigid adherence to a single mainstream paradigm threatens to stifle research and perpetuate an essentially conservative approach: "The bulk of accounting research of today pursues only marginal contributions with one, largely programmed, theoretical and methodological framework and applies taken for granted research methods. While there certainly are several exceptions to this, the outcome is far too often rigorously produced but relatively unsurprising research output" (Lukka, 2010: p.110).

The traditional view of research, espoused by Durkheim, was that it should be free from the personal preconceptions held by the researcher (Durkheim, 1838 in Bryman, 2001). Nowadays, many believe that researchers are social actors who cannot remain objectively detached from the social phenomena that they study (Bryman, 2001; Becker, 2007). Because this tension cannot be entirely eliminated, research is framed according to how the researcher perceives the world in which we live. By defining parameters, ontology articulates the boundaries of epistemology.

> "The different assumptions regarding ontology and human nature pose interesting problems of epistemology. The different world views they reflect imply different grounds for knowledge about the social world" (Morgan & Smircich, 1980: p.493).

Ontology describes the nature of reality as perceived by the researcher (Collis & Hussey, 2003). According to Morgan & Smircich (1980), different ontologies are located along a continuum of assumptions. These are represented in Figure 3.

Figure 3. The continuum of core ontological assumptions



Source: Collis & Hussey (2003: p.51), adapted from Morgan & Smircich (1980)

Each end of the continuum in Figure 3 may be used to group ontologies into broad categories. On the left of the scale, the assumptions describe various degrees of objectivist ontologies. To the right are situated constructivist ontologies. These limits represent extremes that are unlikely to attract many followers in the practical sense (Collis & Hussey, 2003). However, Figure 3 does present a variety of accepted positions, and the polarised categories provide a convenient device with which to group shared characteristics.

The objectivist stance positions the world as being external to the researcher. Its properties affect subjects, yet the world remains unaffected by those who live in it. The job of the researcher is thus to observe and measure phenomena (Collis & Hussey, 2003) from which the resulting empirical elements are "subsumed under overarching universal laws, causal mechanisms, or law-like causal generalization" (Glynos & Howarth, 2007: p.166). The tendency to subsume is termed reductionism; giving an account or explanation of phenomena by reference to its simplest elements (Saunders *et al.*, 2000). Yet reductionism may oversimplify social inquiry where the sum of the parts is greater than the whole. Reductionism can be criticised for attempting to simplify what is essentially complex, and divorcing explanations from the context in which they make sense (Glynos & Howarth, 2007).

According to Morgan & Smircich (1980) objectivism is not confined to an extreme vision of reality as a concrete structure. It admits other shades that recognise more mobile realisms. These include

'reality as a concrete process' in which the social world emerges from the struggle between different influences, or processes, each with desired ends; and 'reality as a contextualised field of information' in which information flows are dynamic and constitutive of the social world.

The subjectivist ontologies sit at the opposite end of the continuum where reality exists solely in the imagination of the subject. However, more moderate shades present reality as a social construction, or as "a pattern of symbolic relationships and meanings sustained through a process of human action and interaction" (Morgan & Smircich, 1980: p.494):

> "The knowledge of administrative science is not built from objective truths but is, instead, an artefact(*sic*) - the product of social definition. Institutional mechanisms reinforce these social definitions of truth by investing them with the stamp of scientific authenticity" (Astley 1985: p.497).

Moreover, in contrast to reductionism, "thick descriptions of individual and collective meanings, beliefs, and traditions are opposed to the search for law-like explanations of social phenomena" (Glynos & Howarth, 2007: p.3). Subjectivist ontologies tend to 'open up' rather than 'close down' the analysis of social phenomena and events.

3.6 Establishing an ontological position for the research

The previous section has described the way in which ontologies are arranged along a continuum, which ranges from positivism, at one extreme, to phenomenology at the other.

This research has adopted an ontological position which is neither exclusively positivist nor social constructivist in nature. Drawing on the information contained within corporate reports of listed FTSE100 firms, it recognises that numbers and narratives are complementary inputs to social research because each reflect and constitute the reality of the phenomena under investigation; and that this approach contributes towards a more inclusive interpretation of the phenomena being studied. This 'middle ground' approach enables the investigation of more interesting social questions while avoiding some of the limitations inherent in exclusively positivist or social constructivist ontologies.

An exclusively positivist approach considers numbers to be objective measures from which cause and effect may be discerned. It is not this researcher's intention to provide a positivist theoretical framing in the FTSE100; for example, by testing hypotheses that establish a relationship between carbon emissions and other specific variables. However, the researcher recognises that numbers can

be useful; for example, the examination of time-series data enable the discernment of direction of travel, scale, relativity and permits comparison with the data produced by other firms, and with aggregations that describe the emissions of industrial groupings or nations. Moreover, physical numbers – such as those describing carbon emissions – can be combined with financial numbers – to express other relative dimensions such as efficiency, which permit the exercise of objective and social judgements.

This researcher appreciates that accounting numbers are socially constructed so that, in addition to reflecting organisational performance, they may influence stakeholder perceptions and lead to changes in objectives and behaviour (Hines, 1988; Callon, 1998):

- As metrics are reported in accounting statements, managers find ways to improve these performance indicators over time (Callon, 1998).
- Accounting numbers are calculated using assumptions and methodologies that derive from socially-negotiated values, which may skew interpretation in particular ways. The debate over the reintroduction of prudence, in place of neutrality, within the *Conceptual Framework for Financial Reporting* exemplifies this phenomenon (Crump, 2014).
- The manner by which accounting numbers are socially constructed changes the way that they are perceived by managers. Carruthers and Espeland (1991: p.36) argue that double-entry bookkeeping "altered … transactions by changing the way businessmen interpreted and understood them".
- The social construction of numbers can be further manipulated through presentational strategies designed to create favourable impressions of the reporting entity (Jones, 2011a, 2011b).

At the opposite scale of the continuum, an exclusively social constructivist position holds that reality is not an objective phenomenon; being created by people and societies through the influence of their own values, the interpretations of others and compromises and agreements that arise between them (Fisher, 2004). It is not this researcher's intention to ground the analysis in the basis of narratives obtained from interviews with key actors. Instead, the researcher intends to draw upon the narrative information resources disclosed in the corporate reports, including disclosures that describe carbon reduction strategies and intentions.

At the same time, this thesis seeks to incorporate narrative disclosures into the research where these can inform social science research in additional valuable ways. Narrative disclosures are well-suited to providing non-financial and forward-looking information, and they tend to feature

prominently in voluntary reporting (Beattie *et al.,* 2004). In addition, their mode of expression permits the articulation of conceptual attributes such as states of mind; and through storytelling, narrative attempts to locate data within a contextual setting. Moreover, when analysed together, numbers and narratives provide a useful means of cross-check, corroboration and refutation which help the reader to discern whether "strategy is being enacted" (Froud *et al*., 2006: p.129) and enable readers of accounting statements to form their own evaluations regarding the credibility of management through the accounting statements.

This thesis argues that the adoption of a middle ground approach enables the researcher to address more interesting research questions that recognise that theory in social science "can only be meaningful in specific contexts and against a background of shared practices" (Dreyfus, 1980: p.7). Piketty illustrates this principle with an example from the study of economics:

> "The new [empirical] methods often lead to a neglect of history and the fact that historical experience remains our principal source of knowledge. We cannot replay the history of the twentieth century as if World War 1 never happened …" (Piketty, 2014: p.575).

The next section considers middle ground theory in more detail, justifying how and why this is most applicable to this research investigation.

3.7 Thesis methodology: a middle ground approach

This chapter has outlined how different ontologies represent the researcher's world view and perception of reality, and how they frame the orientation of research. Adopting objectivist or subjectivist ontologies traditionally requires a commitment to either quantitative or qualitative methodologies. However, an emerging literature provides justification for a third way – a middle ground incorporating aspects of both quantitative and qualitative methodology. Confusingly, a range of terms has been employed to describe the middle ground including multi-methods, multi-strategy and mixed methods research (Bryman, 2006). Yet to conceptualise the middle ground, one must locate it relative to the quantitative and qualitative methodologies from which it derives. Table 3 sets out the main characteristics of the middle ground, placing it in the context of the traditional approaches to research.

Table 3 provides a useful initial specification, which suggests what the middle ground 'looks like'. The combined techniques are compatible because the quantitative and qualitative approaches are

mutually referential (Becker, 1996). They are more alike than different: "Quantities are of qualities, and a measured quality has just the magnitude expressed in its measure" (Kaplan, 1964: p. 207). In this way, the middle ground offers a pluralistic approach in which 'the sum of the whole is greater than its parts' (Johnson & Christensen, 2011) and which legitimises access to the range of techniques required "to gain a more complete understanding of phenomena" (Onwuegbuzie & Leech, 2005: p.380). Combining empirical and descriptive techniques, this thesis aims to obtain and explore data at macro, meso and micro levels (Onwuegbuzie & Leech, 2005: p.383) in order to articulate the tensions and make sense of the ambiguity surrounding carbon footprint accounting. According to Bryman (2006) the middle ground has become assimilated into the mainstream while retaining a distinctive nature. Middle ground research has found favour among pragmatists:

> "I suggest a tolerant pluralism that claims a middle ground where many methods and philosophies have legitimacy and utility. … I think this is the position where most practicing [*sic*] scholars work anyway, since most are more concerned with what works to solve problems than with defending a particular philosophical or theoretical position" (Wilk, 2001: p.311).

Table 3. **A comparison of quantitative and qualitative methods with the 'middle ground'**

	Quantitative	Middle Ground	Qualitative
Research objectives	Numerical description, causal explanation and prediction	Multiple objectives; provide complex and fuller explanation understanding: understand multiple perspectives	Qualitative, subjective description, empathetic understanding and exploration
Focus	Narrow-angle lens, testing specific hypothesis	Multilens focus	Wide-angle and "deep angle" lens, examining depth and breadth of phenomena to learn more about them
Nature of observation	Study behaviour under controlled conditions to isolate the causal effect of single variables	Study multiple contexts, perspectives, or conditions; study multiple factors as they operate together	Study groups and individuals in natural settings; attempt to understand insiders' views, meanings and perspectives
Form of data collected	Collect quantitative data based on precise measurement, using structured and validated data-collection instruments	Collect multiple kinds of data	Collect qualitative data e.g. in-depth interviews, participant observation, field notes and open-ended questions. The researcher is the primary data collection instrument.
Nature of data	Variables	Mixture of variables, words, images and categories	Words, images, categories
Data analysis	Identify statistical relationships among variables	Quantitative and qualitative analysis used separately and in combination	Use descriptive data: locate patterns, themes and holistic features; and appreciate differences/ variations
Results	Generalisable findings providing representation of objective outsider viewpoint of populations	Provision of 'subjective insider' and 'objective outsider' viewpoints; presentation of multiple dimensions and perspectives	Particularistic findings; provision of insider viewpoints
Forms of final report	Formal statistical report	Mixture of numbers and narratives	Informal narrative report with contextual description and direct quotations from research participants

Source: Adapted from Johnson & Christensen (2011: pp.34-35) with kind permission of the author

Bryman (2006) warns that the rationale and application of the middle ground approach may become mismatched. This may be partly due to the relative scarcity of guidelines on how and why to combine different research methods (Bryman, 1988, 2006), potentially leading to redundant data that fails to support findings and the waste of researchers' time (Bryman, 2006). While this can result in shifting research horizons, more beneficial outcomes can include the discovery of unanticipated findings. Arguably, this is the nature of research. However a systematic approach requires the initial formulation of methodological justifications and priorities consistent with the nature of the research question. To this end Greene *et al* (1989) offer five justifications of the middle ground approach, which are reordered here to match the aims and priorities of this thesis's research:

1. Expansion: to increase the breadth and range of enquiry by combining quantitative and qualitative techniques.

2. Initiation: to combine numerical data with descriptive evidence in order to discover and make sense of tension, contradiction and paradox.

3. Complementarities: to obtain evidence of a phenomenon using more than one method so as to clarify, elaborate, enhance and illustrate.

4. Development: to gain insights through the analysis of numerical data, which will be used to aid selection and guide the application of descriptive methods, and vice versa.

5. Triangulation: to compare results achieved by "using more than one method or source of data in the study of social phenomena" (Bryman, 2006: p.274).

This thesis is grounded in accounting, and will employ quantitative techniques to evaluate the credibility of carbon footprint accounting by large corporations, individually and in aggregate. The numbers used to describe the physical properties of greenhouse emissions are a new reporting element, and these will be studied in conjunction with traditional accounting numbers derived from transactions captured by the financial accounting system. Additionally, national carbon footprint numbers will be incorporated into the study. In combination, these numbers describe the carbon reduction performance of the corporation and locate it within the context of the wider business community and the United Kingdom

national economy. This quantitative phase is objectivist in nature, collecting and analysing data which have been presented as though external to, and unshaped by, those involved in its preparation.

The second, qualitative, phase of the research is subjectivist and is concerned with the way in which "New definitions of truth emerge as products of a socially negotiated consensus between truth makers" (Astley, 1985: p.499). Consensus is formed between those who consume accounting information (stakeholders) and those who produce it (accountants), where social reality is jointly construed through reflection and construction (Hopwood, 1987). Just as stakeholders will construct particular and individual versions of reality as they interpret the numbers through their own 'lens', accounting for carbon footprint is a metaphorical artefact created by those who 'account', for corporate greenhouse gas emissions. Accountants operate subjectively at more than one level. This chapter has shown how accountants infuse assumptions and accounting concepts with their own values and perspectives (see Table 1) and that these influences shape the impressions and interpretations delivered by carbon accounting numbers. As Morgan (1988: p.482) observes:

> "accountants are able to do no more than grasp limited aspects of the reality to which their accounting schemes relate. Accounting can never be truly objective …"

However, the manner in which accountants implement accounting policies when routinely accounting for carbon emissions permits a second layer of social construction which is manifested through the implementation of accounting policy:

> "The accountant represents complex situations … in limited and rather one-sided ways. But these representations become part of the fabric through which the situation 'accounted for' is then sustained or changed" (Morgan, 1988: p.482)

The middle ground approach combines elements of objectivist and subjectivist approaches utilising numbers and narratives. Perhaps because of its distance from the pure positivist paradigm, the middle ground adopts a 'middle range' theoretical orientation. Middle range theories can be distinguished from grand theories by the relative modesty of their ambitions: namely "to develop special theories applicable to limited ranges of data … rather than to seek at one the 'integrated' conceptual structure adequate to derive all these and other theories" (Merton, 1957: p.9).

Merton places the work of social scientists within middle range theory, while retaining the ultimate objective of consolidating middle range theories into more general concepts. This section closes by reaffirming the pragmatic nature of the approach to the research undertaken in this thesis, and its objective of selecting the most appropriate methodology with which to investigate the research questions. The middle ground approach of this thesis combines numbers and narratives to generate new critical insights into the credibility of strategic intent within large corporations towards carbon reduction.

3.8 Numbers and narratives

The credibility of accounting numbers and narratives is a central theme in this thesis, and it is anticipated that credible information reflects 'a strategic intent towards something'. Becker (1960) argues that behavioural consistency over time denotes commitment, and this type of consistency is likely to be reflected in corporate communications. Froud *et al*. (2006) employ numbers to construct alternative narratives describing the extent to which strategy is being enacted. Collecting and analysing numbers in a rich dataset therefore enables one to make interpretations about the strategic intent towards carbon reduction among a meso subgroup of large corporations. For the purposes of this thesis the FTSE100 index of leading firms is chosen to represent the United Kingdom corporate sector.

'Numbers and narratives' was originally documented as a research methodology in *Financialization and strategy: narratives and numbers* (Froud *et al.,* 2006). Its motivation derives from the 'world of disappointment', where the combination of optimistic management stories and supporting activities are not subsequently reflected in large-firm financial numbers:

> "If we wish to understand how giant-firm strategy plays in this kind of world of disappointment, the financial numbers are crucially important because they are not a function of the tale that management spins (except in cases of fraud) and management's dilemma is that it has many moves but few levers for improving financial performance" (Froud *et al*., 2006: p.5).

Where numbers and narratives are independent of one another, the 'opposition of fact and fiction' can either corroborate or find discrepancy between 'promise and outcome'. Drawing on the work of Golding (2001), Froud *et al*. describe narratives as 'fictions' because managers understand that 'the City' requires a 'story in a box', where the 'ending' confirms management reputations or the perceived value of the stock. By contrast, numbers represent facts in the sense that they are a 'basis for inference'. Their

analysis recognises that numbers are socially constructed, as seen with carbon data that constitute 'performance stories' rather than physical representations (Bowen & Wittneben, 2011). Froud *et al*. argue that both discrepancy and corroboration become starting points for further investigation, because corroboration does not preclude the possibility of a false association between a strategy and its claimed outcome. In this respect, Andersson *et al*. (2010: p.212) build on the work of Froud *et al*., to reveal how "financial numbers are deployed to construct alternative critically engaged narratives". In other words, the comparison of narratives with numbers can generate very different versions of the same event that stand in contrast to the original, intended message. Table 4 presents an illustrative example.

Table 4. Generation of critical alternative narratives from numbers[7]

Original narrative	Impact of analysis of numbers	Alternative critical narrative
"There has been a consistent fall in the UK's reported greenhouse gas emissions since 1990, and the UK is now virtually sure of meeting its 2008–12 target of a 12.5% reduction in emissions measured under the Kyoto Protocol" (Helm *et al*., 2007: p.6).	Although aggregate emissions have fallen, further analysis reveals structural rigidities pertaining to the emissions of different gases, which indicate that future reductions will be progressively smaller and more difficult to achieve.	The commitment to reducing national greenhouse emissions cannot necessarily be inferred from the trends achieved to date. Future reductions relative to target are likely to prove a greater test of the government's commitment than those achieved to date.

Source: Author

The numbers and narratives methodology is relatively new and features in few published studies. One known environmental accounting example is revealed in Patten (2005), although the methodology is not referred to by name. Patten studied environmental capex forecasts contained in the 10K reports of large US firms, noting that actual investment fell below forecast in 75% of cases. Testing again for total capex, Patten found that forecasts proved reasonably accurate, concluding that the environmental investment forecasts had been deliberately exaggerated.

According to Froud *et al*., (2006: p.126), "management involves doing as well as saying, so any discussion of the narrative needs to be cross-referenced to the performative in a world which, of course,

[7] It should be stated here that Helm *et al*. are critics of United Kingdom climate change policy.

does not consist solely of stories". This argument resonates with the aims of this thesis, where credibility and commitment are argued to coalesce within accounting. Commitment, as demonstrated in the literature review, remains conceptually loose and relatively undeveloped in the academic literature. However, numbers and narratives offer a useful means to evaluate the credibility of carbon reduction through accounting, where productive exchange pivots on commitment and trust (Morgan & Hunt, 1994); and where statements of intention made in accounting and sustainability reports may be framed using language that implies some form of commitment.

3.9 The evaluation of methodology

Earlier in this chapter, it was argued that knowledge acquires legitimacy upon the persuasion of the academic community (Glynos & Howarth, 2007), which is contingent on the observation of its conventions (Becker, 1996). This typically entails that researchers justify their methodology according to established evaluation criteria. In the physical sciences, these usually comprise validity, reliability and objectivity.

'Validity' describes the integrity of conclusions obtained by research, while 'reliability' addresses whether the research outcomes are replicable (Bryman, 2006). 'Objectivity' denotes freedom from bias on the part of the researcher. According to Bryman, an alternative view argues that qualitative research should be evaluated using different criteria to those employed in the physical sciences. Measurement, for example, tends to assume less importance in qualitative studies and validity may take on different meanings more akin to whether one is observing what one claims to be observing. Moreover objectivity can be elusive because the researcher is a part of the world that he or she is interpreting.

To compensate for these difficulties, Lincoln and Guba (1985) and Guba and Lincoln (1994) propose 'trustworthiness' and 'authenticity' as an alternative set of criteria, to adapt the evaluation of research for qualitative studies. Trustworthiness is subdivided into four criteria intended to parallel their counterparts in quantitative research, namely 'credibility', 'transferability', 'dependability' and 'confirmability'. In Table 5, these are ranked according to their relative importance to quantitative, qualitative and middle ground research methodologies.

Table 5. Alternative research evaluation criteria ranked according to methodological approach

Research evaluation criteria **(after Guba & Lincoln)**	**Parallels with criteria employed in quantitative research**	**Quantitative ranking**	**Qualitative ranking**	**Middle ground ranking**
Credibility	Internal validity	4	1	1
Transferability	External validity	3	2	2
Dependability	Reliability	2	3	3
Confirmability	Objectivity	1	4	4

Note: rankings range from highest priority (1) to lowest (4). The author has determined these using his own judgement.

Source: Author, after Lincoln and Guba (1985), Guba and Lincoln (1994), Bryman (2006)

Lincoln and Guba argue that credibility is obtained through peer validation and via triangulation. Transferability, they argue, relies on 'thick description'; as, exemplified by the case study method. Triangulation and thick description are integrated into the research design of this thesis. Dependability and confirmability, they argue, are best achieved through peer auditing which Bryman (2006: p.274) argues "has not become a pervasive approach to validation" because of the demand that it places on auditors. Likewise, Bryman states that the second main criterion of authenticity – fairness and ontological utility – has failed to gain influence in the research community.

While these perceived deficiencies among evaluation criteria are unhelpful, the substitute criteria offered by Lincoln and Guba (shaded in Table 5) appear to be no more effective in practice than the original criteria that they were designed to replace. Fortunately, Table 5 reveals that these flaws are confined to those criteria with the least relevance to qualitative and middle ground research.

3.10 Methodology within an organising framework

There is an important distinction between the middle ground numbers and narratives methodology and the reductionist approach, where the latter seeks to verify relationships and causal direction. The numbers and narratives approach does not attempt to avoid complexities and ambiguities, instead

preferring to develop and understand the complexity inherent in accounting for carbon footprint; extending beyond the disclosure of emissions to encompass their reduction. Accordingly the overall framework of this thesis is organised around four contiguous frames, which provide an organising framework for conducting the research and triangulating its findings.

1. **Levels of aggregation:** Disclosed physical information on carbon will be collected for the UK national economy (macro-level) the FTSE 100 (meso-level) and industry/firm (micro-level). This analysis is intended to provide an interpretation of the differences between levels of analysis and the problems of reconciliation, and to reveal the nature of social construction in carbon footprint numbers.

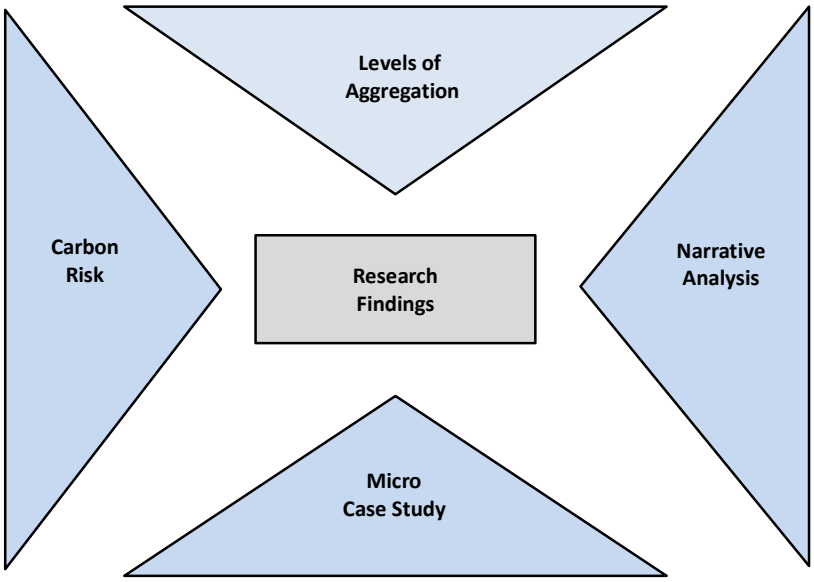
2. **Carbon risk**: Carbon (physical emissions) data for the FTSE 100 group of firms will be combined with financial data extracted from annual reports to calculate intensity values that generate new insights into the relationship between carbon and financial risk. It is anticipated that discrepancies between the intensity values of ostensibly similar firms may also reveal instances where management judgement has shaped estimates of carbon footprint for a firm, or firms.

3. **Narrative analysis**: Narrative statements selected according to 'carbon relevance' criteria will be extracted from company annual reports and sustainability reports of firms in the FTSE100 mixed-retail sector. The research will evaluate whether these statements are internally consistent over time, and consistent with physical carbon numbers, or simply a form of ad-hoc 'bricolage'.

4. **Micro case study**: In addition to the aforementioned frames, a case study using the FTSE100 mixed retail firms will act as a 'laboratory' in which to evaluate the credibility of carbon reduction narrative statements within the context of corporate and industrial strategy.

The arrangement of these frames and their relationship to the eventual research finding is mapped out in Figure 4.

Figure 4. Research data collection: framing and triangulation



Source: Author

The numbers and narratives methodology has a strong intuitive appeal and the potential for broader application. This thesis aims to participate in its dissemination by using it in an original context. At the same time, the methodology may also make a unique contribution towards how to appraise the credibility of sustainability objectives within large corporations. Magretta (2002) described business models in terms of 'tying narratives to numbers', and offered two tests of a business model: whether the numbers add up, and whether the story makes sense. Therefore if structure and purpose of a business model align with actual carbon reduction, as revealed through numbers and narratives, the carbon reduction strategy is inherently manifested within the firm and observable through its accounting (see also Dillard *et al*., 2005).

3.11 Analysis of physical carbon data – levels of aggregation

Where the delivery of national carbon reductions must be achieved through relationships between national government and corporate (and other) stakeholders, commitment and trust are pivotal attributes in securing productive outcomes (Morgan & Hunt, 1994). The literature review establishes

that mutual commitment and the right to receive information (accountability) are inherent, and mutually reinforcing, properties of relationships in which roles and responsibilities exist (Gray *et al*., 2014). This thesis has argued that while stakeholders will wish to evaluate the commitment of other partners with whom they collaborate, the methodology and the medium of accounting are restricted because it is not possible to evaluate commitment in the light of promises or outcomes whose future delivery remains uncertain. For this reason, stakeholders must rely on the assessment of the credibility of statements made by partners in their corporate reports, which describe the strategic intent to reduce carbon emissions.

Where credible accounting and disclosure are the focus of evaluation, an analysis of accounting performed at the macro, meso and micro levels is instructive where it reveals the difficulty in reconciling performances between levels, and performances at variance with the shared objectives and claims in the respective narratives at each level.

3.12 Macro datasets

The macro level analysis will require construction of a dataset of United Kingdom business sector emissions, sourced from the United Kingdom National Accounts (the *Blue Book*). These data are located in the *UK Environmental Accounts* section of the *Blue Book.* In the first instance, these data comprise estimates of the national greenhouse inventory, expressed in tonnes CO_2e and allocated into business sectors allocated a Standard Industrial Code (SIC). Additional reports allocate emissions between each constituent gas (e.g. methane) within the national inventory. These sub-inventories are attributed to specific industries.

The national total greenhouse inventory is presented in Table 5, analysed according to broad industrial classifications. This thesis reviews macro national carbon statistics over the period 1990- 2011, and its analysis of meso and micro statistics covers the period 2006-2011. Accordingly Table 6 presents 2006-2011 data alongside the 1990 baseline.

Table 6. United Kingdom national greenhouse gas inventory (million tonnes CO_2e)

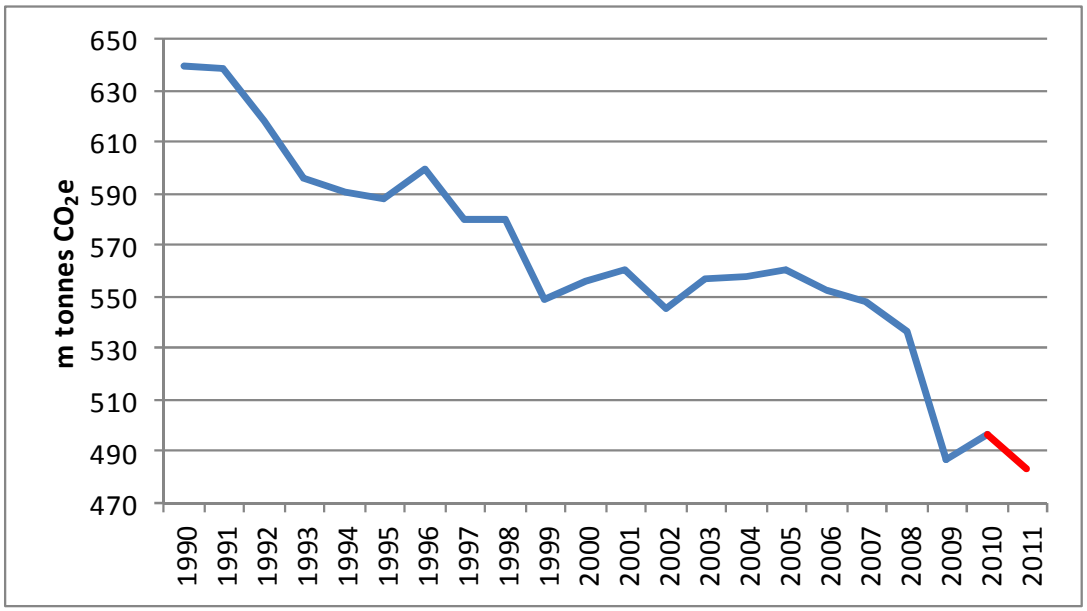
Industrial classifications	2011	2010	2009	2008	2007	2006	1990
Agriculture, forestry and fishing	53.1	53.2	52.4	53.2	53.6	55.1	64.9
Mining and quarrying	21.6	23.2	23.5	23.9	24.7	25.4	38.6
Manufacturing	97.8	97.9	97.0	113.4	116.4	116.6	176.4
Electricity, gas, steam and other utilities	184.0	197.3	191.1	213.8	219.1	223.9	265.7
Construction	10.1	10.4	10.2	11.3	11.7	11.2	8.8
Wholesale and retail trade; repair of motor vehicles and motorcycles	16.7	17.6	16.9	16.4	16.7	16.1	12.6
Transport and storage; information and communication	91.3	88.2	87.1	94.7	95.9	94.8	65.0
Accommodation and food services	3.0	3.3	3.2	3.2	3.2	3.3	2.9
Financial and insurance activities	0.2	0.2	0.2	0.3	0.3	0.2	0.2
Business sector total emissions	**477.8**	**491.3**	**481.6**	**530.2**	**541.7**	**546.6**	**634.9**
Real estate activities; professional, scientific, technical, administrative and support se	5.3	5.6	5.5	6.1	6.1	6.0	5.1
Public administration and defence; compulsory social security	6.3	6.8	6.9	7.6	8.1	8.2	11.0
Education	3.4	3.7	3.5	3.9	4.0	4.1	5.9
Human health and social work activities	4.7	5.3	5.1	5.3	5.2	5.3	4.4
Arts, entertainment and recreation; other service activities	2.4	2.6	2.7	2.8	2.7	2.8	3.3
Activities of households as employers	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Consumer expenditure	134.7	155.7	146.0	152.7	152.0	155.7	141.8
Total greenhouse gas emissions	**634.8**	**671.2**	**651.5**	**708.9**	**720.0**	**728.9**	**806.5**

Source: Author, adapted from Office for National Statistics (2013d)

Table 6 also reveals the 'business sector emissions' incorporated into in this thesis's macro dataset. The decision to restrict the analysis to the business sector is informed by materiality, as the emissions in this sector account for around 75% of the total United Kingdom greenhouse inventory. The quantitative research was conducted before the release of the 2013 *UK Environmental Accounts* and therefore the macro dataset describes the period 1990-2010, which represents a 20-year longitudinal study. An examination of the impact of 2011 data reveals little change to the 1990-2010 emissions profile. It was therefore estimated that the research findings would be unlikely to benefit from the additional work involved in updating the dataset to include 2011. The impact of 2011 emissions data on the longitudinal time series is shown in Figure 5 which supports the decision to adopt the 1990-2010 dataset.

It should be noted that the data in Table 6 are prepared on a 'production' or 'point of issue' basis which estimates emissions generated within the territorial boundary of the United Kingdom, together with net emissions of temporary travellers to and from the United Kingdom. Aviation and shipping emissions are excluded. This methodology differs from the 'consumption basis', which would include emissions embedded in goods and services supplied from overseas, net of emissions incurred in the manufacture of exports. The displacement potential of this alternative methodology is revisited in Chapter 4.

Figure 5. United Kingdom macro business sector emissions 1990-2010 and 2011



Source: Author, using data from Office for National Statistics (2013d)

Chapter 4 will use the macro dataset to create an alternative critical narrative that retells the story of the United Kingdom carbon reduction strategy. National business sector data are a socially constructed abstraction of a physical state, aggregated from the estimated emissions of each constituent gas and their many sources of generation. Chapter 4 will forensically 'unpack' these congealed data to recover information lost on aggregation. Then it will use an innovative statistical method known as CUmulative SUM deviation (CUSUM[8]) to locate the timing of events that have reshaped the emission trajectories of each constituent gas. Once the timing of each 'deviation' has been ascertained, the author will examine the history of significant proximate carbon-relevant events to identify possible influences. To ensure credibility the nature and timing of these events will be well-supported in the analysis.

This process endeavours to reify national greenhouse emissions statistics. It begins with a time-series representing an abstraction of the United Kingdom's physical greenhouse emissions between 1990-2010. It concludes with an alternative story that recounts the events shaping physical emissions over the

[8] CUSUM is an abbreviation of CUmulative SUM deviation; a statistical technique for measuring bias in equal interval sequential data (Harris, 1994).

period and which reflects upon the credibility of the United Kingdom Government carbon footprint strategy.

Accordingly, the first research question is as follows:

> **RQ1.** Can numbers be used to create alternative critical narratives of carbon reduction credibility at macro, meso and micro levels of analysis?

3.13 Meso datasets

This exercise sets out to determine whether a dataset can be constructed to adequately describe the carbon performance and trajectory of the meso group of FTSE100 corporations. To the best of the author's knowledge, no similar dataset exists at the time of writing that is freely accessible in the public domain. If achievable, the dataset will represent an original contribution. It will also form the second quantitative element of the analysis required to address research question 1, as detailed in the previous section of this chapter. Moreover, lessons learned in the construction of the meso dataset will be a useful contribution in their own right, which may prove helpful to future researchers embarking on similar studies.

The meso dataset will be constructed to cover the period 2006 – 2011. It will comprise aggregated numerical estimates (tonnes CO_2e) of corporate greenhouse gas emissions. In the first instance, the research will extract corporate carbon disclosures made by all FTSE100 firms in each of the six years. The raw database will then be refined and restricted to include those firms with six years' continuous disclosure. The FTSE100 index used in the dataset will comprise those firms listed as at the fourth quarter of 2010. The index is a malleable population of firms, and its constituents vary from one quarter to the next as businesses acquire or divest, and as market capitalisations change. The appraisal of factors, and decision made regarding the selection of constituents is discussed in greater detail in Chapter 5.

Corporate annual reports, sustainability reports and websites will provide the inputs to the dataset. The extraction of these data is a substantial, time-consuming activity entailing searching and harvesting up

to 1,300[9] reports, as revealed in Table 7. Moreover the location and format of disclosure varies considerably within these reports, because disclosure is voluntary. At the start of the study, the Carbon Disclosure Project (CDP) was considered as an alternative source of physical corporate carbon data. However, this was rejected for several reasons. Firstly, not all firms subscribe to CDP and the research is interested in quantifying the extent of disclosure among FTE100 firms. Secondly, CDP disclosure differs in character from direct reporting for which the firm remains directly responsible. Thirdly, direct data collection provides an opportunity for learning about the variety of disclosure practices, which reveal much about the attitude of firms and the purpose of disclosure in individual cases. Lastly, academic access to the complete CDP database is relatively expensive, requiring subscription payments over the duration of the research.

Table 7. Potential scope of data collection expressed in terms of number of reports searched

	Annual reports per year	Sustainability reports per year	No. company websites	No. years studied	No. companies surveyed	No. reports/ websites searched (max)
Meso data collection	1	1	1	6	100	**1,300**
Micro data collection	1	1	1	6	4	**52**

Source: Author

Where disclosed, direct (scope 1) and indirect (scope 2) emissions will be collected and assimilated into the meso dataset. Scope 1 emissions are those incurred in the combustion of fossil fuels and from land use change, under the direct responsibility of the reporting firm. Scope 2 emissions are those incurred by power generating firms in connection with the firm's purchased electricity. Other indirect emissions (scope 3), comprising emissions incurred by third parties in upstream and downstream activities, will be omitted from the dataset. Chapter 5 examines the corporate disclosure of scope 3 emissions in greater detail and explains why these are excluded from the meso dataset.

The collation of these data is not straightforward. Once again, the researcher must be concerned with whether the outcome is credible and whether it has validity: in other words, can the meso dataset be

[9] The actual number of reports will be slightly fewer than 1,300 because a minority of companies publish their financial and sustainability information within a single report.

believed and does it represent what it is stated as showing. This researcher must consider the completeness of emissions, the underlying mobility of the FTSE100 population, the impact of acquisitions and divestments, the effect of distortions due to size and volatility and the correspondence of firm accounting periods and their impact on aggregation. These factors are fundamental yet complex, and are set out in detail in Chapter 4. However, the following examples of Centrica and Rio Tinto provide an immediate insight into some of the challenges associated with the creation of the dataset.

In the case of Centrica plc (Table 8) carbon disclosures are available from several company sources. Data are updated over successive years to reflect changes in conversion factors and to correct previous errors and anomalies. Where reports from different years offer a choice of data, the earlier reported emissions are taken into the dataset. As well as being consistent, this approach favours those data that have the most immediate impact on users of information. Data for prior years are not adjusted to reflect changes.

Table 8. **Corporate carbon data collection where later disclosures amend earlier years**

Centrica Carbon Footprint (tonnes CO_2e)

Financial Year End: 31st December	2011	2010	2009	2008	2007	2006
Corporate Responsbility Report 2007					9,684,430	7,571,681
Corporate Responsibility Report 2009				11,103,697	9,694,715	7,582,029
Corporate Responsibility Report 2010		10,714,959	11,762,371	11,159,123		
Corporate Website - Data Centre 2012	7,696,573	10,673,678	11,583,819	10,952,954		
Centrica Carbon Footprint	**7,696,573**	**10,714,959**	**11,762,371**	**11,103,697**	**9,684,430**	**7,571,681**

Key: shaded area indicates data chosen for inclusion within FTSE100 carbon footprint dataset

Source: Author, using data obtained from Centrica plc. corporate reports and company website

Table 9 illustrates how adjustments may become necessary in more complex situations, using the example of Rio Tinto plc., whose figures reflected the acquisition of Alcan in 2007. In this exceptional case, a retrospective adjustment was applied to 2006 data to achieve greater comparability across the data series commensurate with a known substantial event. The author appreciates the need to ensure data consistency when compiling the meso dataset. Appendix C uses the Excel facility of conditional formatting to plot emissions profiles for each FTSE100 company with continuous disclosures over 2006-2011, and lists the aggregated annual emissions for the meso dataset.

Table 9. Corporate carbon footprint data collection – adjustment to control for a large acquisition

Rio Tinto carbon Footprint (tonnes CO_2e)

Financial Year End: 31st December	2011	2010	2009	2008	2007	2006
Corporate Website 2012		43,400,000	41,100,000	49,800,000	49,300,000	29,200,000
Adjustment						20,000,000
Revised 2006 Emissions (post-adjustment)						49,200,000
Corporate Responsibility Report 2011	42,700,000	44,400,000	42,400,000	50,700,000	28,900,000	
Rio Tinto Carbon Footprint	**42,700,000**	**43,400,000**	**41,100,000**	**49,800,000**	**49,300,000**	**49,200,000**

Note: shaded area indicates data chosen for inclusion within FTSE100 carbon footprint dataset

Source: Author, using data obtained from Rio Tinto plc. corporate reports and company website

As well as collecting carbon emissions (scope 1 and 2) data for the FTSE100 meso dataset, this thesis utilises a benchmarking tool, developed in association with others[10], that integrates these data with matching financial numbers to create a range of carbon intensity ratios. These ratios contrast carbon emissions with aspects of financial performance. The primary purpose of this exercise is to create a triangulation mechanism with which to evaluate the narrative statements made in financial and corporate sustainability reports. This is possible because physical carbon and financial numbers are prepared independently of each other, using different methodologies and conventions. Moreover, where disclosures use a relative indicator of carbon emissions to justify a narrative of strategic intent, this method compares the stated numerical ratio with a range of intensities calculated against different denominators. In this way, instances of selective disclosure are revealed which open the way for challenge and the framing of alternative and potentially contradictory narratives.

The benefits of benchmarking will become apparent post-October 2013, when listed companies are required to make annual disclosure of at least one carbon intensity value under the Companies Act 2006 (Strategic and Directors' Reports) Regulations, 2013. Where managers have discretion to determine which intensity value to disclose, they are likely to use the measure that gives the most favourable account of the company's carbon performance. The benchmarking tool represents a potential means of frustrating impression management in corporate carbon reporting. Chapter 8 describes its development in greater detail.

[10] See Haslam *et al.* (2014) 'Accounting for carbon and reinforcing disclosure'. *Focus on Research*. Spring. 30 pp.21-22. This is a small research project, sponsored by the Institute of Chartered Accountants of Scotland (ICAS), which can be accessed at: http://www.scribd.com/doc/222585194/Focus-on-Research-Spring-2014

Table 10 outlines the financial and other data to be extracted from the financial statements of the FTSE100 constituents in order to create these metrics, while table 10 lists the key ratios that will be calculated from the data in Table 9.

These data will be used to construct an aggregated FTSE100 meso dataset, which ranks constituent firms against the average value for each key ratio. These rankings may be used to ascertain whether an individual company's carbon intensity is improving or deteriorating over time, relative to individual firms, industrial sectors or the FTS100 meso grouping.

Table 10: Financial and other data to be extracted from FTSE100 company financial statements

Items from report and accounts	Relevant indicators
Sales Revenue	Total Income
Cash earnings	Earnings pre interest tax and depreciation
Net Earnings	Profit after tax
Labour costs	Labour costs per notes to the accounts
Value Retained	Labour Costs plus Cash earnings
Shareholder Equity	Reserves plus original capital
Long-term debt	Year end balances
Share price and market value	Share price times shares outstanding
Number of Employees	Number of employees per notes to the accounts
Carbon emissions	Scope 1 and 2 emissions

Source: Author

Table 11 lists the key performance indicators to be calculated from these raw data.

Table 11. Key ratios to be calculated from data extracted in Table 10 (FTSE100 companies)

Carbon emissions (tonnes CO_2e per employee)
Sales revenue per tonne of carbon (CO_2e)
Value retained per tonne of carbon (CO_2e)
Cash earnings per tonne of carbon (CO_2e)
Return on Capital
Earnings per share
Market value per tonne of carbon

Source: Author

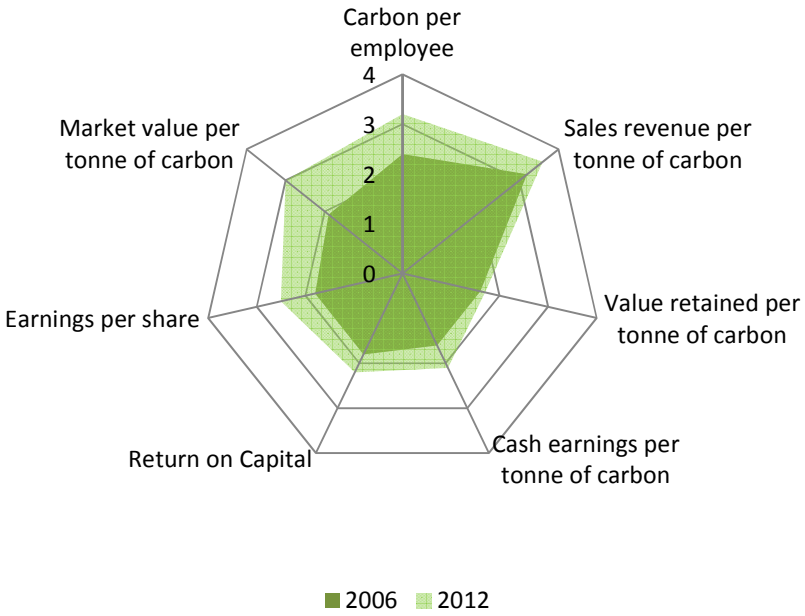
Figure 6 uses a radar diagram to illustrate how these rankings might be presented for a single hypothetical company relative to the aggregate dataset. In this example, '4' indicates the highest score

where ‘0’ is the lowest. Where carbon emissions relative to income, cash or per employee are high, then the score is lower.

For the hypothetical company in Figure 6, there is an improved relative performance from 2006 to 2012, which is visually apparent from the expanded ‘footprint’ occupying the diagram in 2012 compared with 2006.

The calculation and presentation of these relative intensities serves some interesting secondary purposes. Where investment analysts need to incorporate carbon risk assessment into their portfolio appraisals, a software-based tool ranking carbon reduction against a range of financial criteria is a potentially useful screening device with which to inform portfolio choice; identifying companies that combine targeted financial performance with low carbon emissions. The same model may also be help managers evaluate the materiality of carbon impacts of decisions, where carbon emissions are evaluated relative to financial outcomes.

Figure 6. Hypothetical firm rank score relative to all FTSE100 firms



Source: Author. See also See also Haslam *et al*. (2014a), Institute of Chartered Accountants of Scotland Small Research Project, which assisted with the development of the methodology.

Following on from this approach, the second and third research questions are:

> **RQ2.** Can a physical and financial dataset be constructed that reveals trajectory and relative performance at meso (FTSE100), industry and firm level? What are the challenges associated with this construction?
>
> **RQ3.** To what extent have large corporations represented in the FTSE100 index reduced their carbon footprint since 2006?

3.14 Narrative datasets

The third frame of analysis sets out to collect carbon-relevant narratives from the financial statements and sustainability reports of the FTSE100 constituents in the meso dataset. These are the narratives used by managers to provide the 'story in a box' (Golding, 2001), which will be subjected to cross-check with the numbers compiled in the first two frames.

The field of narrative search will be restricted to the annual reports and sustainability reports of four companies comprising the FTSE100 mixed-retail sector. These companies operate supermarket businesses with extensive food and non-food retail activities. The decision to restrict the narrative search to one sector is a pragmatic one, dictated by the sheer volume of textual material from which to search, collect and classify narrative statements. As Table 7 illustrates, the search utilised 52 reports, and each typically comprises over 100 pages.

Using PDF downloads of these reports, the research will identify matches with keyword sets to highlight statements with environmental, sustainability or carbon relevance. Other keyword sets employ terms that are framed in the language of commitment, as these may be incorporated into narratives concerning the strategic intent to reduce carbon emissions. The purpose of this keyword search is twofold: to determine the relative frequency with which these terms are used, and the weight of impression intended by managers; and to create a classification of narrative statements that might prove useful later in the analysis. Table 12 presents the keywords utilised in searching for and obtaining narrative statements for analysis.

Once the narrative statements containing these keywords are stripped from the corporate reports, they will be counted and sifted into categories that enable an overall assessment to be made of the value added by carbon disclosure. The research adopts Omanson's structure, which classifies narratives as having central, supporting or distracting content:

> "Central content is judged as more important, and is better recalled, than Noncentral content, and its recall is enhanced by Supportive, but impaired by Distracting content" (Omanson 1982: p.195).

Supportive content is secondary and subsidiary to central content: "Supportive content includes … characterizing units describing the main characteristics or the setting of Central or Supportive units" (Omanson 1982: p.209). Beyond central and supportive content, all others belong to a residual category which Omanson describes as 'Distracting', which tends to disrupt rather than enhance decision-usefulness. This thesis adapts Omanson's classification by subdividing 'distracting' narratives into six subcategories. 'Vague Statements', 'Hollow Statements', 'Badge Collecting', 'Reflected Glory', 'Deflectors' and 'Immaterial Statements' are presented and defined in Table 13.

Chapter 7 and its appendices set out the results of the narrative search, and count and classify them using Omanson's adapted taxonomy.

Table 12. Keyword search terms used to prepare the narrative statement database

Commit	Committed	Commitment	Environment
Environmental	Environmentally	Stakeholder	Sustainable
Sustainably	Sustainability	Greenhouse	Emissions
Carbon	CO_2	Methane	CH_4
Nitrous	N_2O	Responsibility	Responsible
Responsibly	Climate	Engage	Engages
Engagement	Energy	Refrigeration	Refrigerant
Refrigerator	Refrigerators	Refrigerated	Footprint

Source: Author

Recalling Golding's (2001) characterisation of corporate storytelling, it is possible that the keyword searches will reveal a high incidence of narrative statements appearing to confirm the strategic intent of a given firm to reduce its carbon emissions. In each case, these statements will be compared with the firm's numbers (physical carbon and carbon/ financial intensity metrics) to facilitate further investigation where there is corroboration or discrepancy.

Table 13. Narrative elements classified by content type and sub-category

Central Content	**Definition: causal construction**
Past	Memorable, active narratives describing past actions
Present	Memorable, active narratives describing present actions
Future	Memorable, active narratives describing intended future actions
Supportive Content	**Definition: contributes to understanding the nature of commitment**
Legitimacy	Narratives that support central narratives, describing or confirming a minimalist environmental strategy.
Competitive Advantage	Narratives that support central narratives, describing or confirming a strategy that attempts to improve the firm's economic position as a result of its environmental actions.
Enlightened Management	Narratives that support central narratives, describing or confirming a strategy in which the firm is an ecologically sustaining entity; not merely an economic unit.
Distracting Content	**Definition: disruptive rather than enhancing of decision-usefulness**
Vague Statement	A statement of desire or general intent which is unspecific in terms of quality or extent, which by its nature cannot be used to commit the actor to following through.
Badge Collecting	Claimed recognition by a named organisation, from which the reader is expected to infer a commitment to a virtuous cause.
Hollow Statement	Usually a statement of fact, or a description of a state of being which does not connect with any intention, objective or past action.
Reflected Glory	Often takes the form of a case study, in which a third party supplier is held up as a leader or innovator. In using the case study, the story-teller hopes that the reader will infer an association which may not exist.
Deflector	A statement which implies a meaning to a phenomenon or behaviour, which cannot be justified. Deflectors are of questionable relevance.
Immaterial	A 'grand statement', or 'grand claim', which on further investigation is shown to have insignificant impact.

Source: Author, adapted from Omanson (1982) and Dillard *et al.* (2005)

3.15 Micro case study: the FTSE100 mixed-retail sector

Lastly, the study will use the case study method to examine the congruence between carbon-relevant corporate narrative statements and the specific strategic context in which these companies and their industry operate.

The case study is arguably not a methodology in its own right, but a framework into which other methodologies may be placed. According to Ragin (1992: p.5), "Boundaries around places and time periods define cases", and this enables case studies to frame the field of enquiry and enhance its specificity. Stake (2005: p.443) argues that the subject, rather than method, defines the case study:

> "Case study is not a methodological choice but a choice of what is to be studied. . . . By whatever methods we choose to study *the case*. We could study it analytically or holistically, entirely by repeated measures or hermeneutically, organically or culturally, and by mixed methods—but we concentrate, at least for the time being, on the case".

Thomas (2011: p. 513) adopts this perspective and incorporates it within the following definition:

> "Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame—an object—within which the study is conducted and which the case illuminates and explicates".

This case study will revisit the four FTSE100 mixed-retail sector firms over the period 2006 -2011. The mixed-retail sector is particularly interesting in a carbon disclosure study because of the scale of its operations measured in terms of depth and breadth, and the extent to which it interacts with the public, as customers and employees. Few other industries of this size receive customers into their premises as often as supermarkets do, and few depend to the same extent on maintaining public trust. This creates a tendency within the industry to make purposeful disclosure, which makes supermarkets a compelling subject for this research.

The case study method will provide additional triangulation of narratives by drawing comparisons with different, more intimate or more individual, data than those relating to physical emissions and the standardised financial numbers incorporated into the carbon risk model. The supermarket case study will evaluate narratives in the context of the historic development of the industry, the creation of vast

retail and logistical infrastructures and the way in which the industry has reshaped the society in which it operates. These narratives will also be evaluated in the context of economic financialisation and the behavioural implications associated with the senior executive remuneration. Case studies create thick descriptions that can contribute to the transferability of research findings (Lincoln & Guba, 1985; Guba & Lincoln, 1994). While case study findings are seldom generalisable (Gomm *et al*., 2000), and this case study is confined to a single industry, they can make meaningful contributions where they complement or triangulate other elements within an integrated methodological framework.

Following the approach outlined in this, and the previous section, the fourth and fifth research questions is stated as follows:

> **RQ4.** Can narratives be extracted and categorised to reveal different levels of carbon reduction credibility within large corporations?
>
> **RQ5.** How can the narratives about the credibility of carbon emissions reduction be challenged by imaginative use of numbers that help formulate critical interventions and frame new policy initiatives?

3.16 Conclusions and implications for the research

The focus of this research is within accounting which acts as a conduit by which the strategic intentions of large corporations are made visible to stakeholders with interests in low carbon futures. It is concerned with the extent to which the potentially contradictory strands of personal, professional and managerial engagement with environmental goals impact the outcomes of accounting. Thus the study engages with how socially constructed accounting imparts knowledge of highly conceptualised attributes, or 'states of mind', in such a way as to facilitate assessment and decision making in the environmental context.

With few exceptions, the literature is almost silent regarding the conceptualisation and definition of commitment, offering scholars scant guidance on the meaning and nature of this socially constructed concept, despite its ubiquity within our lexicon. Moreover, despite the tendency in the practice of narrative disclosure to describe intentions using the language of commitment, this thesis argues that the methodology and medium of accounting are restricted in their ability to evaluate commitment because

it is not possible to determine the delivery of strategic outcomes in advance of their realisation. For this reason, the thesis focuses on the appraisal of the credibility of narratives of strategic intent derived from accounting narratives and numbers. The intention to guide the understanding of what makes accounting meaningful to stakeholders who need to assess the extent to which 'saying' and 'doing' are mutually reinforcing.

At the conclusion of this research, the closing chapter of the thesis will offer the recommendations of the thesis for further research and for adoption by those with specific interests in national carbon reduction policies that depend on the corporate sector for successful outcomes.

In summary, the objectives of this thesis are formalised within the following research questions:

RQ1. Can numbers be used to create alternative critical narratives of carbon reduction credibility at macro, meso and micro levels of analysis?

RQ2. Can a physical and financial dataset be constructed that reveals trajectory and relative performance at meso (FTSE100), industry and firm level? What are the challenges associated with this construction?

RQ3. To what extent have large corporations represented in the FTSE100 index reduced their carbon footprint since 2006?

RQ4. Can narratives be extracted and categorised to reveal different levels of carbon reduction credibility within large corporations?

RQ5. How can the narratives about credibility of carbon emissions reductions be challenged by imaginative use of numbers that help formulate critical interventions and frame new policy initiatives?

In the next part, Chapter 4 presents a macro analysis of the United Kingdom national greenhouse inventory for the period 2006 – 2011. Its findings will help to inform the answers to research questions 1 and 5.

Chapter Four

Macro analysis: the United Kingdom national carbon footprint

4.1 Introduction

This Chapter investigates data describing the United Kingdom macro (national) carbon footprint and its methodology aligns with the first research question.

> **RQ1**. Can numbers be used to create alternative critical narratives of carbon reduction credibility at macro, meso and micro levels of analysis?

The chapter begins with a narrative setting out the strategic intention to reduce national greenhouse emissions, assembled from the Climate Change Act (2008) objectives, the Carbon Budget and Carbon Plan. It concludes by countering with an alternative narrative, in which observed carbon reductions are the outcome of spent initiatives which are unrelated to dedicated climate change policy; which challenges the credibility of the original narrative. The analysis demonstrates that the trend of declining emissions lacks momentum because it is influenced by discrete, structural and non-recurring events.

These findings are made possible using a novel method of analysis to investigate a twenty-year time series of emissions data, extracted from the *UK Environmental Accounts* published by the Office for National Statistics. These data are disaggregated into the constituent greenhouse gases and adjusted to remove non-business sector emissions. The statistical method of analysis is the CUmulative SUM deviation technique (CUSUM)[11], which searches for change-points in the data indicating the precise timing of carbon-relevant events. Once identified, these provide locations from which to compile a timeline of carbon-relevant events. It is the evaluation of these events that provides fresh perspective from which to re-examine and challenge the credibility of the carbon reduction narrative.

4.2 The national carbon reduction narrative

In the first instance it is difficult to objectively determine a carbon policy narrative for the United Kingdom. Few clues appear in the speeches of political leaders and one must guard against using selective quotes to infer a more general meaning than that intended by the speaker. Moreover,

[11] A detailed description and explanation of the CUSUM technique is provided in section 4.4 of this chapter.

politicians and officials should be credited with drawing attention to the challenges of carbon policy, as well as their aspirations. The objective of this research is not to 'pick holes' in elements of political speeches. Rather, it is to corroborate, or challenge the 'grand narrative' by confronting it with numbers, and then to decide whether an alternative narrative offers a better fit with the evidence.

It is possible to work around the problem of objectivity by declaring the search for a narrative of strategic intent; one that articulates the government's positive disposition towards carbon reduction. The literature review has considered how productive outcomes, like carbon reduction, require the mutual commitment and trust of partners (Morgan & Hunt, 1994), and the United Kingdom Government appears to recognise the importance of these dynamics:

> "Industry must lead, but the Government can facilitate … As we make the transition, the state will need to solve the co-ordination problems and ensure that the system as a whole coheres" (United Kingdom Department of Energy and Climate Change, 2011: p.12).

The meaning of narrative used in this chapter derives from Froud *et al.*, who are credited with developing the numbers and narratives methodology. Their usage caters for business applications but can be readily adapted to describe government narratives:

> "Giant company CEOs now need a story of purpose and achievement for analysts and shareholders, backed by performative initiatives … which establish that management is doing as well as saying" (Froud *et al.*, 2006: p.9).

Table 1 restates the key elements of the definition, assembling sources and expressions intended to create an objectively-drawn narrative of the government's strategic intent.

Table 1. Construction of the United Kingdom government narrative of strategic intent

	Story of purpose	**Story of achievement**	**Performative initiatives**
Source Document	Climate Change Act (2008)	UK Environmental Accounts	Carbon Budgets
Manifestation	Legally-binding targets	National Greenhouse Inventory	Carbon Plan

Source: Author, after Froud *et al.*, (2006)

From Table 1, the narrative can be stated:

> 'The United Kingdom Government undertakes the legal obligation to achieve an ambitious national carbon reduction plan, evidenced by the mandating of targets in domestic legislation. These targets apply to aggregated, commensurated greenhouse gas emissions. This obligation is supported by the performance achieved to date as stated in the annual UK Environmental Accounts; and is backed by performance initiatives broadly outlined in the Carbon Plan whose contributions are phased into successive Carbon Budgets'.

This chapter, together with chapters 5 and 6, aims to address the first research question (**RQ1**). While the analysis in this chapter may be considered in its own right, this thesis will juxtapose three separate perspectives of carbon footprint performance in order to "construct alternative critically engaged narratives" (Andersson *et al*., 2010: p.212). It is anticipated that this multiple-perspective approach to data analysis will reveal:

> "different micro-, meso- and macro narratives whose interrelation can involve contest and challenge as much as support and confirmation" (Froud *et al*., 2006: p.126).

The disparity between narratives applicable to the micro and macro levels was noted by Keynes, in his *General Theory of Employment Interest and Money* (Beckhart & Keynes, 1936). Keynes observed how the individual virtue of thrift may benefit the savings of a single household, while potentially devastating total savings in an economy if practised by the entire population. This tendency to pursue individual maximising objectives that may harm the achievement of macro goals is compared with the prisoners' dilemma, whereby:

> "Behavior that is rational for each party separately (non-cooperation) is irrational for the two parties collectively" (Morgan & Tindale, 2002: p.46).

A company may benefit financially by 'externalising' its carbon emissions. Yet where the practice is prevalent, that which favours the company may harm its industry and the national economy. Therefore it is plausible that carbon reduction narratives of the micro, meso and macro levels will contest and challenge one another. These contradictory narratives can be assimilated within the plural accounts envisaged by Gray (2010) and Gray *et al*., (2014) as recognised in the literature review as potential elements within an alternative carbon accounting.

4.3 A national account of the United Kingdom carbon footprint

The *UK Greenhouse Gas Emissions*[12] is a high-level aggregation which commensurates and collects estimates of the emissions of each constituent greenhouse gas. Aggregation of the national carbon footprint accumulates data obtained from different processes, industries and segments comprising the national economy. According to Suzuki (2003: p.74), "the process of accounting aggregation necessarily entails the loss of information". The same is true of commensuration, which MacKenzie (2009: p.447) describes as "making things the same". These processes work in tandem to convert quantities of different gases into a common base for the purpose of accounting: for bringing physical matter into the calculative space of an entity. Once accounted for, emissions can be monetised to enable functioning carbon markets, and budgeted against an amalgamated target aligned with mandated obligations. Aggregation and commensuration blend disparate elements to emphasise the 'whole'. The effect can be likened to the computation of an average, which obtains a measure of centrality that diminishes the visibility of difference. Thus the national data congeals important information that would provide a useful insight into the nature of the carbon footprint problem and exaggerates the success of the United Kingdom's record on national decarbonisation (Helm *et al*., 2007).

As previously described in the literature review, six gases are officially designated as greenhouse gases, namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O); and the refrigerant gases comprising hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) (UNFCCC, 1998). Each gas varies according to its relative harmful impact on global warming. Commensuration therefore converts physical quantities of each emitted gas into carbon dioxide equivalents (tonnes CO_2e) by applying the global warming potential (GWP) of a specific gas to the weight of its emissions. According to the IPCC (Houghton *et al*., 1996: p.53):

> "The Global Warming Potential is a measure of the relative, globally-averaged warming effect arising from the emissions of a particular gas".

One tonne of methane, which has a GWP of 25, is therefore commensurated into 25 tonnes CO_2e.

However, the GWP values used to calculate national statistics are those determined in the 1990s and these have become 'hardwired' into the Kyoto Protocol and national laws. Accordingly, these data and the national statistics they inform merit critical appraisal. Commensuration derives from GWP, which is

[12] This title is given to the dataset describing the national carbon footprint in the *UK Environmental Accounts*.

a product of scientific measurement and evaluation. Yet closer inspection of the assumptions that inform science suggests that some are extremely sensitive to adjustment, and reveals that concerns over uncertainty have been resolved by the imposition of arbitrary boundaries. For example, for each greenhouse gas, a range of estimates describe the time horizon over which the harmful warming effect persists. According to Mackenzie (2009: p.446):

> "the choice of a 100-year time period [by the intergovernmental Panel on Climate Change (IPCC)] is in a sense arbitrary, and very different GWPs can be generated if, for example, 25, 50 or 500 years is used".

Table 2 illustrates the variation among scientific GWP assessments.

Assuming satisfactory resolution of the time horizon, additional scientific uncertainties remain. Regarding the GWP estimates exhibited in Table 2, the IPCC admits:

> "The uncertainties of these direct GWPs are taken to be ±35% for the 5 to 95% (90%) confidence range" (Houghton *et al*., 1996).

As climate science advances, more accurate GWP values become available which have the potential to improve the representational quality of greenhouse gas accounting. For example, scientific consensus has revised the GWP for HFC-23 from 11,700 to 14,800 (IPCC, 2007b; see also Lohmann, 2009, MacKenzie, 2009). However laws, regulations and protocols do not automatically update to take account of scientific discovery, and the GWP values inscribed in the Kyoto Protocol remain the basis on which accounting is practised (Mackenzie, 2009). In this respect, accounting "produces explicitly "hybrid" knowledge that is neither purely scientific nor purely political, but both" (Ascui & Lovell, 2011: p.984). As Bowen and Wittneben (2011) observe, carbon accounting is concerned more with performance stories than the true and objective reflection of a physical reality.

Table 2. Global warming potential – variation according to time horizon[13]

Greenhouse Gas	GWP per given time horizon			
	20 years	**IPCC (1995) 100 years**	**100 years**	**500 years**
Carbon Dioxide CO_2)	1	1	1	1
Methane (CH_4)	72	21	25	7.6
Nitrous Oxide (N_2O)	289	310	298	153
Refrigerant Gases	12,000	11,700	14,800	12,200

Source: Author, adapted from [Vincent] Gray (2007).

This chapter tells the national performance story in the context of the legally-binding objectives enshrined in the Climate Change Act, 2008. These converge on the requirement to reduce national greenhouse emissions by:

i. 34% by 2020, and
ii. 80% by 2050

Both targets are reductions against the 1990 baseline emissions as stipulated in the Kyoto Protocol. This chapter sets out to evaluate the United Kingdom progress against these targets over a twenty-year period of study (1990-2010). The timescale is significant, for it covers a substantial part of each commitment period; two-thirds of the interim period ending 2020, and one-third of the longer commitment period ending in 2050. The availability of high quality data (*UK Environmental Accounts,* 2011) throughout these periods enables realistic assessment of progress towards successful completion of the objective.

The 1990 baseline predates the Act by 18 years, and the intervening period witnessed significant economic growth. In the first phase, the United Kingdom would need to play 'catch up' to reverse the emissions associated with higher levels of economic output before recording reductions against the baseline. One might expect that the early years of the commitment period should experience the

[13] For simplicity, GWP values of HFC-23 have been included to represent the refrigerant gases group.

greatest reductions, as proactive firms become 'first-movers' and their reductions are 'banked'; and progress is consistent with the law of diminishing marginal returns. The replacement of large capital projects provides an important exception, where facility lifetimes and investment funding create implementation lags and uncertainties.

Moving next to the data, the *UK Environmental Accounts* are compiled using the national accounts methodology. A familiarity with their method of preparation facilitates an appreciation of the limitations of the dataset. First, it should be noted that the *UK Environmental Accounts* defines boundaries using different principles to those applied in corporate carbon accounting. Accounting employs boundaries so that accountants may determine what is to be considered 'inside' and 'outside' the calculative space of the reporting entity, and to provide a basis for recognising emissions (Callon, 1998, 2009; Lohmann, 2009). As Ascui and Lovell (2011: p.985) observe:

> "the political framing of carbon accounting takes a step away from the scientific mode of measurement, calculation and estimation of greenhouse gas emissions at the global level, towards a function of monitoring and reporting at the national level. Political expediency dictates the scope of national inventories".

National accounting recognises those emissions incurred within the United Kingdom economic territory, comprising Great Britain and Northern Ireland, facilities under the control of United Kingdom Customs and the national airspace, territorial waters and United Kingdom sector of the continental shelf. These boundaries include United Kingdom territorial enclaves, such as military bases and embassies situated overseas, while excluding foreign-owned counterparts located in the United Kingdom (Office for National Statistics, 2012b). Notable externalities, or 'overflows' kept outside of the frame, include emissions embedded in imported final goods, services and manufacturing supplies; and emissions incurred by overseas facilities owned and operated by United Kingdom firms. The national footprint is significantly understated because carbon is a 'global pollutant', and these overflows are incurred within the United Kingdom value chain. In contrast, corporate emissions are framed to include emissions from overseas company-owned facilities according to criteria of control or equity ownership (WRI & WBCSD, 2001), and this represents a reconciling item when comparing national accounting and aggregated corporate emissions.

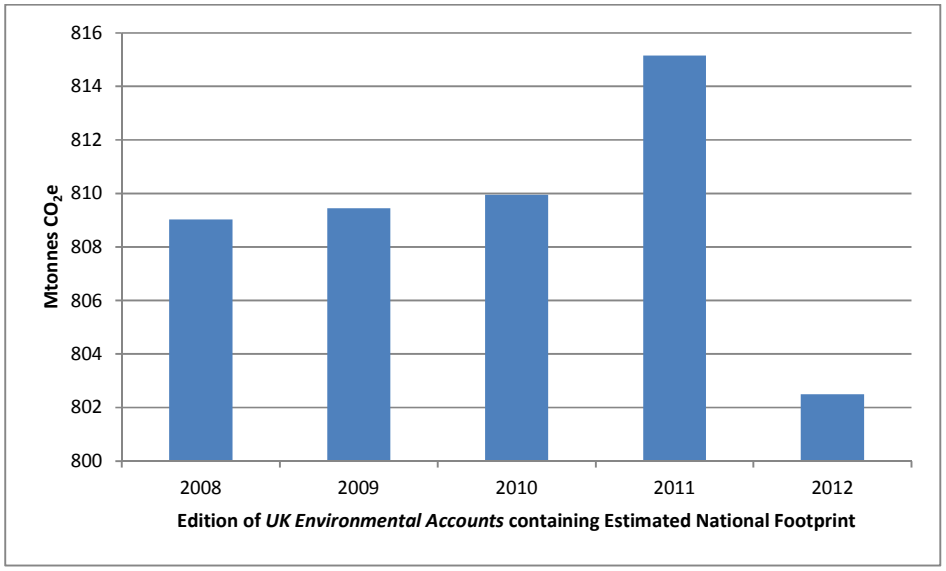
Within national accounting, emissions are estimated rather than directly measured:

> "Emissions are estimated by multiplying fuel consumption by emissions factors and adding releases unrelated to fuel use such as methane arising from landfill and collieries" (Office for National Statistics, 2011: p.270).

These estimates are then disaggregated using data that identify processes and industries responsible for the emissions. Industries are identified according the Standard Industrial Classification system to ensure comparability between periods, and with benchmarks from other national accounting systems. Various methods are used to allocate emissions to industrial sectors using information about activities or expenditure to which fossil fuel use can be attributed (Office for National Statistics, 2011). The emerging picture is a 'top-down' calculation of national emissions, disaggregated in considerable detail to include emissions generated by industrial and public sectors and consumer expenditure.

The Office for National Statistics (ONS) has operated as a non-ministerial department since the enactment of the Statistics and Registration Service Act, 2007. In this capacity it reports to the United Kingdom Parliament without the direct oversight of a responsible government minister (Office for National Statistics, 2013a). The ONS demonstrated the quality of its independence in January 2013, when it decided to retain the Retail Prices Index as the basis for index-linking in the United Kingdom, at a cost of £3bn to the Exchequer (Financial Times, 2013). ONS independence provides some reassurance that the source data used in our datasets has validity and objectivity inasmuch as it is free from government manipulation. However, the data are unstable because each subsequent release of *UK Environmental Accounts* restates all comparative emissions estimates. This takes account of the regular retrospective revision of scientific factors used to convert fuel usage into greenhouse emissions, and the effect is to restate the national carbon footprint and its constituent elements for the entire time series spanning back to 1990. Figure 1 illustrates the progressive impact of these revisions on the 1990 baseline, which simultaneously affects the ongoing target and the required reduction in physical carbon emissions.

Figure 1. Restatements of 1990 UK emissions baseline in successive reports.



Source: Author, using data obtained from Office for National Statistics (2012b)[14]

Figure 1 reveals a 12.6 million tonnes variance in the baseline estimates provided between 2011 and 2012, and this represents a reduction of almost 1% in the baseline over the five-year period shown in the chart.

In summary, the data on which the datasets in this chapter are constructed must be treated with a degree of caution. The science and estimation of climate change is evolving, bringing improvements in GWP estimation which is lagged by the political and accounting processes. Carbon accounting is therefore configured to tell 'performance stories' rather than provide a faithful representation of physical reality. These data remain mobile due to frequent revision of the baseline and cumulative estimates of carbon reduction.

Moreover, the designation of reporting boundaries along politically expedient lines militates against the global impact of greenhouse gas pollution and glosses over international dependencies in the value chain of nations and large corporations. The resulting data therefore represent one, albeit contested, version of national carbon footprint.

[14] The horizontal axis denotes the year of publication e.g. 2012 contains the 2011 national greenhouse inventory.

Having due regard for the limitations of the national footprint data, the next section describes the analytical approach with which the dataset is analysed before moving on to present and discuss the findings.

4.4 Method of deconstruction and analysis

In the first instance, this thesis focuses on the greenhouse emissions released by the business sector, which represent a large subset of the national carbon footprint. Establishing the dataset requires extraction of the business sector components from the *UK Environmental Accounts* as shown in Appendix D, which reveals business sector totals for the years 1990-2010 analysed according to industrial segments.

The classification of the business sector used in this thesis differs from the form used in the government's 2011 *Carbon Plan,* which specifically targets measures to reduce emissions incurred in buildings, transport, industry, electricity, agriculture forestry and land management, and waste and resource efficiency (United Kingdom Department of Energy and Climate Change, 2011). Adopting a 'total business sector' makes sense for the purpose of this research, which compares the macro business sector emissions with aggregated emissions from the meso group of FTSE100 companies. This is because the meso group is 'lumpy'; where constituents span diverse industries and some sectors are represented by a very small number of very large companies. Moreover, for the purpose of comparison, corporate firms seldom report emissions at the functional level (e.g. buildings, transport), tending instead to report scopes 1 and 2 emissions at the organisational level.

In general this chapter presents a twenty-year longitudinal study of national business sector greenhouse emissions. However, it is anticipated that the emissions profiles of individual, disaggregated, greenhouse gases have different stories to tell about the national carbon reduction performance, which provide the opportunity to reflect on the Government's carbon reduction narrative.

The methodology seeks to identify the underlying events that have affected greenhouse gas generation in the United Kingdom economy. For this purpose, the univariate CUSUM is used to examine temporal changes in a single variable (e.g. methane emissions) and to divine precise 'change points' in the emissions data (Harris, 1994). These reveal the timing of carbon-relevant events that have caused a reversal in the emissions trajectory; or alternatively, the time at which a more gradual process change – or series of linked events – has deflected emissions from an established course.

CUSUM is an abbreviation for CUmulative SUM deviation. According to Harris (1994: p.364):

> "It [CUSUM] is a technique for measuring bias in *equal interval sequential* data. That is, if information is gathered at equal intervals on some aspect of a process or system, if there is then some change to an existing pattern of behaviour, CUSUM will detect and measure it …" [italics in original].

In the case of greenhouse gas emissions, the univariate CUSUM calculation and analysis is performed via the following five stages:

1. Obtain sequential emissions data series over an extended period (20 years).
2. Calculate the mean value of the data in the series, by summing the data and dividing the resulting total by the number of data points in the series.
3. For each data point in the series, subtract the mean value from the estimated emissions value to arrive at a *residual* for each year in the twenty-year series.
4. For each of the years, 1990-2010, calculate the cumulative sum of the residuals, starting with the residual for 1990 and including all other residuals up to, and including, the year of calculation. Each of these accumulations can be referred to as the cumulative sum of the residuals.
5. Plot the cumulative sum of the residuals for each year, in a line graph with twenty data points. If calculated and plotted correctly, the line should end on zero on the horizontal axis for the final year (2010).

When plotted, the CUSUM chart displays a characteristic form:

> "the accumulation of these differences, will track either up or down the page. It will do this until something else alters the pattern when there will be another change in direction. In most cases, therefore the graph of CUSUM against time produces a graph comprising a series of straight lines with sharp kinks at each event, which changes the underlying pattern. Extrapolation of the individual segments of the graph to the current date provides a measure of the cumulative impact of the change" (Harris, 1994: p.368).

CUSUM helps to identify 'events' that can be separately distinguished between discrete occurrences and more gradual or incremental influences. Such insight can help to determine whether an emissions trend can be expected to continue, or whether the factor that influenced its trajectory is exhausted.

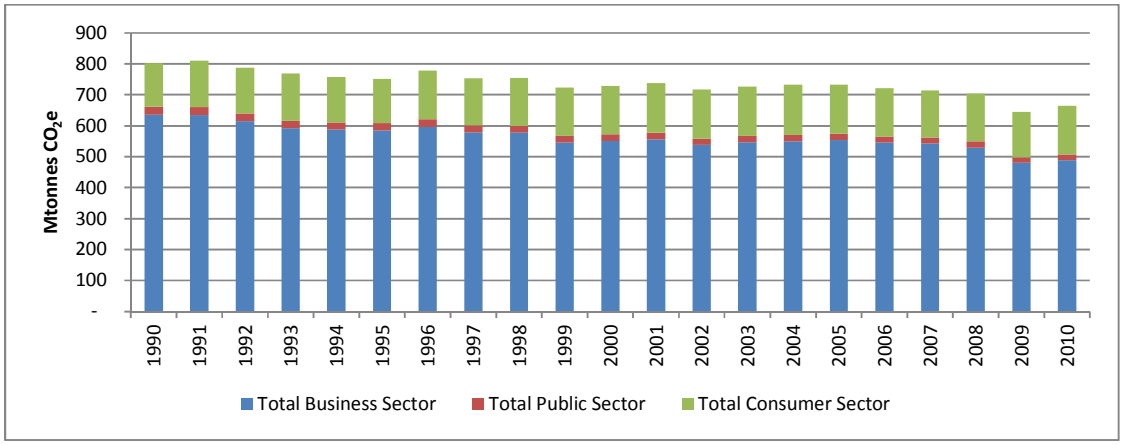
The author's experience shows CUSUM to be a very sensitive tool with the capacity to detect even small underlying changes, which can be attributed to specific events. Not only can CUSUM detect events, it can also detect the impact of changes in methods of estimation and accounting which might otherwise remain undisclosed, thus giving the technique a potentially forensic application. In the context of this research, the CUSUM technique has two principal limitations. While CUSUM can very accurately determine the date at which a shift in a charted pattern occurs, the determination of the event that is potentially responsible for the shift requires time, skill and an extensive knowledge of the phenomena under study. Researching events revealed by CUSUM demands considerable knowledge of the interface between industry and energy consumption. Because an element of human judgement is necessary, the risk that a shift is attributed to a plausible yet spurious event cannot be completely discounted. The second limitation is that the magnitude of the shift-inducing event cannot be precisely read from the vertical axis (Harris, 1994). This issue is easily overcome by producing a separate chart, which follows increases and decreases in the variable – for example emissions of a given gas – which presents the magnitude of change in each year of the study period.

The CUSUM technique is relatively unknown in the academic fields of business and management. From a review of 607 journal article abstracts taken from a fifty-year period, Khodadi and Asgharian (2008) identified seven economics and another seven finance articles utilising CUSUM. One article studied materials accounting, one other addressed environmental compliance, and only one article featured climate change from the perspective of physical science. None examined the issue of greenhouse gas emissions. To the best of the author's knowledge this thesis makes original use of CUSUM to investigate the impact of structural changes in the national economy on the United Kingdom carbon footprint.

4.5 Findings: structural analysis of the United Kingdom carbon footprint

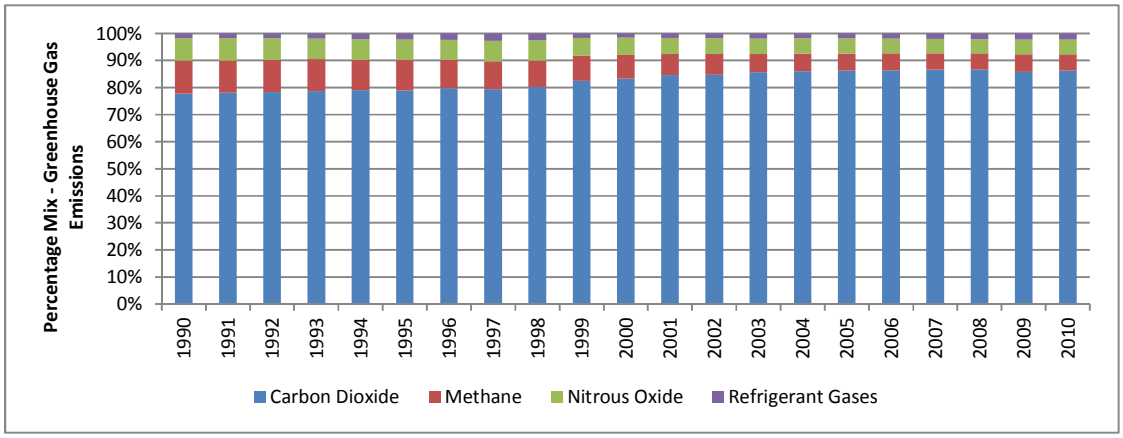
The United Kingdom carbon footprint is estimated at 664 million tonnes CO_2e as at 2010 measured on a national accounts basis (see Appendix D). A summary overview of the total national footprint in Figure 2 reveals a 17% reduction in the national greenhouse gas inventory between 1990-2010. Taken at face value, this represents a significant reduction for the period and presents stakeholders with a tangible indicator of progress against the government's climate change obligations. While carbon dioxide has increased its share of the overall carbon footprint, currently making up 86% of the mix, methane and nitrous oxide have reduced commensurately. The refrigerant gases have remained a minor and proportionately stable component equivalent to 2% of the national carbon footprint (see Figure 3).

Figure 2. UK greenhouse gas emissions by broad sector: 1990-2010



Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics, 2012a)

Figure 3. Mix of gases in the UK total carbon footprint: 1990-2010



Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics, 2012a)

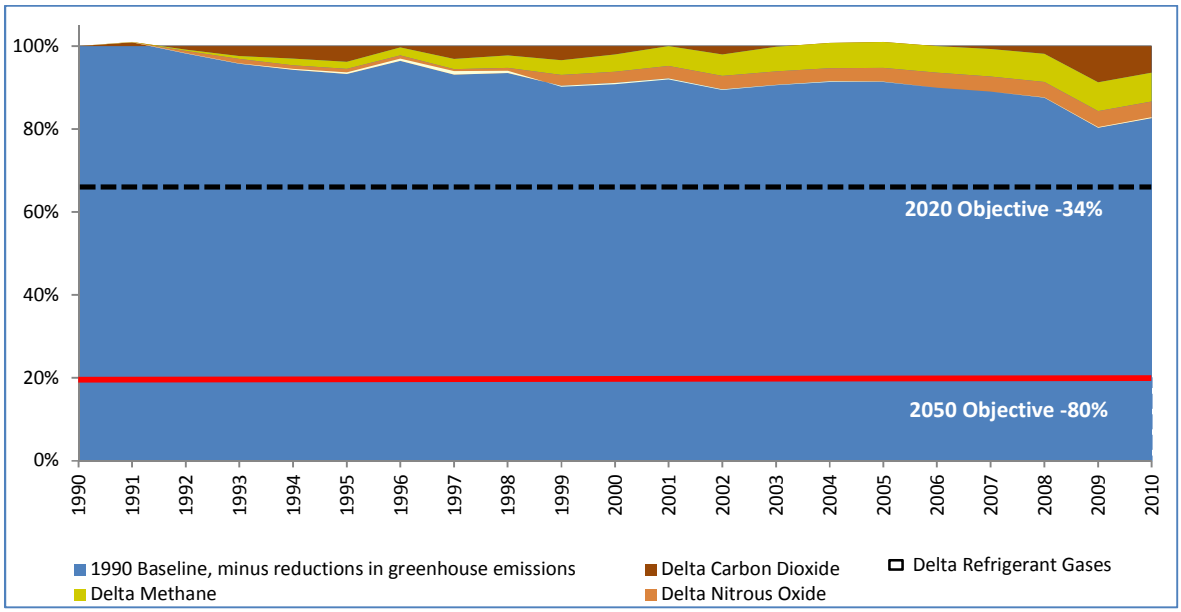
During the twenty-year period, business sector emissions, as calculated in Appendix D, have fallen by some 23%, while remaining the largest-emitting sector of the United Kingdom economy (see Figure 2). Emissions from consumer spending have increased by around 10% over the same period. While public sector emissions have reduced they present a very small proportion of the national footprint, according to the national accounts classification.

The 23% reduction in the United Kingdom business sector emissions is an aggregation of the reduction in several greenhouse gases expressed as carbon dioxide equivalents. Yet on disaggregation it becomes

clear that the reduction is unevenly distributed between each of the constituent greenhouse gases, as revealed in Figure 4.

Figure 4 has been charted using data prepared for the UK Environmental Accounts. Strictly speaking, the correct comparator for use against the Climate Change Act objectives requires adjustment to include Crown dependency (CD) and overseas territory (OT) emissions (United Kingdom Department for Transport, 2010). However, these adjustments are disregarded here on the basis of materiality. The combined CD + OT emissions never rise above 1% of UK Environmental Accounts emissions, and over the twenty-year period, these combined emissions increase by a mere 358,000 tonnes CO_2e. Statistics for these communities are not sub-analysed in the UK Environmental Accounts. If it were possible to allocate the CD + OT business sector emissions, then it is likely that these adjustments would have a negligible effect on estimated UK business sector emissions.

Figure 4. Progress against UK Climate Change Act (2008) obligations



Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a)

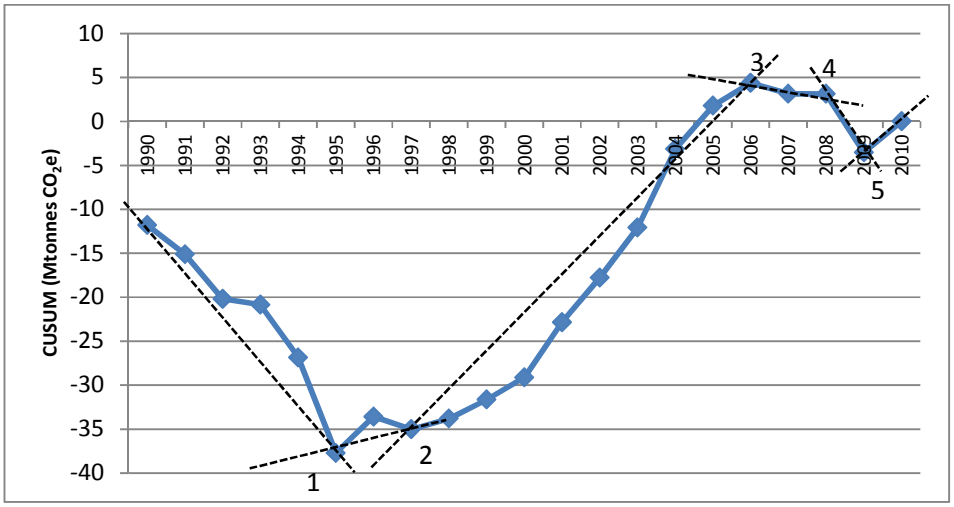
Figure 4 shows that methane sources have contributed most to emissions reduction. Nitrous oxide emissions present a similar profile and reductions in both gases follow a predictable pattern over successive years. Refrigerant gas reductions are comparatively insignificant because these gases represent a small element in the greenhouse gas mix. Accordingly this thesis does not analyse the refrigerant gases in further detail.

However, carbon dioxide emissions have not reduced to the same manner and extent as methane and nitrous oxide, suggesting that emissions of each constituent gas may be driven by different factors. Given that carbon dioxide emissions do not reduce significantly until 2009 – a year of sharp economic recession – there is no evidence yet that these carbon dioxide reductions are permanent or sustainable. Recalling that carbon dioxide accounts for 86% of greenhouse emissions, initial impressions suggest that the largest part of the carbon footprint is resistant to decarbonisation strategy, which may undermine prospects for meeting the Climate Change Act obligations.

Figure 4 therefore provides a perspective on how the United Kingdom is tracking its long-term goal. Meeting the 2050 objective would require a further 60% reduction in emissions, relative to the baseline, over the next 40 years. This represents a 50% increase in the rate of reduction established during the first third of the commitment period. If this were to be achieved, it would run counter to expectations of diminishing marginal returns over time, and would be heavily dependent on the implementation of large structural measures that have no precedent in the existing emissions dataset.

It should also be noted from Figure 2 that consumer expenditure also contributes significantly to the national footprint, and some further investigation is merited here before resuming the analysis of the business sector. Figure 5 presents a CUSUM chart of emissions categorised within consumer expenditure by the national accounts method, based on CUSUM calculations contained within Appendix E.

Figure 5. CUSUM Chart - UK consumer expenditure greenhouse gas emissions: 1990-2010



Source: Author, using data from Environmental Accounts (Office for National Statistics 2012a) Calculations attached in Appendix E.

Figure 5 presents a curve, with six straight sections indicated by the broken lines. Initially, emissions from consumer expenditure are falling through a period which includes the 1992 economic recession, before change-points – indicated by numbers on the chart – reflect events that cause emissions from consumer expenditure to rise, before encountering the disturbances associated with the major economic recession of 2009. Table 3 should be read alongside Figure 5 as it details the significant economic events that coincide with change-points as indicated in the CUSUM chart.

Table 3. Significant economic events affecting consumer expenditure: 1995 – 2010

No.	Year	Events at change-point	Sustaining events in subsequent period
1	1995	Acquisition of Cheltenham & Gloucester Building Society by Lloyds TSB. Windfalls for members increase disposable cash.	National and Provincial Building Society demutualises in 1996, with windfalls for members. Bank base rates fall from 6.63% to 5.69% in 1996, reducing the cost of borrowing by 15%
2	1997	Five further building societies demutualise, giving windfalls to members: Bristol & West, Woolwich, Alliance & Leicester, Halifax and Northern Rock.	Between 1997-2006, bank base rates fell progressively from 7.5% to 4.75%, reducing the cost of borrowing by 37%.
3	2006	Bank base rate rises by half a percentage point (4.5% - 5%), increasing the cost of borrowing by 11%	
4	2008	Economic recession 2009.	
5	2009	Recession ends 2010.	

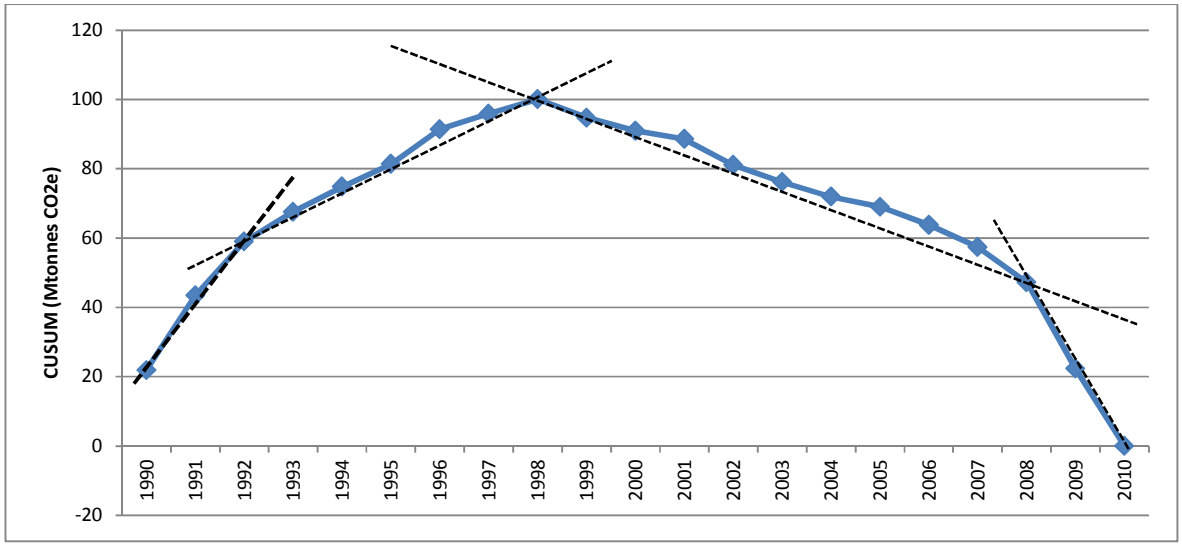
Source: Author, using data obtained from Rex (2011), Rogers (2012).

Taken together, Figure 5 and Table 3 reveal the confluence of significant economic events, affecting the disposable cash held by consumers, with same-direction changes in carbon emissions from consumer

expenditure. The analysis is not intended to establish causality, as social behaviour such as consumer spending is often complex, unstable over time and is not amenable to simple analysis of 'cause and effect'. However the data imply that consumers have increased their spending when their access to disposable cash has increased, and that carbon consequences have followed. Further development of carbon reduction policy linked to consumer spending lies beyond the scope of this thesis. But by focusing on the business sector, the overflow of less carbon-intensive production into consumer expenditure may provide a route to carbon footprint reduction on a broader basis.

Moving on to the business sector, Figure 6 presents a CUSUM chart revealing three significant change-points occurring in 1992, 1998 and in 2008.

Figure 6. CUSUM chart - UK business sector greenhouse gas emissions: 1990-2010



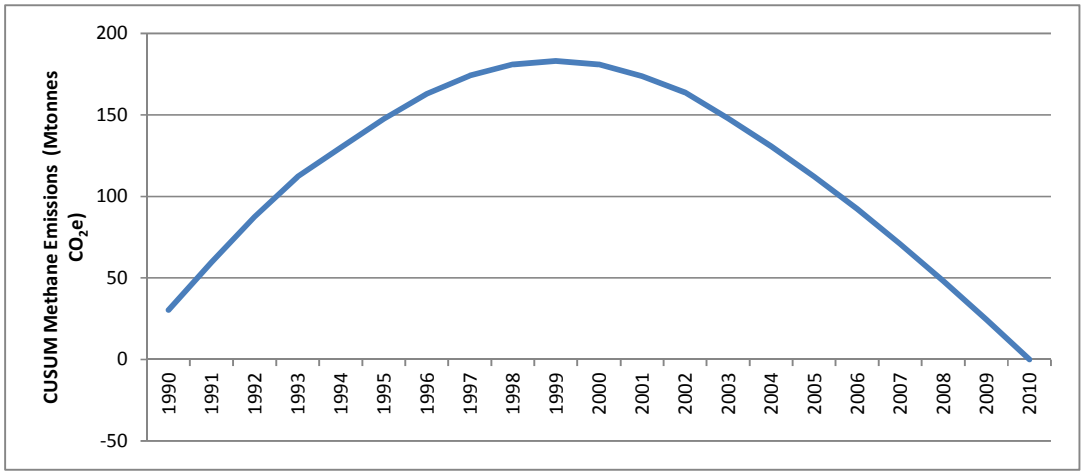
Source: Author, using data from *UK Environmental Accounts 2012* (Office for National Statistics 2012a) Calculations attached in Appendix E.

In common with the previous chart, Figure 6 derives from data aggregating all six greenhouse gases. To make visible the variation among emissions profiles described in Figure 4, the data will be unpacked into its constituent gases and subjected to individual CUSUM analyses. Refrigerant gases are excluded from further analysis because they exert a less significant impact on national carbon footprint, as previously shown in Figures 3 and 4.

Starting with methane, Figure 7 presents the CUSUM chart revealing a smooth curve with a single arc, in contrast to the series of multi-directional straight sections encountered in the previous CUSUM charts.

The methane profile suggests the likelihood not of a single event, but a trend occurring progressively over a number of successive intervals in the time series.

Figure 7. CUSUM chart - UK business sector methane emissions: 1990-2010

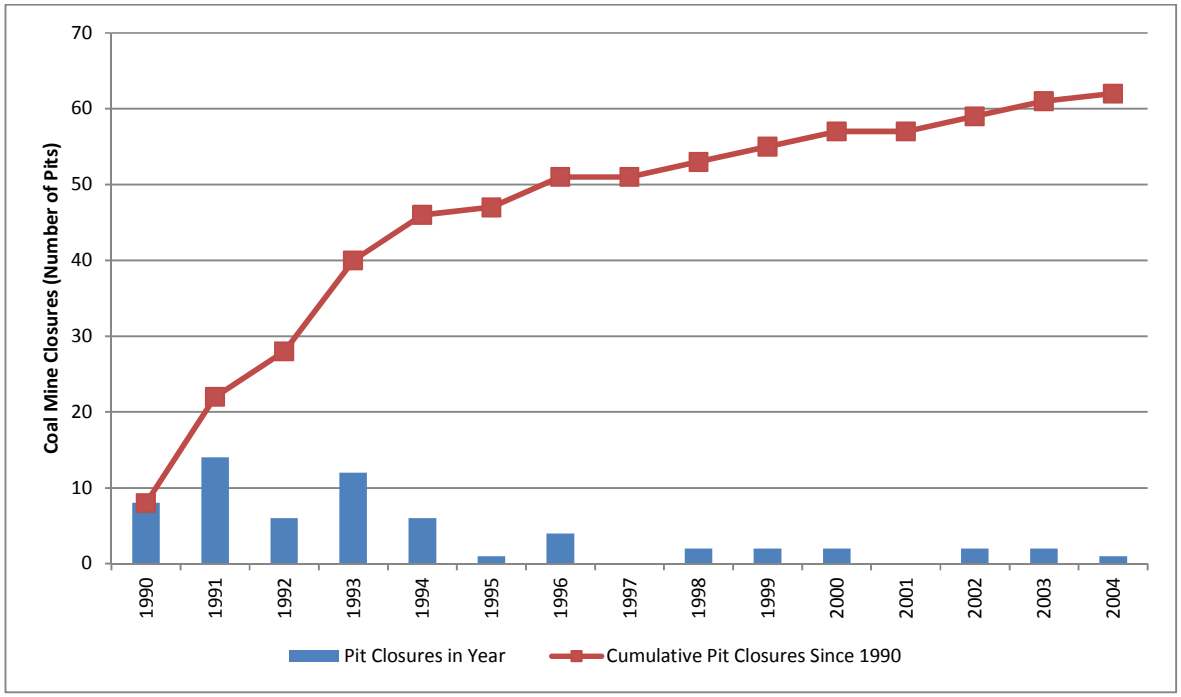


Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a) Calculations attached in Appendix E.

Coal mining, landfill and agriculture combined account for approximately half of the United Kingdom anthropogenic methane emissions (IPCC, 2007b). Figure 7 shows that the CUSUM arc peaks in 1999 as cumulative increased methane emissions revert into a cumulative decline. Bowen and Rydge (2011) attribute much of this decline to improved landfill and waste management efficiency, following the implementation of the landfill tax in 1996 and Landfill Allowance Trading Scheme in 2005. The landfill tax increased threefold in 1999, from £3 to £10 per tonne (Seely, 2009) which coincides with the timing of the CUSUM peak.

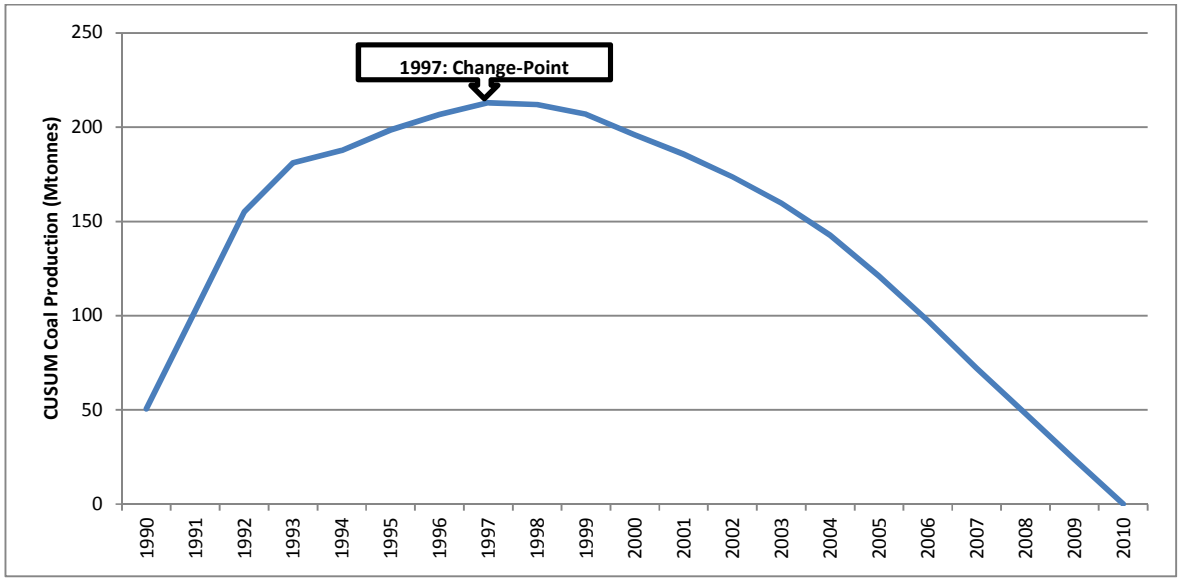
In addition, the period 1990-2010 has witnessed a simultaneous closure of coal mines and a reduction in coal mined in the United Kingdom (see Figures 8 & 9). In 2010, the United Kingdom produced around 18 million tonnes of coal from a rump of 9 deep and 31 opencast mines. This compares with a total production of 93 million tonnes in 1990 (United Kingdom Department of Energy and Climate Change, 2012a). Figure 9 reveals that the cumulative differences between actual and mean production began to reduce from 1997: a turning point in production signalling that coal production had moved into a significant phase of decline within the period of study.

Figure 8. United Kingdom coal mine closures: 1990-2004



Source: Author, using data obtained from BBC (2004).

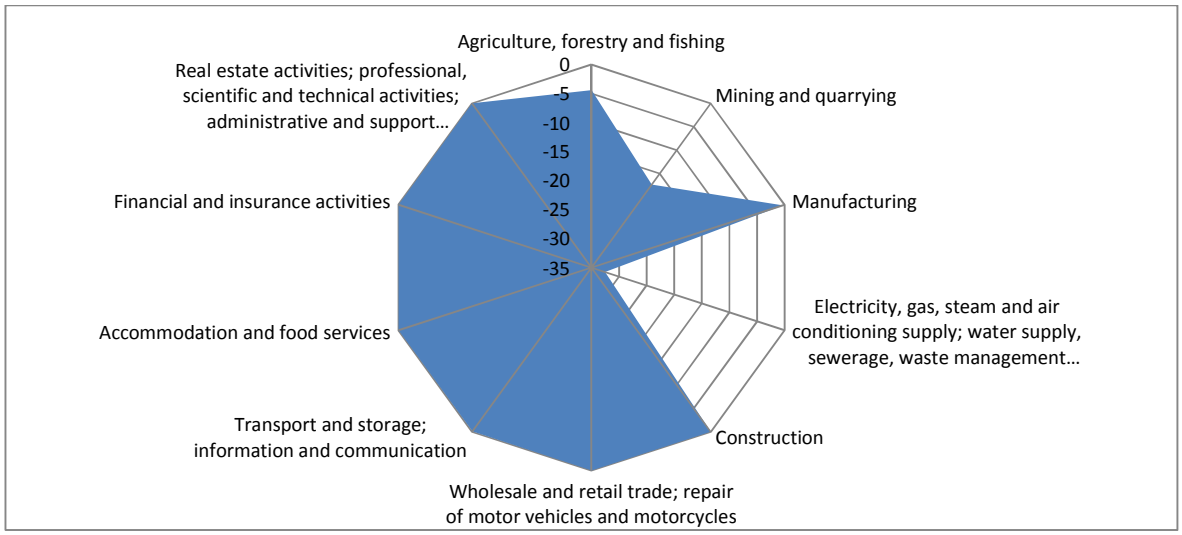
Figure 9. CUSUM chart - UK coal production: 1990-2010



Source: Author, using data obtained from DECC (2012a: p.202). Calculations attached in Appendix F.

Taken together, the reduction in waste to landfill and the extensive pit closures represent significant reductions in methane emissions and impact of these events appears to conflate at around the same time (1999) as the change-point in total business-sector methane emissions. The analysis of all-industry data into sectoral data, illustrated in Figure 10, confirms the significant reductions in both waste disposal and mining industries and – importantly – also confirms that other industrial sectors are far less relevant sources of methane reduction over the time series.

Figure 10. Reduction in UK business sector methane emissions by industrial grouping: 1990-2010

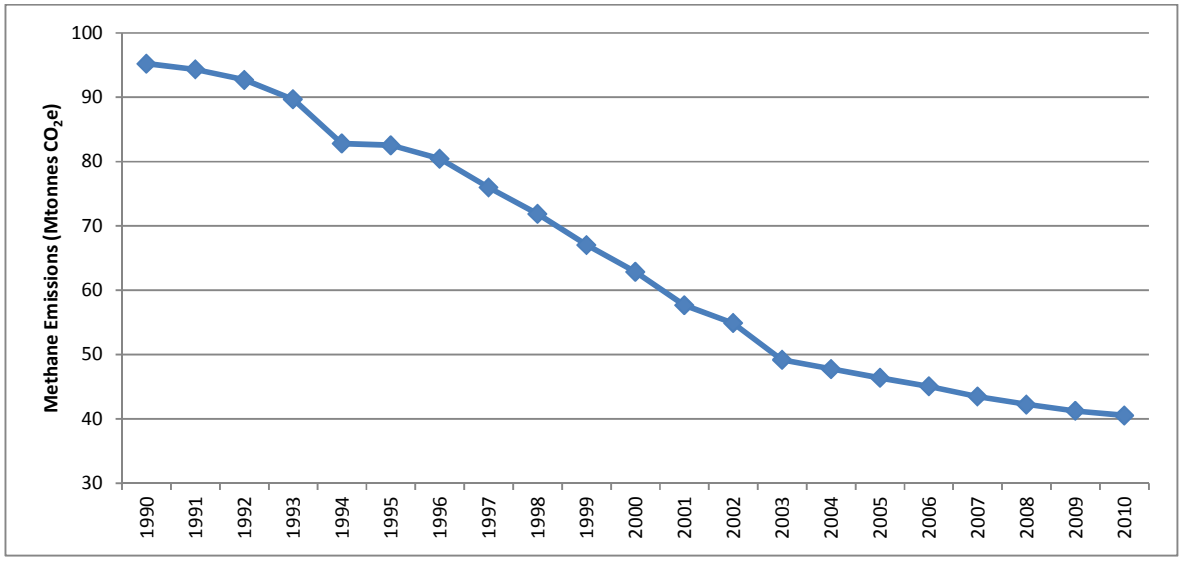


All data in million tonnes CO_2e

Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a)

Earlier, Figure 4 showed that lower methane emissions represent the largest component of the 21% reduction in the United Kingdom total carbon footprint. However, the events aligning with CUSUM change points signify structural changes within the United Kingdom economy. Those events appear to have exhausted their potential to reduce methane emissions and cannot be expected to produce significant savings into the future. Figure 11 shows that as methane emissions stabilise in the business sector, it is likely that the rate of reduction in the overall carbon footprint will deteriorate.

Figure 11. United Kingdom business sector methane emissions: 1990-2010

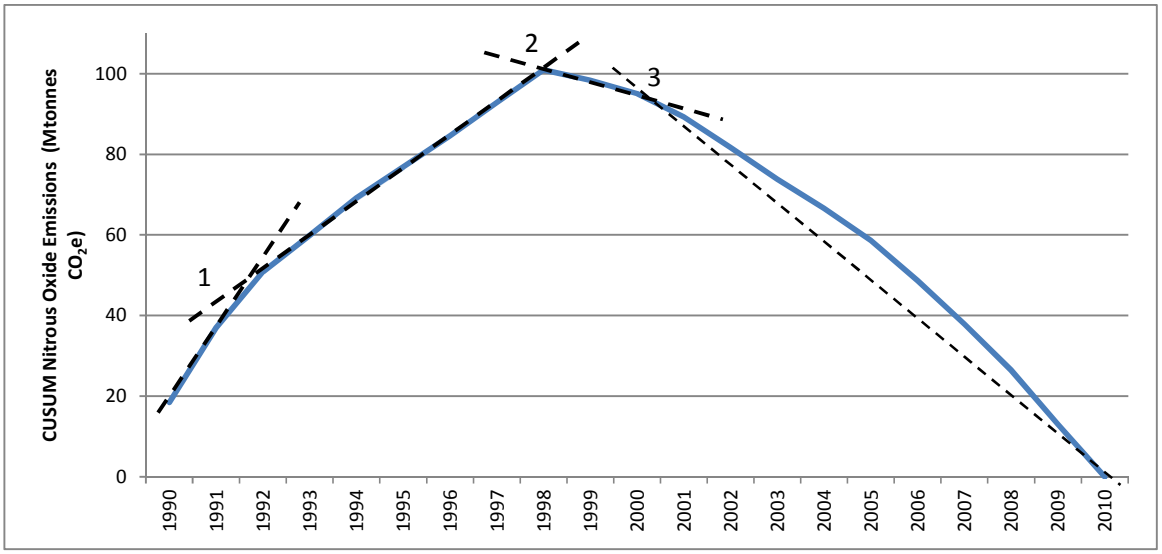


Source: Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a)

Nitrous oxide is the other greenhouse gas showing sustained reduction over 1990-2010 (see Figure 4). Natural anaerobic bacterial processes in the soil produce around 90% of nitrous oxide emissions. Approximately half of the anthropogenic emissions originate from fossil fuel combustion in power generation, with the remainder released during the production of adipic acid from which a range of further products are manufactured including nylon 66, and nitric acid used to manufacture synthetic commercial fertilisers (World Bank Group 1999; Mainhardt & Kruger 2000). Standard Industrial Classification codes allocate the production of adipic acid for nylon manufacture to 'manufacture of man-made fibres' (SIC 20.6). Emissions of nitrous oxide in this sector have dropped from 21 million tonnes CO_2e in 1990 to almost nothing (28,000 tonnes CO_2e) by 2010. This outcome reflects the virtual eradication of an entire industry from the United Kingdom economy, which has taken with it a third of the country's nitrous oxide emissions. As will be shown shortly, these emissions originated from a single industrial installation.

As with methane, the nitrous oxide CUSUM curve forms an arc. However, rather than being smooth in appearance the arc, as shown in Figure 12, is punctuated by distinct kinks. The events coinciding with these kinks are identified in Table 4.

Figure 12. CUSUM Chart – UK business sector nitrous oxide emissions: 1990-2010



Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a) Calculations attached in Appendix E.

Table 4. Significant economic events relevant to nitrous oxide: 1992–2000

No.	Year	Events at change-point
1	1992	1992: Reduction in emissions from petrochemical manufacturing of 4m tonnes CO_2e (1992-1993). Setaside was introduced in 1992 as a European Union requirement that farmers remove 15% of their arable land from all agricultural production. 1993: Ban on burning stubble and other crop residues in fields.
2	1998	1998-1999: Reduction in emissions from petrochemical manufacturing of 11.4m tonnes CO_2e.
3	2000	2000-2001: Reduction in emissions from agriculture of 1.8 m tonnes CO_2e. Setaside requirement reduced from 15% to 10% of cropped farmland in 2000.

Author, using data obtained from United Kingdom Parliament (1993); Office for National Statistics (2012a); UK Agriculture (2013).

When interpreting these events it should be noted that agriculture, which accounted for one fifth of the total reduction of nitrous oxide emissions, became less dependent on nitrogen-based synthetic fertilisers, whose use peaked in the 1980s and subsequently declined as a result of greater efficiency in the use of nutrients (Carne, 2006). During this period the active content of fertilisers shifted away from nitric acid towards urea, bringing benefits of lower production and storage costs while reducing greenhouse emissions in use (University of Nebraska Cooperative Extension, 2012). The more gentle curvature of the CUSUM line is attributed to the effect of progressive agricultural efficiencies, whereas the definite kink observed in 1992-1993 coincides with the introduction of setaside (defined in Table 4) and the legal ban on burning stubble in fields. These latter two events are significant: for example, setaside was said to remove land twice the size of the area bounded by the M25 Motorway from agricultural production (UK Agriculture, 2013). However, compulsory setaside was abolished in 2008, and no longer contributes to emissions reduction. As time-limited or one-off events, neither setaside nor the stubble-burning ban will contribute to future reductions in emissions.

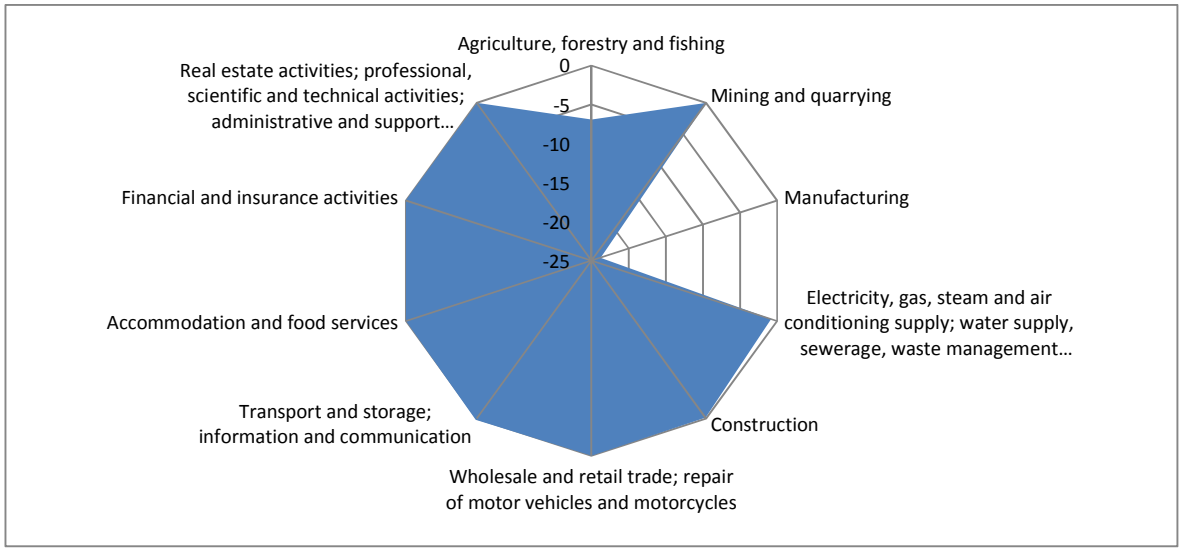
The data reveal step-changes in emissions from petrochemical manufacture in both 1992 and 1998. These coincide with the phased implementation of nitrous oxide abatement technology into the United Kingdom's sole adipic acid manufacturing plant, owned by Invista, and located in Wilton, Teesside. According to Mainhardt and Kruger (2000: p.184).

> "As reported by industrial sources, the decrease [in N_2O emissions] is a result of nearly all adipic acid producers' installation of N_2O abatement technologies. Overall, N_2O abatement is estimated to have improved from approximately 32% in 1990 to approximately 90% in 2000 … Abatement technologies' current efficiency range is 90 to 99 percent reduction of N_2O emissions".

Following these enhancements, the plant closed in 2009, leaving the United Kingdom with no capacity to manufacture adipic acid (United Kingdom Department of Energy and Climate Change, 2012b). The plant closure, with its associated loss of 300 jobs, was attributed by its US owner to overcapacity in traditional manufacturing locations as industrial demand for nylon has shifted to Asia and other regions worldwide (Meehan, 2009). Therefore the defining nitrous oxide event in the adipic acid industry - despite the significant earlier process improvements - is the cessation of national production; a structural and one-off change to the emissions-generating capacity of the United Kingdom economy.

All of these changes are reflected in Figure 13, which also confirms that other sectors have had minimal impact on reductions of nitrous oxide.

Figure 13. Reduction in UK business sector nitrous oxide emissions: 1990-2010



(All data in million tonnes CO_2e)

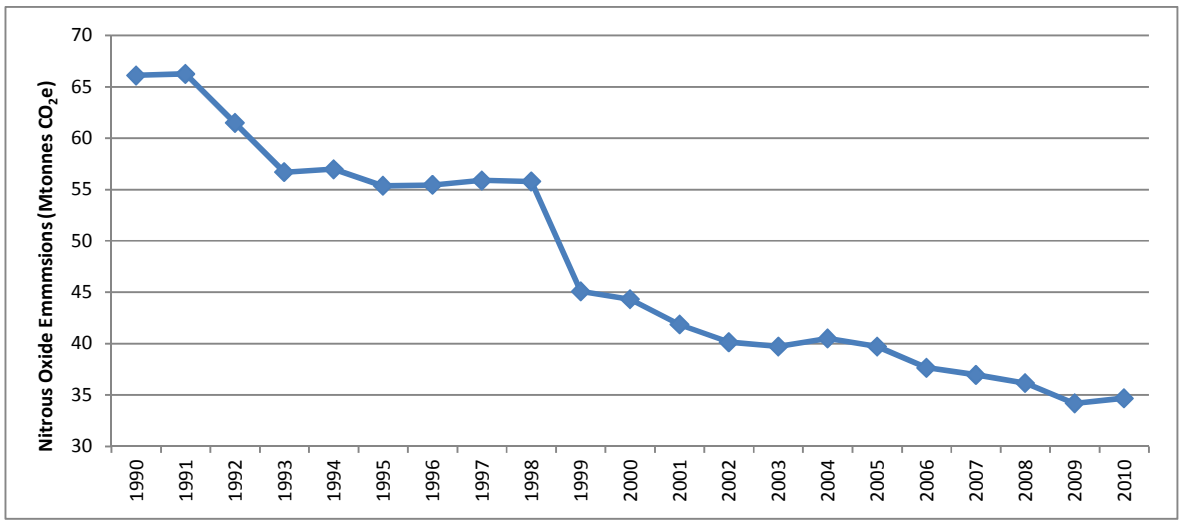
Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a)

In summary, the overwhelming majority (around two-thirds) of nitrous oxide emissions cut from 1990-2010 are attributable to the closure of a single manufacturing plant. This is a discrete, structural and non-recurring change, and future nitrous oxide reductions will be realised more gradually and from other sources. Similar logic applies to agriculture, where observed emissions reductions are discrete and non-recurring. In future, smaller efficiency changes in the use of nitrates in fertiliser production may offer limited scope for further emissions savings. Figure 14 confirms that overall nitrous oxide emissions have stabilised by 2010.

Before leaving nitrous oxide, the closure of the adipic acid plant/industry offers an obvious corollary. Just as manufacturing divestment is possible, so is new investment, which would increase the size of an incumbent industry or create a new one. Because investment is 'lumpy', involving the addition of discrete installations, emissions would increase in 'steps', which cannot be predicted from the examination of historic data[15]. Conversely, it is likely that future investments will be less carbon-intensive due to developments in abatement technology, as was the case in the manufacture of adipic acid.

[15] See the example of the emergence of a new industry, and its attendant carbon consequences later in this chapter, when the impact of the low-cost airline industry is considered in detail.

Figure 14. United Kingdom business sector nitrous oxide emissions: 1990-2010

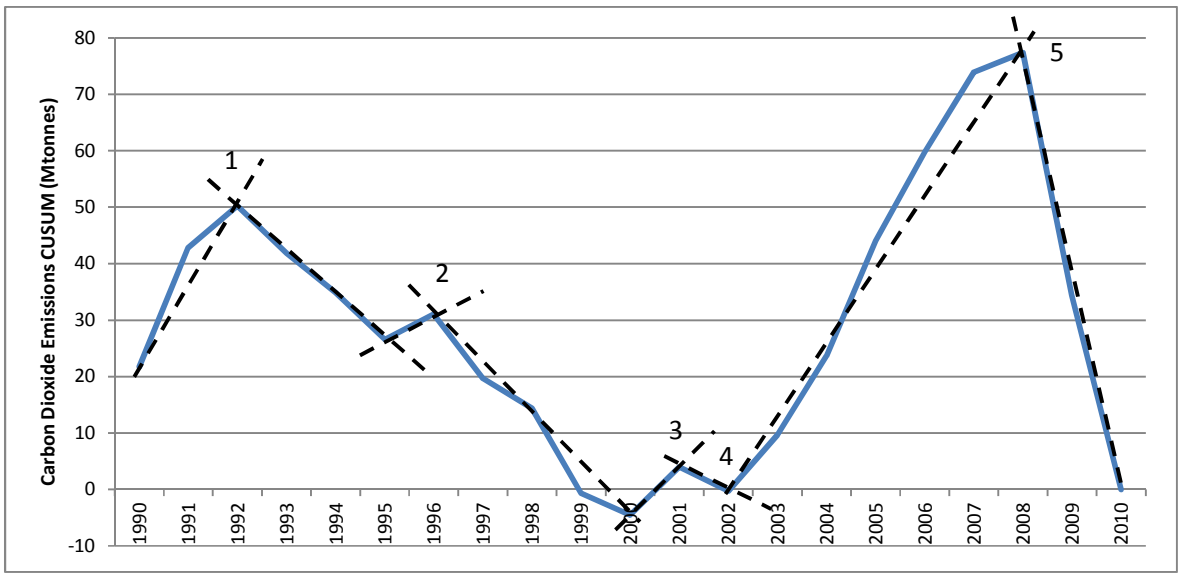


Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a)

The last part of this analysis considers carbon dioxide, the most abundant greenhouse gas. The emissions profile is immediately more complex than methane or nitrous oxide, and the CUSUM analysis reveals that carbon dioxide emissions are subject to a wider range of influences.

Figure 15 shows that the direction of the CUSUM curve is frequently interrupted as depicted by the eight discrete sections represented by broken lines. As before, the chart is annotated with references to details of the underlying events, which are set out in Table 5.

Figure 15. CUSUM Chart – UK business sector carbon dioxide emissions: 1990-2010



Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a) Calculations attached in Appendix E.

Table 5. Significant economic events relevant to carbon dioxide: 1992 – 2010

No.	Year	Events at Change-Point	Sustaining Events in Subsequent Period
1	1992	Beginning of economic recession with corresponding reduction in economic activity.	1990-2000 was the period described as the 'dash for gas', during which 34 new gas-powered electricity generating facilities were brought into commission contributing 20,435 Megawatts (MW) capacity (**Appendix 4**). This is significant given that electricity generated by gas is substantially less carbon-intensive than that generated by coal, because of the energy, chemical and operational considerations. 1993 represents the point at which industrial production stabilised in the United Kingdom after a sustained period of decline.
2	1996	Channel tunnel fire in November 1996. Freight diverted to ferry services.	Channel tunnel re-opened in May 1997. Dash for gas continued during this period: the Channel Tunnel event caused a step in the CUSUM curve, which continued its trajectory consistent with the reduced carbon-intensity of an ongoing switch from coal to gas-generated electricity.
3	2001	Implementation of New Electricity Trading Arrangements (NETA). Buyers of electricity no longer required to purchase from a 'pool'. NETA enabled firms to negotiate contracts directly with electricity generators.	Electricity contracts generally have a duration of 12 months. The year of change, 2001, was period of market 'disturbance' where coal-powered generators exercise their new ability to compete by bidding lower for contracts. The position was reversed in 2002 as gas-powered generators were able to reassert their lower cost advantage to recapture business lost in 2001.
4	2002	Closure of Bradwell Nuclear Power Station, a relatively small plant with a capacity of 246 Megawatt electrical (MWe). Corresponding switch to more carbon-intensive electricity generation.	2003 – 2006 saw a continuation in the retirement of older nuclear power stations: Calder Hall (2003), Chapelcross (2004), Sizewell A (2006) and Dungeness A (2006). In total 1,270 MWe capacity was switched to more carbon-intensive generation, with no new nuclear plants commissioned during this timescale.
5	2009	Beginning of economic recession	

Source: Author, using data obtained from Comptroller and Auditor General, 2003; Helm *et al*., 2007; The Telegraph, 2008; United Kingdom Department of Energy and Climate Change, 2010, 2012c; Bailey, 2012.

The carbon dioxide CUSUM chart is immediately distinguished from those exhibited by methane and nitrous oxide counterparts, both of which present broadly similar graphical profiles. In contrast to these sweeping arcs, the carbon dioxide CUSUM line presents two pronounced peaks, separated by two smaller disturbances. As Table 5 shows, the events mapped from the CUSUM analysis are mostly related to economic activity and electricity production: a growing economy requires increased energy input, exerting a pull effect on the consumption of fossil fuels. However, in addition, the fuel mix in electricity generation and the investment decisions determining the mix, have significant effects on the change in carbon dioxide emissions. Natural gas, for example, generates far less carbon dioxide on combustion than the equivalent mass of coal. Nuclear power can be used to produce electricity with zero carbon emissions, except for those embedded in the initial construction of the plant.

The period 1990-2000 is known in the electricity supply industry (ESI) as the 'dash for gas'. As Winskell writes in the late 1990s:

> "Since privatisation in 1991, there has been a transformation in electricity generation technology within the British electricity supply industry (ESI). In a sudden *dash for gas*, previously unused combined cycle gas turbine (CCGT) technology has been adopted for all new power stations in Britain. The dominant generation technologies before privatisation – coal-fired steam turbines and nuclear power – have been marginalised, and all proposals for new coal-fired and nuclear plant cancelled" [italics in original] (Winskell, 1997).

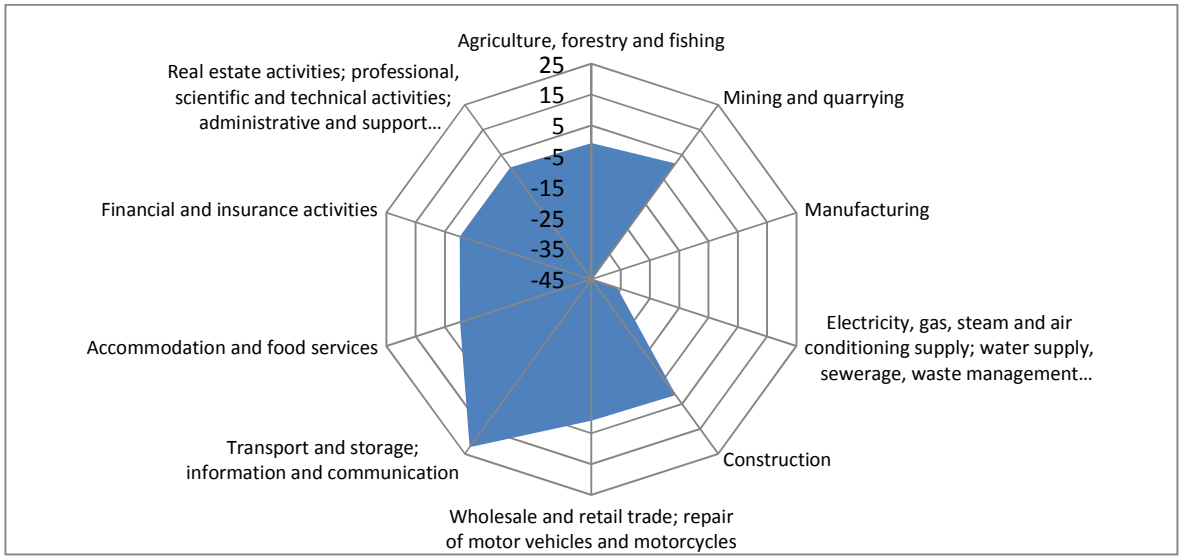
Winskell goes on to explain the reasons behind the dash for gas:

> "CCGT technology, politically and institutionally excluded from the industry before privatisation, has gained ascendancy due to the interaction of a number of coinciding and largely unrelated dynamics. These include improved gas turbine technology, greater availability of natural gas, structural changes in the ESI, and the introduction of pollution abatement legislation" (Winskell, 1997: p.2).

However, 'pollution abatement legislation' in this case refers to the *EC Large Combustion Plants Directive*, which required the United Kingdom to reduce its sulphur dioxide emissions, a major cause of acid rain, by 11% by 1993, 40% by 1998 and 60% by 2000 (Winskell, 1997). Any corresponding reduction in greenhouse gas emissions, as a result of the dash for gas was therefore largely serendipitous, and not the outcome of a dedicated climate change policy.

Figure 16 confirms an overall reduction in the emissions from electricity generation, suggesting that the carbon dioxide emissions saved as a result of the dash for gas considerably outweighed the negative impact of the nuclear plant retirements occurring between 2003 and 2006 (see Appendix G & Table 5). The reduced emissions from manufacturing coincide with the economic slowdown in 2009. The unusual feature of Figure 16 is the increase in carbon dioxide emissions attributed to transport, storage and communications. Growth in transport emissions were subsumed in the CUSUM analysis to the impact of the dash for gas, due to their relative differences in scale. Therefore, the analysis displayed in Figure 16 represents a useful triangulation, highlighting changes that might otherwise have been overlooked if reliant on a single method.

Figure 16. Reduction in UK business sector carbon dioxide emissions: 1990-2010



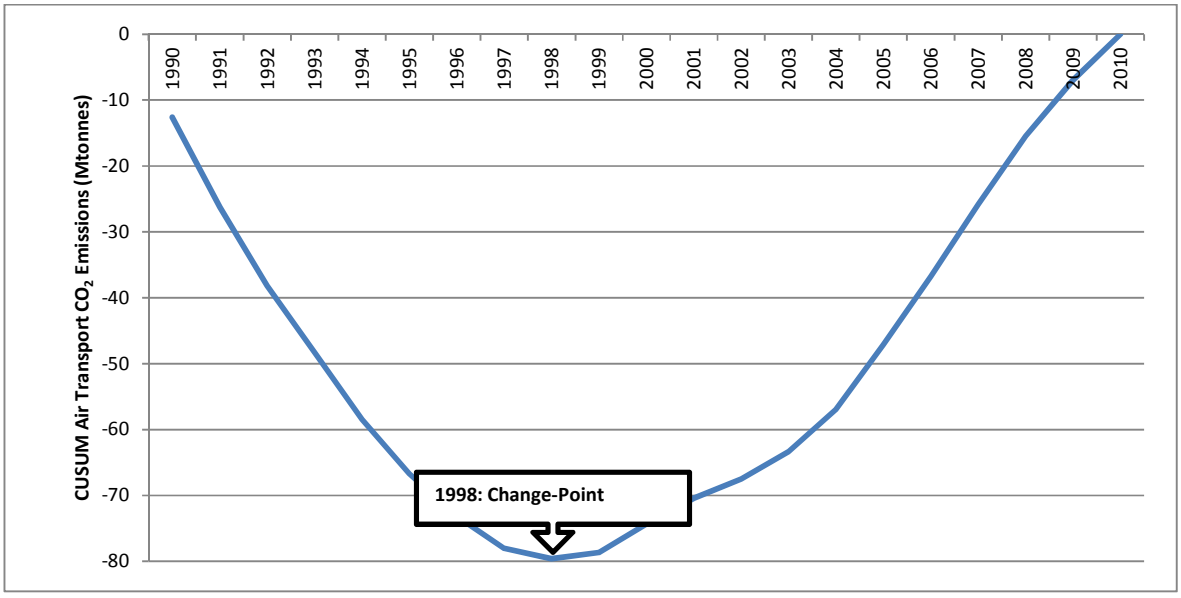
(All data in million tonnes CO_2e)

Source: Author, using data from *UK Environmental Accounts 2012* (Office for National Statistics 2012a)

Data from the *UK Environmental Accounts* include emissions from aviation services within Transport (code H), and these aviation statistics comprise domestic and international travel. In 2010, these amounted to 35 million tonnes CO_2e, and in 2011 aviation emissions were formally brought into the 2050 target (Committee on Climate Change, 2012). These data reveal that carbon dioxide emissions from air transport services (SIC code 51) increased by 19.5 million tonnes between 1990 and 2010 (Office for National Statistics 2012a). Moreover the CUSUM chart in Figure 17 reveals a single change-

point located in 1998, pinpointing the year in which aviation carbon dioxide residual emissions began to accumulate in surplus.

Figure 17. CUSUM Chart – carbon dioxide emissions from United Kingdom air transport: 1990-2010



Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics 2012a) Calculations attached in Appendix E.

The change-point in Figure 17 coincides with the rise in flights from the low-cost airline sector. Ryanair, the Irish low-cost airline accounts for almost 70% of the traffic at London's fourth airport, London Stansted (Ryanair, 2012). Its growth began in earnest in 1997 when it floated on the Dublin and NASDAQ exchanges. Meanwhile Go, British Airways' entry to the market was launched in 1998. It is highly significant that the expansion of budget flights was stimulated by the arrival of e-business, as easyjet and Ryanair launched their online ticketing websites in 1998 and 2000 respectively (Funding Universe, 2001; Easyjet, 2013). The combination of these events led to an extraordinary effect: a definable new business sector commencing the growth phase of its life-cycle at precisely the same time as the emergence of a transformative business process (e-commerce), using one of these new phenomena to leverage gains from the other. The impact of these developments within a single industry sector on the United Kingdom's carbon dioxide emissions has been significant. Using *UK Environmental Accounts* data, it is estimated that the increase in air transport carbon dioxide (19.5 million tonnes) represents an increase in national carbon dioxide emissions of around 3.1% during the twenty-year period, when

compared with baseline 1990 carbon dioxide emissions of 624.2 million tonnes (Office for National Statistics, 2012a). Writing a few years earlier, Monbiot (2006) agrees:

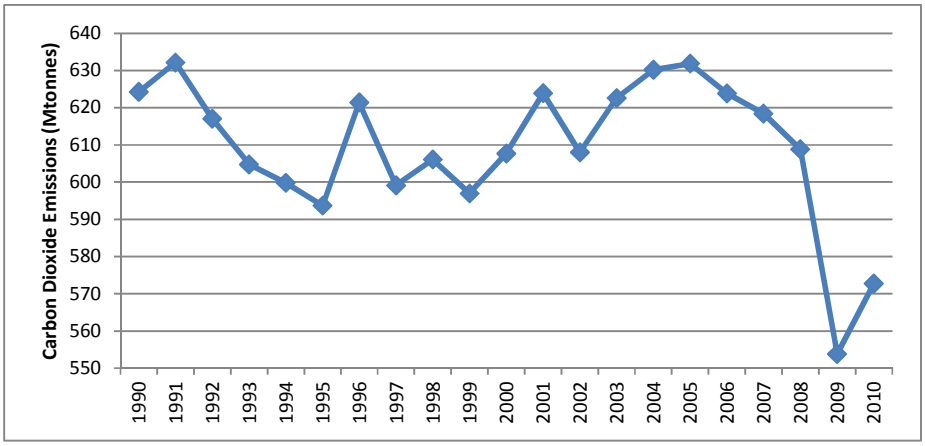
> "Aviation has been growing faster than any other source of greenhouse gases. Between 1990 and 2004, the number of people using airports in the UK rose by 120%, and the energy the planes consumed increased by 79%. Their carbon dioxide emissions almost doubled in that period - from 20.1 to 39.5m tonnes, or 5.5% of all the emissions this country produces".

In the context of the United Kingdom economy, the emergence of a new, high-growth industry in a carbon-intensive sector would have placed the government in a difficult position. On the one hand, the opportunities for economic growth and employment must be welcomed. On the other, the resulting increase in carbon dioxide emissions places its climate change policies under considerable strain.

The sheer range and complexity of events underlying carbon dioxide emissions in the United Kingdom creates an extremely variable pattern of business sector emissions, as illustrated in Figure 18.

Unlike methane and nitrous oxide which both show clear reducing, then stabilising, trends (Figures 11 & 14) carbon dioxide emissions have been affected by a broader range of discrete factors and present a less reliable trend. It is therefore clear that carbon dioxide emissions cannot be fully understood from a simple review of the raw statistical data because they are subject to a greater range of influences than the other constituent greenhouse gases. Moreover, because of its weight in the greenhouse mix, and the extent to which its emissions converge with movements in specific industries, national infrastructure and the wider economy, carbon dioxide appears to be the toughest beast to tame among the greenhouse gases.

Figure 18. United Kingdom business sector carbon dioxide emissions: 1990-2010



Source: Author, using data from *UK Environmental Accounts 2012* (Office for National Statistics 2012a)

4.6 Conclusions and implications for the research

This chapter began by considering the difficulty in obtaining a national carbon reduction narrative, and assembling a 'narrative of strategic intent' from the Climate Change Act, 2008. From the analysis that followed, an alternative critical narrative emerges:

> 'The activities that have brought about carbon reduction within the United Kingdom in recent years have been effected by strategic priorities unconnected with climate change policy. These are discrete, structural and non-recurring. Because these activities are now complete, there is no momentum in the data from which future carbon reductions can be inferred. Fulfilment of the Government's obligations will require future investments and accretions not previously represented in the data'.

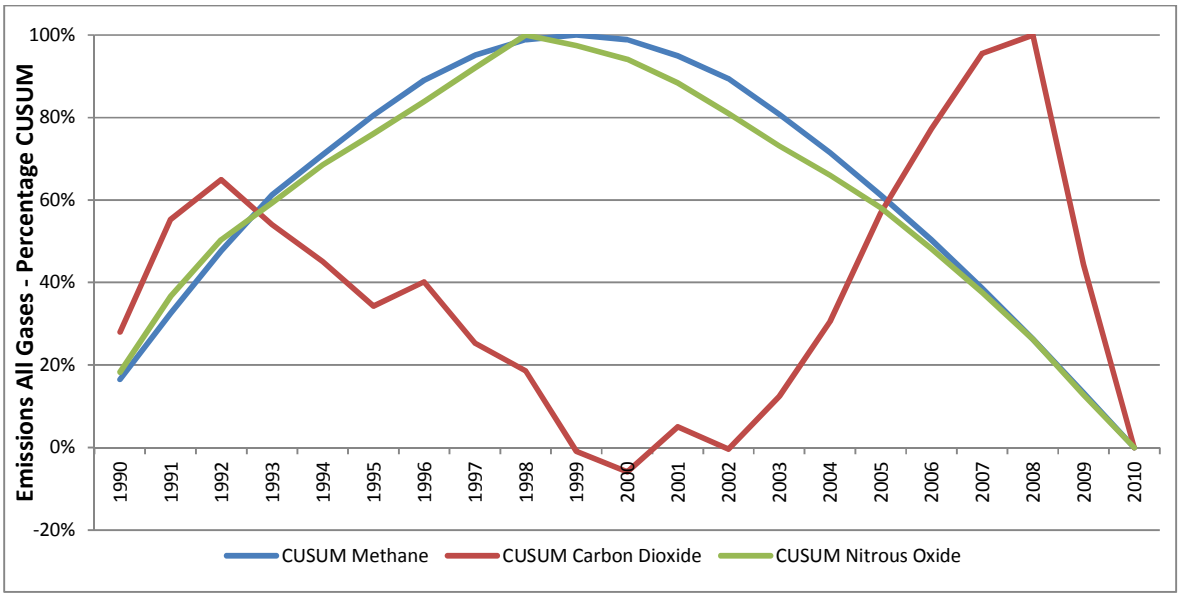
Drafting an alternative critical narrative refocuses consideration on what constitutes 'strategic intention' and how the government might act in future to reinforce its ability to fulfil its carbon reduction obligations. One means of enhancing its credibility is by placing alternative strategies beyond reach. For example, the government could transfer the responsibility for certain carbon-relevant decisions to an independent authority. This is not the first study to make such a recommendation (see Bowen & Rydge, 2011; also Helm, 1992; Helm, 2003 and Helm *et al.*, 2005 cited in Bowen & Rydge, 2011). However it is consistent with the way that some academics and politicians interpret commitment. Ghemawat and del Sol (1998) relate how the conquistador Hénan Cortés inspired commitment among his men, during the 1519 expedition to loot the Aztec capital. Where capture would bring certain torture and death, Cortés

denied his men the alternative of deserting by destroying their ships, thereby imposing the sole viable strategy of fighting to win. In contemporary United Kingdom politics, interest rate decisions have been delegated to the Bank of England as a means of demonstrating the government's commitment to controlling inflation, since 1997. More recently the British Foreign Secretary announced that legislation binding the government to hold a referendum on EU membership in the next Parliament would be a means of "strengthening … reinforcing and demonstrating our commitment to a referendum" (Hague, 2013).

The findings of this chapter therefore contribute to the resolution of the first research question (**RQ1**) by offering an alternative narrative of carbon reduction credibility at the macro level, which will integrate with the outcome of analysis in Chapters 5 and 6.

Some aspects of these findings are similar to those encountered in previous studies. For example, Helm *et al*. (2007) focused on carbon dioxide emissions extracted from aggregated greenhouse emissions. Bowen and Rydge (2011) observed the one-off nature of many emissions, the reductions in non-CO_2 gases and the insignificance of explicit climate change policies in effecting these reductions. This chapter adds to the earlier work by using the novel CUSUM technique to research the issue, and exploits the sensitivity of the method to provide a more detailed identification of the events that have impacted the national carbon footprint profile, and some new insights into how these might be shaped in future. In the first instance, CUSUM graphically reveals the difference in carbon influences on specific gases, as shown by the summary chart in Figure 19.

Figure 19. CUSUM Chart – United Kingdom business sector emissions: methane, nitrous oxide and carbon dioxide (1990-2010)



Source: Author, using data from *UK Environmental Accounts 2012* (Office for National Statistics 2012a) Calculations attached in Appendix E.

Figure 19 summarises the three CUSUM charts, originally presented in Figures 7, 12 and 15. Comparison is made easier by calibrating the vertical axis according to percentage rather than absolute CUSUM, thereby accommodating a wider range of values. While Figure 19 does not provide any new information, it permits a useful comparison of the timing of carbon-relevant events. It also highlights the similar profiles of methane and nitrous oxide reductions; and brings the different character of carbon dioxide emission reductions into sharp relief. Assuming that no significant new sources of methane and nitrous oxide emerge, carbon dioxide reduction represents the focus of future climate change policy in the United Kingdom.

Among the new insights offered in this chapter is the effect of whole industry exits and entries, as revealed by the cases of the adipic acid and low-cost airline industries. In the future, similar issues are likely to challenge the Government's credibility on carbon reduction. For example, large infrastructure projects, such as High Speed Rail 2 (HS2) will have a potential impact on the national carbon footprint. This impact is not yet known or budgeted. The Carbon Plan does little to clarify the potential carbon impact of HS2:

> "A decision on the Government's strategy for a national high speed rail network, and on the proposed route of the initial London–West Midlands link, is due in December 2011. This initial phase would be broadly carbon neutral, with the potential for valuable carbon reductions as the network is expanded further north. Such a national network could see as many as 6 million air trips and 9 million road trips switching to high speed rail each year, reducing carbon and cutting congestion on roads and at airports" (United Kingdom Department of Energy and Climate Change, 2011: p.54).

Such analysis is flawed in at least three respects. First, because projects of this size demand private funding, return on investment displaces simple cost-volume-profit criteria. Emphasis is placed on maximising revenue through the aggressive creation of demand that ensures facilities are run as close to capacity as possible. The outcome is likely to be an increase in total journeys rather than simply altering existing passenger choices. Second, any carbon consequences are likely to be affected by the source of electricity used to power HS2. The Carbon Plan states its case at a time when the funding and implementation of replacement nuclear power stations is uncertain. Third, the Carbon Plan treats its analysis if HS2 existed in isolation from other transport alternatives. The evaluation of a third runway at London's Heathrow Airport is a live policy issue. If construction were to proceed, the United Kingdom aviation capacity would expand at the same time as HS2 is building its customer base. Accordingly the airlines and airport operator would respond by aggressively seeking to attract incremental customers to fill the (expensive) expanded capacity.

The exploitation of shale gas represents another dilemma affecting climate change policy. On one hand gas is a less carbon-intensive fuel than coal. However, greater abundance of natural gas together with the difficulties in securing the next generation of nuclear power stations may help sway the government towards building more of the cheaper gas-powered electricity plants, and forgoing the prospect of more decarbonised electricity. In addition, studies at Cornell University have drawn attention to the global warming potential of fugitive methane emissions from fracking, and observe:

> "viewed on the 20-year time horizon after emission, the greenhouse gas footprint of shale gas is considerably greater than that for coal or diesel oil, when the full effects of the methane emissions are considered" (Howath, 2012).

Governments are generally receptive to new industries, which bring the potential of growth in GDP, tax revenues and jobs. Such opportunities are likely to place other commitments under stress, as the economic imperative triumphs over subordinate constraints. Presently, there is no indication of how the

government might find additional carbon savings to offset the adverse carbon consequences arising from such investments.

These dilemmas can arise because it is possible to pursue more than one strategy at a time. Under these circumstances, where specific strategies are resource-hungry and time critical, it may be necessary to 'rest' other strategies; phasing them back in when time and resources permit. Indeed, resting and phasing may be essential to ensure that all obligations can be met. Unfortunately, the legitimacy of resting and phasing makes it more difficult to evaluate the credibility of narratives describing a specific and individual strategy. Under these circumstances, it will be necessary to evaluate strategic intent over an extended timescale.

In closing this chapter, it is helpful to reflect on why the macro narrative of strategic intent matters. When one party makes a public declaration of intent, others are entitled to predicate their actions on the declared intention, where they believe the declaration to be credible. This chapter has revealed how the credibility of United Kingdom government's declared carbon reduction obligation is vulnerable to criticism. Where business leaders perceive government credibility to be fallible, it may affect their willingness to engage their organisations in support of government objectives over the long term.

Chapter Five

Meso analysis: the FTSE100 index of leading companies

5.1 Introduction

The second phase of the research investigates the credibility of carbon reduction articulated through accounting information at the industry, or meso, level of analysis. It continues the evaluation of the first research question and addresses questions 2 and 3:

> **RQ1.** Can numbers be used to create alternative critical narratives of carbon reduction credibility at macro, meso and micro levels of analysis?
>
> **RQ2.** Can a physical and financial dataset be constructed that reveals trajectory and relative performance at meso (FTSE100) industry and firm level? What are the challenges associated with its construction?
>
> **RQ3.** To what extent have large corporations represented in the FTSE100 index reduced their carbon footprint since 2006?

In Chapter 4, a national carbon reduction narrative was presumed which recognised the difficulty in constructing a grand narrative from selective political pronouncements. The process of constructing an industry narrative is also difficult, but for different reasons. Just as the aggregation of data congeals information and presents a misleading picture of homogeneity, one cannot obtain a narrative of strategic intent that fairly represents 'industry at large' by attempting to blend selected quotations. The following examples illustrate the different manner by which FTSE100 company reports express their intentions:

> "We are committed to meeting our obligations to the countries and communities in which we do business" (BP, 2014).
>
> "We will do what we can to minimise our impact on the environment" (GKN, 2014).

> "We recognise the impact that energy can have on the climate and we remain committed to reducing carbon emissions. It is also important to balance the challenges of tackling climate change with other core priorities, in particular to ensure secure, affordable supplies of gas and power for all our customers" (Centrica ,2014).
>
> "We will improve our carbon efficiency and reduce the energy … we use:
>
> - A reduction in energy used, normalised per tonne of production.
> - A reduction in carbon intensity per tonne of production" (Rexam, 2012).

As in Chapter 4, it becomes necessary to employ a presumption that expresses a common core: a 'lowest common denominator' that provides a starting point for the analysis, and a platform on which to build a critical approach. This chapter begins with the following narrative:

> 'Companies represented by the FTSE100 group will pursue carbon reduction strategies that support the government's objective, quantified in the Climate Change Act, 2008. Each company will contribute to this objective using an approach that aligns with its individual strategic objectives'.

This chapter will also reveal the difficulty in establishing a robust carbon footprint dataset for the FTSE100 group of firms listed on the London Stock Exchange. The purpose of the dataset is to reveal the trajectory and relative performance of a proxy for industry at large. It must therefore meet the essential criteria of validity (credibility, transferability), reliability and objectivity. In approaching these criteria, the chapter explores the various challenges and explains how these are addressed. These include the determination of a base period from which to 'capture' the FTSE100 population; the mobility of firms within this group; the movement of firm boundaries to accommodate acquisitions and divestments. In addition the collection of data is exacerbated where not all companies disclose, disclosure practice is not standardised and comparative year disclosures are annually revised and updated. This chapter considers these difficulties and explains their influence over decisions made when constructing the dataset. Where appropriate, the limitations of the dataset are clearly set out.

The analysis then considers whether the data demonstrate a reduction in FTSE100 group greenhouse emissions. The interpretation extends beyond the serial data profile, to appraise whether performance is consistent among firms in the group; whether this is homogeneous, and broadly consistent with the aggregated trend.

5.2 Identifying the FTSE carbon footprint

This chapter is concerned with accounting for the carbon footprint of the FTSE100 group of leading companies. The analysis of these firms commenced in October 2010, and is based on the constituents of the FTSE100 as at the 4th Quarter 2010. Starting with the list of firms comprising the FTSE100 index, an initial search identified which companies reported contemporaneous emissions by checking and manually collecting data published in the 2010 annual reports, corporate social responsibility (CSR) reports and corporate websites. Next, for this reduced core of firms, the data collection was extended backwards to incorporate years 2006 – 2009, and then forwards to include 2011. The objective of the exercise was to identify which firms made continuous disclosure of their carbon emissions over the period 2006-2011 inclusive. The result is a core of 62 firms, hereafter described as the 'FTSE62'.

The full FTSE62 listing is displayed in Appendix H; and as a subset of the FTSE100, from which it is derived, in Table 1. The core FTSE62 emerges because firms are acquired and disappear from the FTSE100 index (see Table 2), other firms exit the index due to a change in their relative market capitalisation and other residual surviving firms do not continuously disclose their emissions throughout the period of study. Thus to generate a consistent meso carbon footprint dataset, one must first remove firms that have exited from the FTSE100 index, and then establish how many 'survivors' consistently disclose their carbon footprint from 2006 to 2011.

Table 1. FTSE100 companies with continuous carbon footprint disclosures: 2006-2011[16,17]

	FTSE 62: Firms with Continuous Carbon Footprint Disclosure 2006-2011		Remaining FTSE 100 Firms - Incomplete Carbon Footprint Disclosures 2006-2011
1	3i Group	63	Admiral Group
2	Alliance Trust	64	African Barrick Gold
3	AMEC	65	Aggreko
4	Anglo American	66	Antofagasta
5	Associated British Foods	67	ARM Holdings
6	Astrazeneca	68	Autonomy Corporation
7	Aviva	69	British Airways
8	BAE Systems	70	Bunzl
9	Barclays	71	Burberry
10	BG Group	72	Carnival
11	BHP Billiton	73	Cobham
12	BP	74	Compass Group
13	British American Tobacco	75	Essar Energy
14	The British Land Company	76	Fresnillo
15	British Sky Broadcasting Group	77	G4S
16	BT Group	78	GKN
17	Cairn Energy	79	ICAP
18	Capital Shopping Centres	80	Imperial Tobacco Group
19	Centrica	81	Inmarsat
20	Diageo	82	Intercontinental Hotels Group
21	Experian	83	Intertek
22	Glaxosmithkline	84	Investec
23	Hammerson	85	Eurasian Natural Resources Corporation
24	HSBC Holdings	86	Old Mutual
25	International Power	87	Petrofac
26	Invensys	88	Prudential
27	Johnson Matthey	89	Randgold Resources
28	Kazakhmys	90	Resolution
29	Kingfisher	91	Rexam
30	Land Securites Group	92	Schroders
31	Legal and General	93	Serco Group
32	Lloyds Banking Group	94	Shire
33	Lonmin	95	The Sage Group
34	Man Group	96	Unilever
35	Marks and Spencer Group	97	Vedanta Resources
36	Wm Morrison Supermarkets	98	The Weir Group
37	National Grid	99	Whitbread
38	Next	100	Wolseley
39	Pearson		
40	Reckitt Benckiser Group		
41	Reed Elsevier		
42	Rio Tinto		
43	Rolls-Royce Group		
44	Royal Bank of Scotland		
45	Royal Dutch Shell		
46	RSA Insurance Group		
47	SABMiller		
48	J Sainsbury		
49	Scottish and Southern Energy		
50	Severn Trent		
51	Smith and Nephew		
52	Smiths Group		
53	Standard Chartered		
54	Standard Life		
55	Tesco		
56	The Capita Group		
57	TUI Travel		
58	Tullow Oil		
59	United Utilities Group		
60	Vodafone Group		
61	WPP		
62	Xstrata		

Source: Author

[16] Population comprises FTSE100 constituents as at Q4, 2010. 62 firms out of 100 made continuous carbon footprint disclosures during 2006-2010.

[17] Numbering is solely for convenience and does not signify firm rankings

Table 2. FTSE100 constituents (Q4, 2010) exits assimilated by acquisition as at Q4, 2011.

Former FTSE 100 Constituent	Date of Acquisition	Acquiring Company
Autonomy Corporation	October 2011	Hewlett-Packard
British Airways	January 2011	IAG (Merger with Iberia)

Source: Author

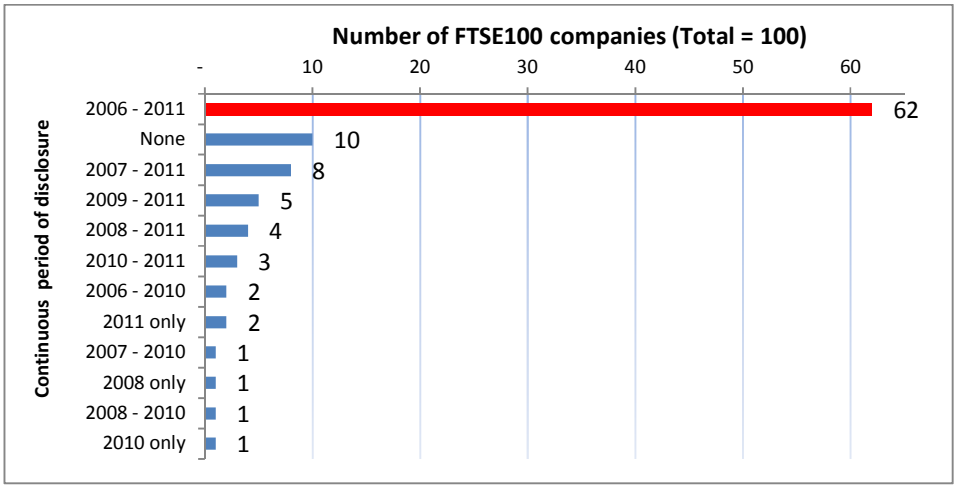
The remaining group of firms constitute a list of companies from which to appraise the frequency with which annual disclosures were duly made. In total 84 firms made continuous carbon footprint disclosures during all, or part of, the period 2006 to 2011, as shown in Table 3 and in Figure 1 below.

Table 3. FTSE100 firms with carbon footprint disclosures

Years continuous disclosure	No. of firms disclosing
2006 - 2011	62
2007 - 2011	8
2008 - 2011	4
2009 - 2011	5
2010 - 2011	3
2011 only	2
Total no. disclosing firms	84

Source: Author

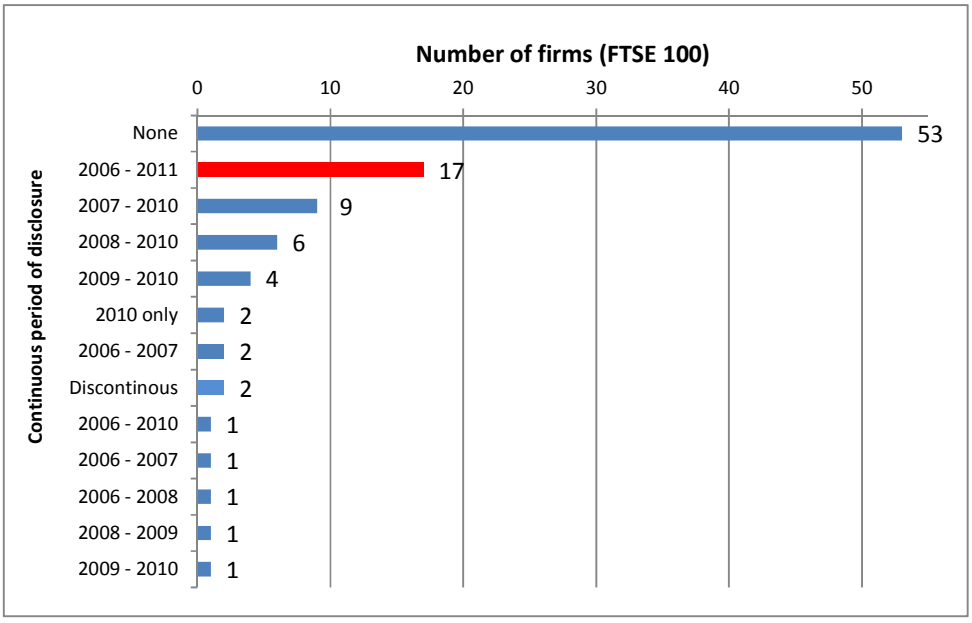
Figure 1. FTSE100 (all companies) frequency of carbon footprint disclosure



Source: Author, using data from annual reports, corporate social responsibility reports and company websites.

The next step was to identify which firms from the FTSE62 group disclosed scope 1 and 2 plus scope 3 emissions. The Greenhouse Gas Protocol (GHG Protocol) divides total greenhouse emissions into three scopes: scope 1, arising directly from combustion of fossil fuels; scope 2 embedded in purchased electricity; and scope 3 – other indirect emissions –incurred through business travel, waste disposal and in the use of the firm's products by final customers. Thus for completeness, the FTSE62 group of companies should aggregate scope 1, 2 and 3 emissions of all 62 firms. However, it was established that only 17 firms attempted to disclose scope 3 emissions throughout the six year period 2006-2011, and that 53 companies made no disclosure at all during the same period, as shown in Figure 2.

Figure 2. FTSE100 (all companies) frequency of scope 3 emissions disclosure: 2006-2011



Source: Author, using data from annual reports, corporate social responsibility reports and company websites.

Figure 2 reveals an erratic pattern of scope 3 disclosure among large companies. It was initially expected that a relatively large number of firms would have begun disclosing in 2011, and that progressively fewer companies would display two years or more of continuous disclosure, the further back one looked. This type of pattern would reflect the problematic nature of scope 3 accounting and the practical difficulties in obtaining complete and relevant data. It would also indicate a growing uptake of

scope 3 accounting consistent with learning and an increased social awareness of the of greenhouse emissions across the value chain. Instead, Figure 2 shows a progressive decline in new companies taking up scope 3 reporting, with the result that the 'stock' of disclosing firms is increasing more slowly than in the past. In addition, 8 firms have reported scope 3 emissions less systematically; either discontinuously during 2006-2011, or abandoning disclosure before 2010. As a result of these findings, it was decided to exclude scope 3 emissions from the meso dataset because scope 1 and 2 accounting is more comprehensive over time.

The apparent reluctance of large corporations to disclose their scope 3 emissions may have more than one explanation. The GHG Protocol describes scope 3 emissions as an 'optional' category, which implies an expectation that many firms will choose to opt out of reporting them (WRI & WBCSD, 2012). Secondly 'other indirect emissions' are more burdensome for companies to report. For example, British Sky Broadcasting (2007) reports 'selected scope 3 emissions', while BT Group (2010) specifically mentions eighteen scope 3 elements that it excludes from its greenhouse gas inventory. The examination of corporate reports for this study reveals that the full range of scope 3 emissions is rarely reported by disclosing firms. While many companies separate the reporting of business travel emissions from scopes 1 and 2, only five firms – Astra Zeneca, GlaxoSmithKline, Reckitt Benckiser, Royal Dutch Shell, and Xstrata - include the emissions attributable to their customers' use of products within their scope 3 emissions. For some companies, these can be the most substantial element of total emissions. For example GlaxoSmithKline estimates that emissions from patients' use of respiratory inhalers account for approximately 73% their total carbon footprint (GlaxoSmithKline, 2011).

While only a minority of firms consistently disclose scope 3 emissions, evidence from those who do suggests that scope 3 emissions represent a potential area of material incompleteness in corporate carbon footprint reporting. Moreover, this is unlikely to be addressed in the short term, under the current framework of greenhouse gas accounting. Accordingly, the FTSE62 meso dataset compiled for this research incorporates scopes 1 and 2 carbon emissions exclusively.

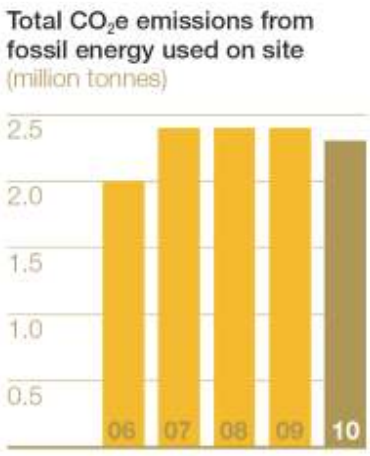
5.3 Data collection method for the FTSE62 group

The FTSE62 dataset was created manually, without recourse to secondary databases. Instead, preparation entailed extensive online searches of corporate websites, downloaded annual reports and CSR reports for all FTSE 100 constituents. Electronic copies of these reports have been saved to hard

drive, and it became necessary to search each of these reports on very many occasions to double-check entries and their consistency over successive years. Moreover, the absence of a standard presentational form increased the time required to extract emissions data from these various sources. The location of disclosures varies among companies: some publish data in their annual report while others prefer to report their emissions in separate corporate social responsibility, sustainability or citizenship reports, or in sections of their corporate websites.

A further presentational anomaly arises when companies choose to present their emissions data using charts in place of numerical disclosures. In many cases, the researcher has noted that the text of the report fails to disclose numerical emissions data, instead using a chart to present an emissions profile over time. In these situations, the researcher has examined these charts on a computer screen and used a pixel ruler to estimate the height of bars, or other data points, relative to the axis intervals. From here, it is straightforward – if time-consuming – to extrapolate numerical emissions estimates using simple proportions. Figure 3 illustrates an example of this method in use, using the example of SAB Miller plc.

Figure 3. Extrapolation of SAB Miller greenhouse emissions from chart using a pixel ruler



CO_2 tonnes per Interval	0.5	million
CO_2 tonnes per Pixel	0.005952	million

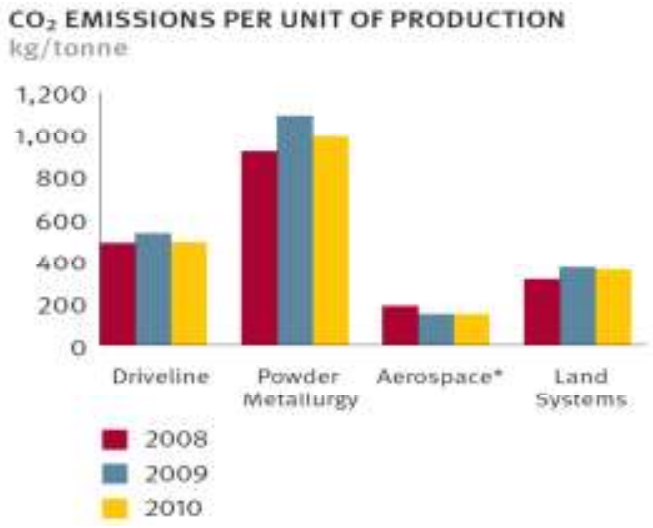
	Pixels	million tonnes
2006	336	2.000
2007	403	2.399
2008	403	2.399
2009	403	2.399
2010	390	2.321

Source: Chart disclosed by SAB Miller plc (2010: p.19). Author's calculations.

In a small number of other cases, companies have chosen to rely exclusively on relative disclosures rather than publishing the absolute quantity of greenhouse gas emissions. GKN plc is a notable example, quantifying its carbon emissions in kg/ tonne of product, without disclosing the quantity of product

measured in tonnes. Regardless of intention, this manner of presentation, as shown in Figure 4, obfuscates disclosure and for this reason GKN's emissions have been omitted from the FTSE62 dataset.

Figure 4. Disclosure of relative greenhouse emissions by GKN plc using chart



Source: GKN (2010: p.37)

Table 4 provides another example of a complex case where it was judged necessary to adjust the carbon footprint profile of one of the FTSE62 core firms. TUI Travel plc acquired First Choice Travel in 2006; the same year in which it acquired Hapag Lloyd AG's fleet of shipping containers. The emissions generated by the Hapag Lloyd business were not captured by TUI Travel's greenhouse accounting until 2007, when they appear as a large spike in emissions as shown in Table 4. Because TUI Travel sold Hapag Lloyd in 2009, the researcher decided to incorporate TUI's historically adjusted emissions figures into the meso dataset, as stated in the 2009 corporate social responsibility report. This decision is justified because Hapag Lloyd remained within the FTSE100 boundary for a short and transitory part of the study period. If the Hapag Lloyd emissions were retained within the dataset, they would have introduced a material distortion; particularly if the same treatment were applied to other constituents in similar circumstances.

In contrast, First Choice remained part of the TUI group beyond 2011 and represented a growth in core operating capacity through a process of assimilation, rather than the temporary ownership and

divestment of a non-core business unit. Here the decision was taken to adjust the emissions reported by First Choice in 2006 in order to more fairly reflect the likely pattern of emissions by the TUI group across the entire period of the study.

Table 4. TUI Travel – annual carbon footprint workings: 2006 - 2011

	2011	2010	2009	2008	2007	2006
Corporate Responsibility Report 2006 (First Choice)						1,272,800
Corporate Responsibility Report 2007					16,439,949	8,465,463
Corporate Responsibility Report 2009			6,402,202	6,617,501	7,268,835	
Corporate Responsibility Report 2010		6,100,123	6,402,202	6,617,501	7,268,835	
Adjustment						8,000,000
Corporate Responsibility Report 2011	6,428,164	6,100,123	6,402,202	6,617,501		
TUI Travel Carbon Footprint	6,428,164	6,100,123	6,402,202	6,617,501	7,268,835	9,272,800

Source: Author, using data from corporate social responsibility reports.

Where firms have used multiple channels – annual report, corporate social responsibility report and/or company website - to report emissions, data have been listed and considered from each source before choosing the appropriate value to include in the meso dataset. It was useful to search the various corporate reports for each individual year within the period of study, as companies often update comparative year figures to take account of revised energy to greenhouse gas conversion factors; or to adjust in order to remove the emissions from a disposed business unit. Accordingly, in straightforward cases, the earliest disclosed emissions by a given company for each year of the study have been taken into the dataset. While attempting to keep adjustments to the disclosed data to an absolute minimum, adjustments have been made in individual cases where this is necessary.

Thus there are a number of caveats attached to the FTSE62 meso carbon footprint dataset. First, only survivors have been included in the dataset, to ensure a consistent run of firms over the period 2006 to 2011. Second, scope 3 emissions are excluded because of the (increasing) scarcity of disclosure. Third, the dataset includes estimations from charts and also assumptions about the nature of the disclosures

to try and ensure consistency from one year to the next. With these caveats in mind, Table 5 presents an overview of the aggregate emissions profile of the FTSE62 meso subset.

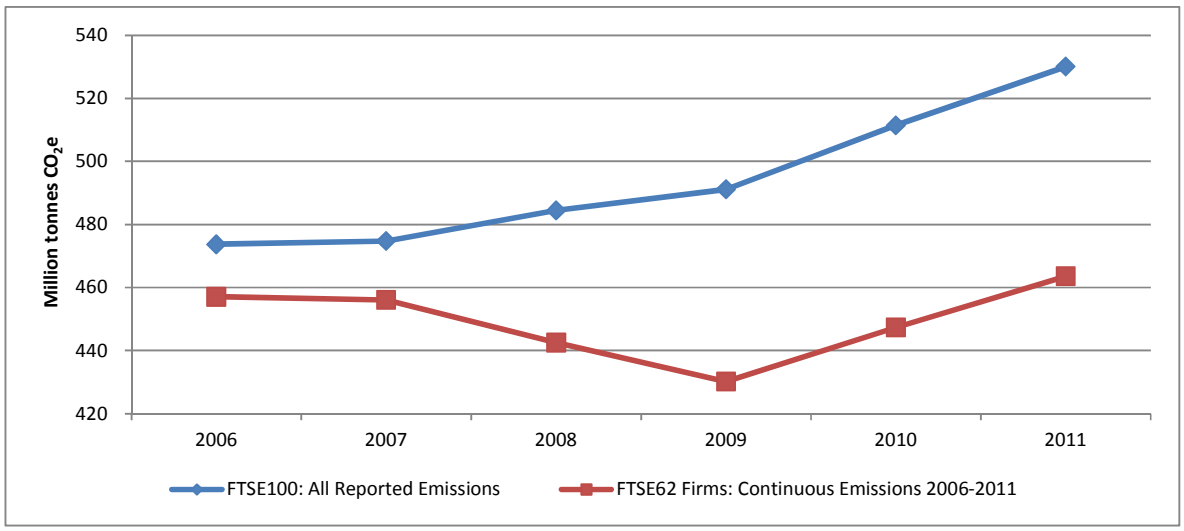
Table 5. Aggregated CO_2e emissions (tonnes): 2006 – 2011

	FTSE 62	**All disclosing FTSE firms**	**FTSE 62 (%)**
Year/Column	(1)	(2)	(3)
2006	457,103,691	473,719,229	96.5
2007	456,052,801	474,744,778	93.1
2008	442,549,761	484,514,384	91.3
2009	430,202,076	491,151,719	87.6
2010	447,377,951	511,471,483	87.5
2011	463,569,157	530,103,114	87.4
No. Firms (at 2011)	**62**	**84**	

Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Column (1) of Table 5 presents the aggregated meso emissions of the FTSE62 core subset, for the years 2006-2011 inclusive. As of 2011, column (2) reveals that 84 out of the 100 constituents of the FTSE100 index publicly disclosed their carbon footprints; a total that will rise to 100 from 2013, as greenhouse gas reporting becomes mandatory for all companies listed on the Main Market of the London Stock Exchange (DEFRA, 2012). Column 2 adds up the carbon footprint for all firms available for all years rather than a consistent group as represented by the FTSE62.Figure 5 presents the aggregated emissions profile for the FTSE62 core of firms with 6 years of continuous disclosures over 2006-2011. Alongside the FTSE62 line, the same chart also presents aggregate reported emissions for all firms that make disclosure in each year regardless of whether these are continuous over 2006-2011.

Figure 5. Aggregated CO_2e emissions - FTSE62 and all FTSE 100 disclosures: 2006 – 2011



Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Comparing FTSE62 core emissions in Figure 5 with total reported emissions reveals that both lines diverge noticeably in 2008 due to four large reported declines in emissions (Anglo American, International Power, Royal Dutch Shell and Scottish and Southern Electricity). These profiles resume parallel trajectories from 2009 as the emissions growth of Royal Dutch Shell and Scottish and Southern Electricity resumes, simultaneous with a 228% rise in emissions at mining group Kazakhmys, attributed to "a significant rise in power generation unattributed to copper production" (Kazakhmys, 2010: p.37). The divergence in 2008 is exacerbated by the reporting of 9 million tonnes CO_2e by InterContinental Hotels Group: 2008 is the only year in which the company disclosed its footprint. Thereafter, this effect falls away from 2009 as both lines resume parallel paths.

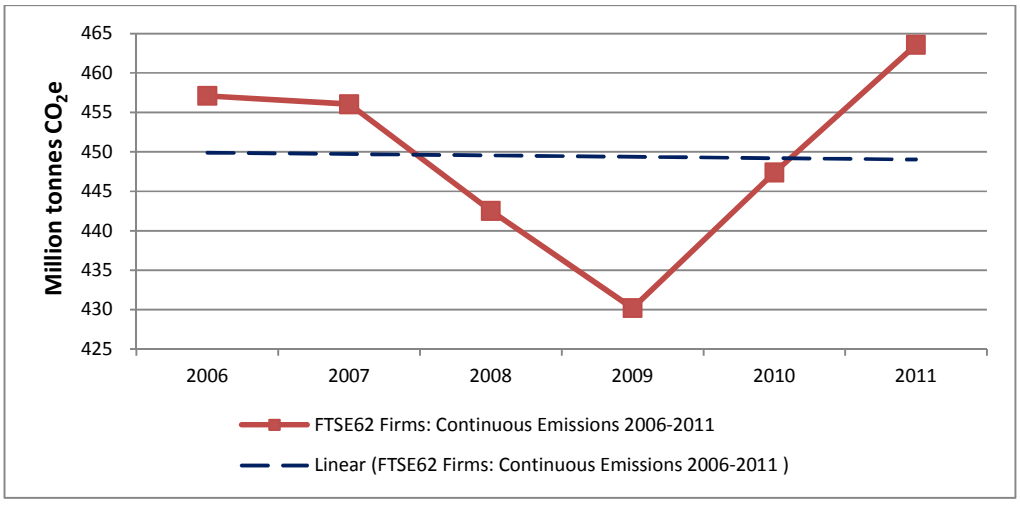
Figure 5 is plotted from the data supplied in Table 5, which demonstrates that the FTSE62 core group of firms is responsible for a very high proportion of total (aggregate) emissions reported by all FTSE100 firms. It should be noted that column 3 (FTSE62 %) represents the FTSE62 core emissions as a percentage of total (aggregate) emissions reported by all FTSE100 firms for each year in the series 2006–2011. FTSE62 carbon emissions do not fall significantly below 90% of total reported emissions until 2009. The dilution of FTSE62 emissions after 2008 can be explained by the commencement of disclosure by two mining companies: Eurasian Natural Resources in 2009 and Vedanta Resources in 2011, counteracted by the exit of British Airways in 2011 (due to its merger with Iberia) and the non-disclosure

in 2011 by Carnival. From this analysis, it is argued that the FTSE62 core provides a suitable basis for constructing a meso corporate dataset that possesses the necessary quality (in terms of consistency) and weight (in terms of share of total FTSE carbon footprint) upon which to conduct the remaining analysis.

5.4 Accounting for the FTSE62 Carbon Footprint

This next section considers the carbon reduction performance of the FTSE62 group during 2006-2011 using the meso dataset. The analysis deliberately focuses on performance at the sectoral level, and avoids discussion of individual firms, whose pattern of emissions may be used to explain variations in the dataset. Discussion of firm-level performance is reserved for Chapter 6 of this thesis, which constructs a case study of the United Kingdom mixed-retail sector featuring the four supermarket companies in the FTSE62.

Figure 6. FTSE62 meso subset: greenhouse gas emissions (scopes 1 & 2): 2006-2011



Source: Author, using data compiled from company annual reports, corporate responsibility reports and corporate websites.

Figure 6 is adapted from Figure 5, and isolates the scope 1 and 2 greenhouse gas emissions for the core FTSE62 meso subset. The dotted line represents the linear trend of FTSE62 group emissions over 2006-2011, which presents a barely perceptible downward profile. There is some cyclicality in the level of carbon emissions but this coincides with the timing of the economic slowdown over the period 2008 to 2010. In 2011, aggregate FTSE62 emissions stood at 464 million tonnes; a 1.41% increase from 2006. If

taken as a proxy for industry at large, data for the FTSE62 imply that the large corporate sector as a whole is failing to reduce its aggregate carbon footprint.

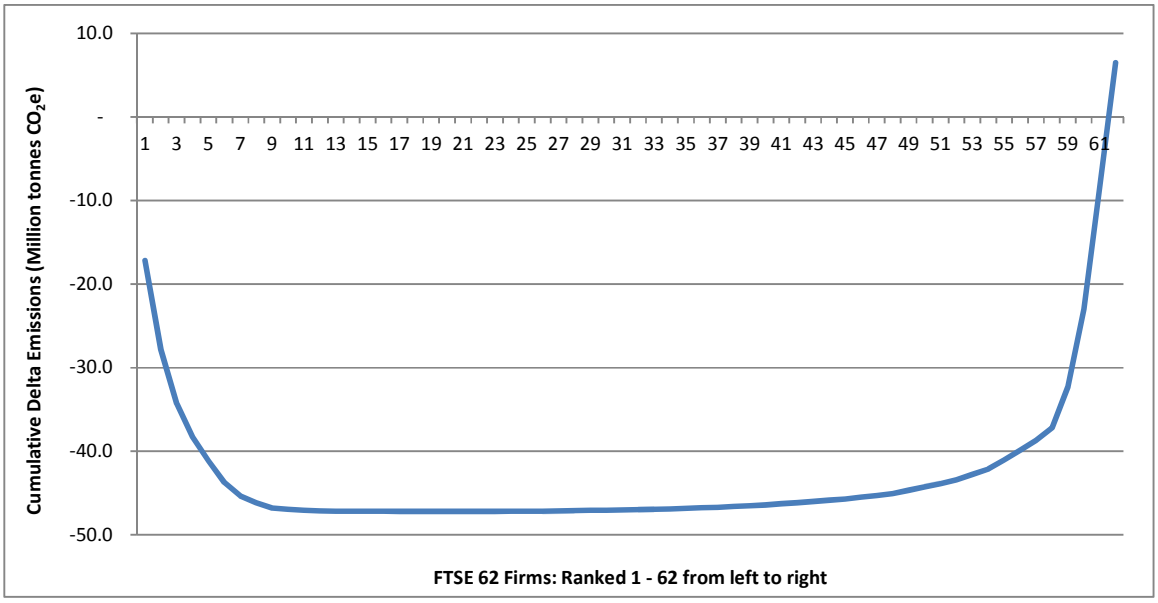
Table 6. FTSE62 meso subset: calculation of cumulative changes in emissions: 2006-2011

Firm	Difference Emissions (Million tonnes CO_2e)	Cumulative Frequencies (Million tonnes CO_2e)	Firm Rank by Difference
Anglo American plc	-17.2	-17.2	1
BHP Billiton plc	-10.6	-27.8	2
Rio Tinto plc	- 6.5	-34.3	3
Royal Dutch Shell plc	- 4.0	-38.3	4
TUI Travel plc	-2.8	-41.1	5
[Firms ranked 6 – 57 are included here]			
BG Group plc	1.5	-37.2	58
National Grid plc	4.9	-32.3	59
Xstrata plc	9.3	-23.0	60
Kazakhmys plc	14.5	-8.5	61
International Power plc	15.0	6.5	62

Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Within the dynamic profile of FTSE62 emissions, one would expect to find variation, as some firms generate increasing carbon emissions while others realise reductions. To identify these positive and negative movements, a chart is used to plot a cumulative frequency of the change in emissions over 2006-2011 (Figure 7). The analysis begins by calculating the difference in carbon footprint (2006-2011) as a positive (increase) or negative (fall) in carbon footprints for each individual FTSE62 firm. These differences are then accumulated and the data are represented in summary in Table 6, from which the chart in Figure 7 is plotted.

Figure 7. FTSE62 cumulative frequency chart - greenhouse emissions: 2006-2011



Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Figure 7 presents a cumulative frequency chart displaying a 'bathtub' profile. The initial downward slope represents the accumulating number of FTSE62 firms whose emissions decline over the period 2006-2011. In total, 13 firms record significant emissions reductions over the period. The second phase of the curve presents a flat section, which reveals that 35 firms record little change in their emissions. In the final upward section of the curve, 22 firms disclose significant increases in greenhouse gas emissions for the period. Where the data in Table 5 and Figure 6 demonstrate how the aggregate FTSE62 meso emissions have not reduced over 2006-2011, Figure 7 disaggregates the trend to reveal that the majority of firms in the group have either increased or maintained their emissions over the period, and this reveals the difficulty of trying to ascribe a homogenous carbon reduction narrative to a diverse grouping of companies assembled purely according to their relative market capitalisations. Accordingly, further investigation in Chapters 6 and 7 considers whether company narrative statements and numbers align to support the credibility of corporate carbon reduction narratives.

Given that carbon reduction is heterogeneous between FTSE62 companies, the next stage in the analysis sorts and ranks the constituents according to their carbon intensity values. The objective is to observe whether reported increases or decreases in emissions can be stratified into 'carbon-intensive' and 'non

carbon-intensive' groups. Here, carbon intensity is defined as revenue divided by greenhouse emissions (scopes 1 and 2) expressed in sales per tonne CO_2e.

Appendix H presents the FTSE62 meso subset, setting out the constituents ranked according to their carbon intensities and organised into four quartiles ranging from High (1st Quartile) to Low (4th Quartile). The data contained in Appendix H are summarised in Table 7 below.

Table 7. FTSE62 meso subset ranked by carbon intensity, and grouped into quartiles: 2006-2011

Carbon intensity ranking	Quartile	Aggregated Δ tonnes CO_2 (2006-2011)	No. firms increased emissions	No. firms reduced emissions	Δ % tonnes per quartile (2006-2011)
Firms 1 - 16	1	+3,932,398	8	8	+1.06%
Firms 17 - 31	2	-557,818	10	5	-0.71%
Firms 32 - 47	3	+1,914,147	12	4	+31.43%
Firms 48 - 62	4	+1,176,739	12	3	+68.99%

Source: Author, using data compiled from company annual reports, corporate responsibility reports and corporate websites.

Table 7 reveals that, when ranked and grouped in this way, only one quartile – the second highest, by carbon intensity - recorded a reduction in greenhouse gas emissions. Moreover, the reduction was small when stated as a percentage fall (-0.71%). Composition of this quartile is diverse. It comprises three of the four major United Kingdom supermarkets, which feature in the micro-level case study developed in Chapter 6 of this thesis. Other represented sectors include pharmaceuticals, alcoholic drinks, property, oil and engineering.

The most carbon-intensive group (1st quartile) has increased its aggregate emissions, but by a modest 1.06%. The constituents include power generators, utilities, mining, oil, food manufacturing and travel companies. In percentage terms, the two most carbon-intensive quartiles appear to have held their emissions almost level throughout 2006-2011. However, in absolute terms, these upper quartiles have increased their aggregate emissions by 3.4 million tonnes CO_2e. Among the quartile 1 and 2

constituents, 18 have increased while 13 have reduced their emissions, further demonstrating how disaggregating the numbers highlights diverse performances[18].

In contrast, the two least carbon-intensive groups (3rd and 4th quartiles) record the greatest increases in emissions for the period; of approximately one-third and two-thirds respectively. The mix of constituents is varied, taking in companies from the engineering, manufacturing and mixed retail industries in common with the 1st and 2nd quartiles, additionally encompassing financial services, insurance, communications and publishing. While it is initially surprising that the least carbon-intensive companies have performed less well over the period, it may be that high carbon-intensive firms have adopted more proactive carbon reduction strategies, becoming 'first movers' because of their greater exposure to carbon risk.

From the analysis of the FTSE 62 meso subset data, it emerges that accounting numbers alone provide little comfort regarding the credibility of collective carbon reduction within large United Kingdom corporations. The companies with the best record of carbon management over the period 2006-2011 appear to have effectively stood still; neither increasing nor reducing emissions to any significant extent. This observation admits the possibility that earlier action preceded 2006, and that the period of study fails to give credit to 'first movers'. However, it is evident that most of the 'heavy lifting' required to achieve the United Kingdom's statutory carbon reduction target lies in the future. In this respect, it is concerning that overall emissions are increasing, and that the number of firms whose emissions in 2011 exceed 2006 levels outweighs those for which emissions have fallen. It is apparent that the least carbon-intensive firms have been slower to adopt effective carbon reduction strategies. This contrasts with public perceptions that the highly carbon-intensive firms are lagging those less carbon-intensive firms that are seen to be 'cleaner'.

In summary, the aggregation of accounting numbers within and among FTSE62 firms leads to a loss of information (Suzuki, 2003) that might be helpful in evaluating the credibility of narratives of strategic intent. Therefore the thesis will attempt to recover some of this information by analysing narrative statements obtained from corporate reports alongside the accounting numbers, with the intention of

[18] Following the first oil shock in 1974, some companies such as those in the Scotch Whisky industry, made significant progress in reducing their energy consumption. These 'first movers' are likely to have less potential than 'laggard' firms to make further reductions consistent with the Government's emissions objectives. The irony is that the by being proactive in the past, these first movers could easily be mistaken for laggards on the basis of year on year emissions, and vice versa.

evaluating the credibility of carbon accounting and disclosure. It is clear that the dataset must be interpreted with care, due to the inherent limitations revealed during its compilation. These limitations are classified under the headings of identity, time and space, and are set out in detail in the next section of this chapter.

5.5 Data Limitations

This section contains several 'health warnings' concerning the FTSE62 meso dataset, which represents the best currently available knowledge of the carbon footprint for a core of FTSE100 firms over an extended period. Nevertheless, as has been shown, the dataset is incomplete because it omits the scope 3 emissions that are such a problematic, yet equally significant, part of total corporate carbon footprint. The discussion that follows shows how identity, time and space present further difficulty for those wishing to define and characterise corporate carbon footprint through the medium of accounting numbers.

Merger and acquisition activity (M&A) among listed public companies ensures that identity is a fluid concept that changes in character with each business combination. Where one firm acquires another, it incorporates additional carbon-generating capacity, which causes its reported emissions to rise post-acquisition. It is therefore important to appreciate that it can be difficult to compare corporate carbon emissions from one year to the next, if M&A activity has fundamentally altered the identity and structure of the firm within a period of study. Comparative accounting ignores the fact that the boundary framing emissions has changed; to the extent that the carbon profiles of two different organisations are being compared, rather than the carbon transition of a single organisation. Table 8 estimates the scale of net acquisitions against the aggregated FTSE62 market capitalisation value for each year, and cumulatively for each year since 2006.

Table 8. FTSE62 meso subset - M&A activity and market capitalisation: 2006-2011[19]

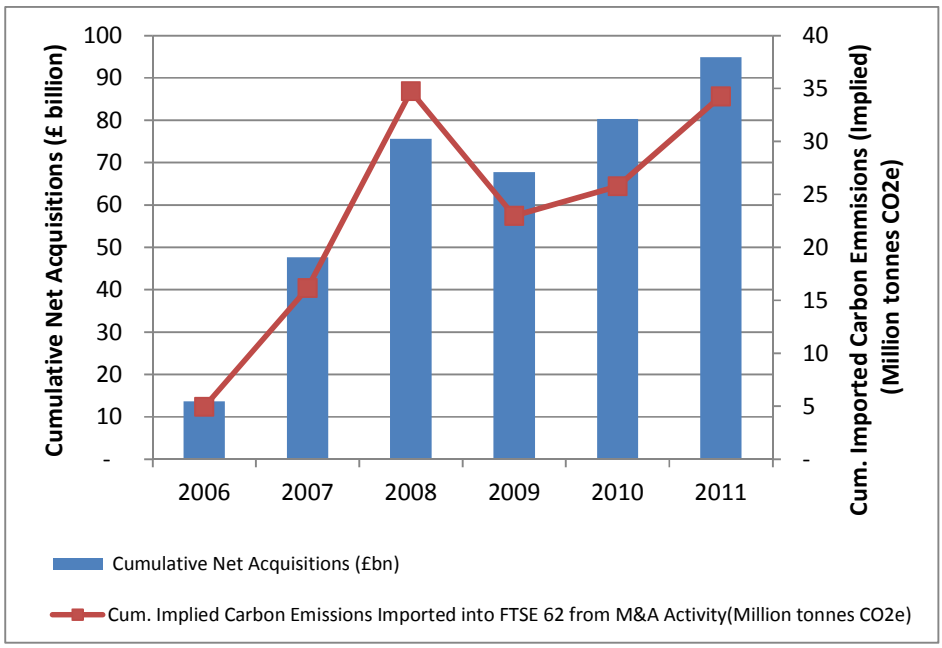
	2006	2007	2008	2009	2010	2011
Acquisitions (£bn)	15.9	39.9	30.0	4.1	20.0	26.0
Disposals (£bn)	2.2	5.9	2.0	12.0	7.5	11.5
Net acquisitions (£bn)	13.71	33.93	27.99	- 7.84	12.55	14.53
Cumulative net acquisitions (£bn)	13.71	47.64	75.63	67.78	80.33	94.86
Market capitalisation (£bn)	1,266.6	1,344.2	963.0	1,268.2	1,393.6	1,283.0
Acquisitions % market capitalisation	1.26%	2.97%	3.12%	0.33%	1.44%	2.02%
Disposals % market capitalisation	0.18%	0.44%	0.21%	0.94%	0.54%	0.89%
Net acquisitions % market capitalisation	1.08%	2.52%	2.91%	-0.62%	0.90%	1.13%
Cumulative net acquisition/ original market capitalisation	1%	4%	6%	5%	6%	7%

Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Table 8 estimates the effect of M&A activity, which increases the market value of the aggregated FTSE62 firms through the acquisition and consolidation of other firms. By implication, acquired assets can only add value by using energy and other inputs, with inevitable incremental carbon emissions. Table 8 also estimates that net assets acquired during 2006-2011 represent an additional 7% of the original (2006) market capitalisation. This implies that incremental carbon capacity, acquired, through M&A activity, is highly significant. Figure 8 plots the cumulative net acquisitions during 2006-2011 to give a more vivid representation of the pattern of accumulation, and the underlying estimates are given credibility by the net reduction in 2009; a year of economic recession in which M&A activity was sharply reduced.

[19] Market capitalisation data obtained from London Stock Exchange datasets (2006-2011)

Figure 8. FTSE62 meso subset - cumulative net M&A activity and implied carbon emissions: 2006-2011



Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Figure 8 also presents an implied, accumulated quantity of carbon emissions imported into the FTSE62 greenhouse gas inventory, due to the acquisition of incremental carbon-generating assets. These implied emissions have been calculated by dividing the value of cumulative net acquisitions by the estimated market capitalisation per tonne of carbon shown in Table 9. The correspondence between the two variables plotted in Figure 6 is obvious, given that the implied emissions are the outcome of dividing the cumulative net acquisitions by a given denominator. However, the implied emissions shown in Figure 6 do illustrate an inward osmosis of greenhouse emissions over time, across the semi-permeable reporting boundaries of FTSE62 companies, and within the frame of the FTSE62 meso dataset. While the M&A activity has not in itself triggered any physical increase in emissions, the FTSE62 group has become responsible for a greenhouse inventory that has swelled by an estimated 34 million tonnes during 2006-2011. These 'imported' emissions also include an element incurred outside the United Kingdom, where foreign firms have been acquired. This makes it more difficult to compare the aggregated meso dataset against the national carbon footprint statically, and over time, because the national footprint does not include overseas emissions.

Table 9. FTSE62 group of firms: market capitalisation per tonne CO_2e

	Carbon Footprint (million tonnes)	Market Capitalisation (£ million)	Market Capitalisation (£ per tonne CO_2e)
2006	457.10	1,266,609	2,771
2007	456.05	1,344,241	2,948
2008	442.55	962,994	2,176
2009	430.20	1,268,194	2,948
2010	447.38	1,393,567	3,115
2011	463.57	1,283,041	2,768
Change/ Average	**1.41%**	**1.30%**	**2,788**

Source: London Stock Exchange datasets 2006-2011 and corporate annual reports, social responsibility reports, corporate websites

It is necessary to add the caveat that the M&A activity described in Table 8 and presented in Figure 8 is only an estimate, and one that is likely to be understated. Table 8 is compiled by searching open sources on the internet featuring company history for each of the FTSE62 firms, and confirmed acquisitions and disposals by obtaining and following up references to independent news sources online. However, this process is only likely to identify substantial acquisitions and it remains possible that some may have been missed. Moreover, it is ambiguous whether an acquisition or disposal should include asset sales such as supermarket property portfolios, as these could constitute assets or possibly be held in an asset-owning company structure. The M&A analysis therefore adds to the evidence regarding the ambiguity of comparisons made between the emissions of FTSE 62 companies over successive years, due to the changing identities of constituent firms.

Some firms have chosen to disclose greenhouse gas emissions in the form of carbon intensity figures; for example, supermarkets may present emissions per square foot more prominently than their absolute carbon emissions in tonnes CO_2e (Mintel, 2009). However relative carbon intensity metrics may be used to mask an overall increase in absolute emissions, where the strategy prioritises sales growth over other non-financial objectives. Accounting entities should take note that the United Kingdom obligation under the Climate Change Act (2008) is to reduce absolute, rather than relative, greenhouse gas emissions.

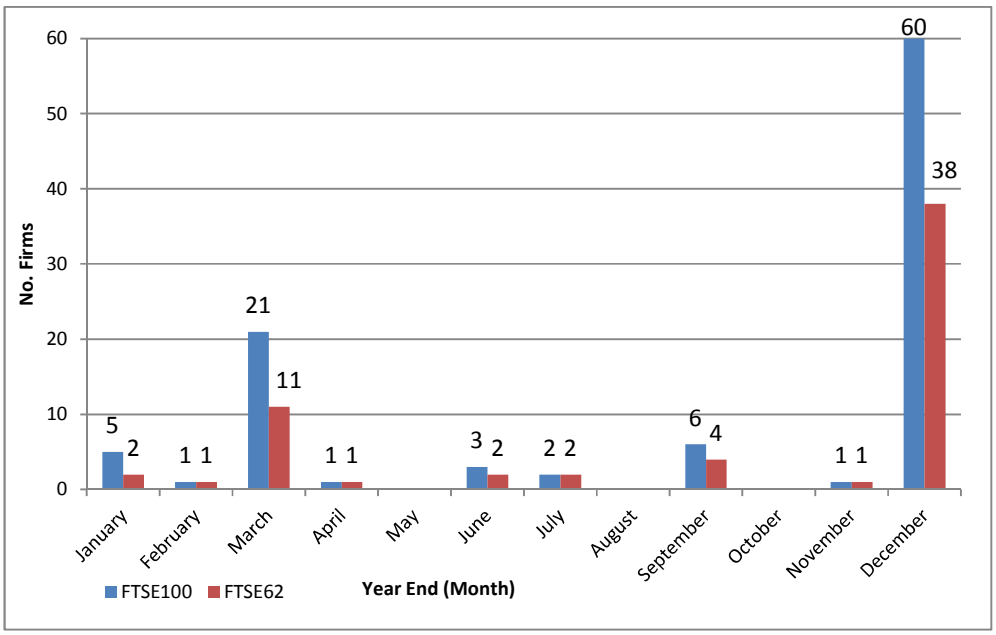
The morphing of corporate identity through M&A activity is a potential source of ambiguity within the dataset. Ambiguity can be taken to mean a definitional 'fuzziness' in a dataset that arises from a failure to operationalise a concept with precision. Bridgman (1927) described how the meaning of concepts can

vary according to the way in which they are measured, when he coined the term 'operationalization'; here it is helpful to recall that framing sets boundaries within which emissions are counted and estimated (Callon, 1998; Lohmann, 2009; Mackenzie, 2009) and which determine the meaning of carbon footprint by specifying its components. Hence M&A activity, which flexes the boundaries that frame carbon emissions, increases the ambiguity of corporate carbon footprints.

Time, calibrated by accounting cut-off decisions, presents further scope for ambiguity and also for malleability. Malleability implies that the accounting entity is able to make choices regarding scope and method, which may affect the content or presentation of accounting outcomes. While the concept of cut-off is firmly established in financial accounting, incorporated within accounting standards and subject to audit, the research has been unable to determine the extent to which rigorous cut-off has been applied to carbon footprint accounting. In other words, where the financial cut-off is clearly stated in annual reports, the review of individual reports has been unable to confirm whether a matching cut-off has been applied in every case. However, assuming for a moment that financial and carbon accounting cut-offs align; Figure 9 demonstrates that a range of different year-ends applies across the FTSE62 subset.

The distribution of year-ends creates ambiguity on aggregation. Fourteen (22.5%) of the subset firms have year-ends in the first quarter, which means that the majority of their emissions aggregated into a given calendar year were incurred in the year before. Although there is no evidence to show intent, companies could manipulate cut-off by disclosing emissions that were substantially incurred in the previous calendar year. If emissions were rising, the effect would be to understate current year emissions. By creating a lag between reported financials and disclosed emissions, attempts to calculate carbon intensity metrics would result in understatement. From a different perspective, the staggering of year-ends across the FTSE62 means that comparison of the meso and macro datasets is compromised because national accounting aligns estimates from different sectors with a 31 December cut-off.

Figure 9. FTSE62 meso subset–distribution of firms by financial year-end month: 2006-2011



Source: Author, using data from corporate annual reports.

Lastly, space creates ambiguity in meso carbon accounting where large listed companies among the FTSE62 conduct business operations around the globe; estimating and reporting their total worldwide emissions. Once again ambiguity arises on comparison with national macro carbon footprints, where national accounting imposes territorial boundaries to frame the United Kingdom carbon footprint. In order to establish the likely impact of overseas emissions on the FTSE62 meso dataset, the research reviewed the annual reports of the 62 companies for evidence of business location, specifically reviewing the notes of segment reporting governed by IAS14, as superseded by IFRS8 in 2009:

> "IFRS 8 Operating Segments requires particular classes of entities (essentially those with publicly traded securities) to disclose information about their operating segments, products and services, geographical areas in which they operate, and their major customers" (Deloitte, 2012).

According to the review, 87% of FTSE62 firms conduct significant operations overseas. Specifically 4 firms operate entirely overseas, a further 50 firms have operations in both the United Kingdom and overseas while only 4 operate exclusively within the United Kingdom. These data confirm the heterogeneity of the meso dataset, which must now be interpreted as a melange of domestic and

international emissions. Moreover, while carbon reporting is a voluntary practice, firms have the discretion to exclude or gradually phase in emissions incurred by overseas facilities.

The data gathered and analysed in this section does not actively support the credibility of carbon reduction among FTSE62 firms, when the group is viewed in aggregate. However, the analysis reveals that the data are heterogeneous, and this allows the possibility that some firms are engaged in credible strategies, that the quality of individual strategies may vary, and that the strategies of other firms may be lacking in coherence and credibility. Also, the inherent limitations of the dataset impose constraints on the ability of researchers to draw conclusions from the data; and the translation of observations into conclusions must be treated with care.

5.6 Conclusions and implications for the research

This chapter describes the challenges associated with the creation of a FTSE100 meso dataset of reported corporate carbon emissions. Ultimately the result is an extensive and original dataset for a core of 62 firms covering an extended, six-year period comprising 2006-2011. Moreover, enquiries among contacts in the academic and investment communities confirm that the dataset is unique in its completeness and coverage. Creation of this type of dataset requires considerable persistence and care, and the chapter contains much detail on the manner and scope of its compilation.

Previously, this thesis has emphasised the need for validity (credibility, transferability), reliability and objectivity in relation to the dataset. Although compiling the dataset has incurred challenges, many of these have been overcome; for example, appropriate decisions have been taken to determine the dataset population and to establish a consistent basis on which to include reported annual emissions where frequent data revision is the norm.

Rather than dismiss the validity of the dataset in the face of these challenges, it is argued that the process of handling these issues has enhanced the research. In the first instance, the dataset is credible, because it provides an *indicator* of the extent to which 'industry at large' is reducing its total emissions in line with government objectives. While scope 3 emissions are omitted, the dataset is complete to the extent feasible under current reporting guidelines. It is also transferable, as the chapter provides sufficient detail to enable others to replicate the dataset for the same or different periods. It is likely

that future researchers will build upon the methodology used to construct the FTSE62 dataset, as the framework for accounting and reporting greenhouse emissions moves into its next generation.

Secondly, categorising dataset numbers into quartiles, and firms with increasing and decreasing emissions, reveals that the performance in the FTSE62 is heterogeneous. This is instructive, because it justifies the decision to conduct further case study research of a specific industry. The case study, featured in Chapters 6 and 7, aims to use numbers and narratives to provide thick descriptions describing the credibility of carbon reduction in a specific sector within the FTSE62 group.

Notwithstanding these initial findings, the interpretation of these data must be treated with great care due to their inherent ambiguity and malleability. Some shortcomings relate to the manner in which boundaries are used to frame carbon emissions, which must be accounted for at firm level. Other problems derive from the well-documented limitations of numbers to describe physical phenomena and the loss of information that arises from aggregation. The research will attempt to address these shortcomings in two ways: by extending the levels of analysis to include the interpretation of macro and micro numbers alongside the meso dataset, and by complementing the analysis of numbers with an evaluation of narrative statements obtained from corporate reports.

The findings in this chapter therefore contribute to the resolution of the second research question, which seeks to establish whether a FTSE100 emissions dataset could be constructed to reveal trajectory and relative performance at meso and firm level, and to identify the challenges associated with its construction. The construction of the dataset and its inherent challenges have been addressed in the chapter and summarised in this concluding section. The aspect of the research that considers relative performance is deferred until Chapter 9, which constructs a software benchmarking tool designed to evaluate corporate carbon risk. The dataset estimates the emissions trajectory of the FTSE62 firms, and here the second and third research questions partially overlap.

The third research question considers the extent to which large corporations within the FTSE100 have reduced their carbon footprint since 2006. The FTSE62 dataset indicates that carbon emissions from leading United Kingdom firms are actually rising, rather than falling in line with government objectives. The number of firms with rising emissions outstrips those whose emissions are declining; while all firms appear to be slow in converting the government agenda into tangible decarbonisation, those with lesser

carbon intensity appear to be slower to incorporate decarbonisation into corporate strategy. While the dataset provides an indication of the trajectory of total FTSE62 emissions, it does not give an indication of the possible reasons for the direction of trend. This deficit will be addressed by the case study in Chapter 6, which will investigate the mixed-retail sector firms within the FTSE62, using numbers and narratives to explore the consistency between saying (narratives) and doing (numbers) (after Froud *et al*, 2006).

Finally, it is useful to recall that the chapter began with a presumed carbon reduction narrative for industry at large, setting out the collective intention of these companies to reduce emissions, and which it was intended to compare with the trajectory revealed by the dataset. On face value the fact that FTSE62 emissions are stable and not reducing does not explicitly support such a narrative. However, neither does it provide sufficient evidence with which to argue the contrary and therefore further research is required and will be undertaken in Chapters 6 and 7. At this stage, the alternative critical narrative at the meso level can be articulated as follows:

> 'Despite the presumption of alignment with the United Kingdom government's programme of targeted carbon reduction, large corporations as a whole have yet to respond by making aggregate reductions in their total emissions. While this could imply that large companies in the United Kingdom have yet to devise credible carbon reduction strategies, there may be other reasons and the explanation remains worthy of further research'.

Chapter 6 begins this next phase of research by examining carbon disclosure in a case study of the four large supermarket companies representing the mixed-retail sector in the FTSE100 index.

Chapter Six

Micro analysis: carbon disclosure in the FTSE100 United Kingdom mixed-retail sector

6.1 Introduction

This is the first of two chapters that set out a micro (firm-level) analysis of carbon accounting and disclosure using the case-study method. The subject of the case study is the FTSE100 mixed-retail sector comprising four companies: Tesco, J. Sainsbury, Wm. Morrison Supermarkets and Marks and Spencer. The analysis in this chapter is intended to contribute towards to the resolution of the first three research questions:

> **RQ1.** Can numbers be used to create alternative critical narratives of carbon reduction credibility at macro, meso and micro levels of analysis?
>
> **RQ2.** Can a physical and financial dataset be constructed that reveals trajectory and relative performance at meso (FTSE100, industry and firm level? What are the challenges associated with its construction?
>
> **RQ3.** To what extent have large corporations represented in the FTSE100 index reduced their carbon footprint since 2006?

Consistent with Chapters 4 and 5, a narrative of strategic intent to reduce carbon emissions is presumed on behalf of the four supermarket companies. At the present stage, this can be considered a simplifying instruction because more detailed narrative analysis of these firms is undertaken in Chapter 7. For the most part, supermarket firms can be expected to express an intention to support the government's position on climate change:

> "We are supportive of the Government's leadership position to reduce the UK's carbon emissions by 80% by 2050" (J. Sainsbury, 2010: p.41)
>
> "The target [to reduce operational emissions] was set to be in alignment with government aims and applies not only to our stores but also to our manufacturing and logistics operations" (Wm. Morrison Supermarkets, 2011a: p.30)

In other instances, supermarkets may express a desire to transcend compliance and assume a leadership role in climate and environmental policies:

> "So there is much more to be achieved on sustainability in the coming years. Tesco has a huge contribution to make and I want that to be a major focus of my leadership" (Philip Clarke cited in Tesco plc., 2011b: p.3)

For the purpose of this chapter, the narrative of strategic intent generated in Chapter 5 is adapted as follows:

> 'The company will pursue carbon reduction strategies that support the government's objective, quantified in the Climate Change Act, 2008, in a manner consistent with achieving its own strategic objectives'.

The case study is introduced in this chapter, which begins by explaining the criteria used in selecting the appropriate sector from which to construct the case study. Having introduced the case study firms it proceeds to locate them within the context of their business models, the industry and its significance within the economy and society. The focus of the chapter then switches to carbon accounting and disclosure by the mixed-retail firms, the carbon reduction performance of the both the sector and its constituent firms; before drilling down into the numerical disclosures and analysing them with regard to reporting strategies and credibility of disclosure.

6.2 The FTSE100 mixed-retail sector: case study rationale

Before constructing the meso case study, it is helpful to explain the rationale behind the choice of the mixed-retail sector. In order to ensure that the relevant sector was chosen in a methodical manner, certain criteria were specified in advance to help guide the selection process:

- The chosen sector should represent an economically and socially important group of companies.
- The chosen sector should be one that engages in medium to high carbon-intensive activities, such that managing carbon reduction is an important aspect of strategy and one for which the company will held to account.
- The chosen sector should be one that engages in a mix of numerical and narrative disclosure of non-financial performance through the medium of its published corporate reports.
- Six years of continuous carbon emission data must be available from the published annual and/ or sustainability reports of all companies in the sector.

- Companies should be chosen from among those that conduct a substantial proportion of their business within the United Kingdom, as this serves to align their carbon reduction objectives with those of the host government.
- The FTSE100 listing must include a selection of firms which account for a sizeable share of the total United Kingdom market for goods and services supplied in the chosen sector, to ensure an acceptable representation of the sector in the case study analysis.
- Preference should be given to sectors comprising a manageable number of companies, in order to achieve a balance between the time required to perform the analysis and the benefit achieved from its results.

Table 1 in Chapter 5 contains a list of companies in the FTSE62 group for which there are six consecutive years of reported carbon emissions data. These firms have been sorted into quartiles according to their relative carbon intensity in Appendix H. Excluding the fourth quartile, on the grounds that it contains the least carbon-intensive firms, 47 firms remain from which to choose the case study sector. This process of elimination marks publishing, banking, investment, telecommunications, construction, insurance, and advertising as being ineligible for selection. Therefore the range of eligible sectors is refined and reduced by this process to comprise engineering, property, retailing, mixed retail, information technology, pharmaceuticals, food and beverages, utilities, mining, energy and travel.

Of these eligible sectors, this researcher considers that the mixed-retail presents the best fit against the original selection criteria. Mixed-retail stands out from other eligible sectors because its business is primarily concentrated in the United Kingdom, with half of its constituents operating exclusively within Britain, and the largest (Tesco) actively divesting overseas businesses; notably those in Japan and the United States. Moreover, the FTSE100 mixed-retail group comprises just four firms and each operates broadly similar business models, offering a reasonable basis to compare and contrast companies within the case study. Furthermore, Table 1 reveals that the combined market share of the four supermarket firms represents almost 62% of the United Kingdom mixed-retail market in 2013 (Kantar Worldpanel, 2013). Although the retail sector is similar to in many respects to mixed-retail, there were only two of the former companies – Kingfisher and Next – represented in the FTSE100 as at the fourth quarter of 2010.

Moving on for these selection criteria, in a separate development, Tesco – the largest of Britain's supermarkets – has featured prominently in the financial press as this thesis is being prepared. In

October 2014, the company announced that its first-half profits had been overstated by £263 million (Wood, 2014). This announcement precipitated the resignation of its Chairman, Sir Richard Broadbent (Felsted & Oakley, 2014), which followed the replacement of Chief Executive Philip Clarke in July, and the suspension of four other senior executives. However, from as early as April 2014, Tesco had been operating without the services of a Finance Director, as steps had not been taken to replace the outgoing Laurie McIlwee (Shah, 2014). .

At the time of writing, Tesco has declined to provide a detailed explanation of the causes of the accounting misstatement, pending the outcome of a review by the Financial Reporting Council (Trotman, 2014). It would unwise to prejudge the outcome of the review. However, analysts at Citigroup have claimed that Tesco's accounting is 'consistently aggressive' and that, while not improper, reported profits and earnings per share are significantly higher than they would be if they had been calculated under the same basis as used by other supermarket firms (Finch, 2014).

The circumstances at Tesco, and the extent to which responsibility for the crisis has been shared among former directors and senior executives, prompts serious question over its accounting practices and its corporate governance. In addition, the mixed-retail sector is undergoing a period of market share instability as low cost rivals are capturing market share from the mainstream FTSE100 grocers and frustrating their market and profit growth ambitions (see Table 1 in this chapter).

Supermarkets enjoy a unique position in the United Kingdom, both economically and socially, due to the scale of their combined businesses, and the depth and breadth of their relationship with the public. Trust is an essential component of this relationship, and the mixed-retailers have the resources and the motivation to protect their legitimacy through their corporate communications, including their accounting and sustainability reports. In addition to providing a good fit against the advance selection criteria specified earlier in this section, there is a public interest argument for investigating whether the concerns over Tesco's accounting practices and corporate governance should extend beyond finance into other areas of accountability, such as the responsibility to reduce its carbon emissions and render credible accounts of these activities. This interest should also extend to others in the sector, to provide a basis for comparison and to evaluate credibility within respect to individual firms and to the sector as a whole.

6.3 Background to the mixed-retail sector

The supermarket firms comprising the United Kingdom mixed-retail sector occupy a unique space in British business and society and have also become embedded in Western economic and social culture. As its name suggests, the sector has grown to encompass substantial sales of non-food items. However, the four mixed-retail firms featured in this case study account for 62% market share of the £100 billion United Kingdom grocery market. Table 1 presents the market shares of Tesco, J. Sainsbury, Wm. Morrison Supermarkets and Marks and Spencer shown in bold type, alongside other significant competitors who are excluded from this study because they are not listed in the FTSE100 index. The case study will argue that the key attributes of supermarket business models have encouraged growth in consumption, with carbon consequences, and that supermarkets represent an interesting case regarding the extent to which carbon emissions can be decoupled from economic growth.

Table 1. The United Kingdom mixed-retail sector by national % market share (groceries)

Company	**2013**	**2012**
Tesco	**29.8**	**30.5**
Asda (part of Walmart)	17.2	17.6
J. Sainsbury	**16.8**	**16.9**
Wm. Morrison Supermarkets	**11.5**	**11.7**
The Co-Operative	6.3	6.5
Waitrose	4.8	4.6
Aldi	3.9	3.0
Marks and Spencer	**3.8**	**3.8**
Lidl	3.0	2.7
Iceland	2.0	2.0

Source: Author, using data from Kantar Worldpanel (cited in Butler & Bowers, 2013) and Marks and Spencer (2013).

Like financial intermediaries before them, supermarkets have developed into part of the nation's 'soft infrastructure'; bringing suppliers and final customers together in a complex network of stakeholders. The supermarket's product is its supply chain (Steeneken & Ackley, 2012) which in the case of Tesco, Britain's largest supermarket, comprises 5,000 suppliers (Wills, 2013). With regard to carbon footprint, scope 1 and 2 emissions reported by supermarkets account for only a minor proportion of greenhouse gases emitted throughout the financial value chain. Indeed, the emissions incurred by the supply chain exceed those of the supermarket by an order of magnitude, according to Sullivan and Gouldson (2012).

The separation of emissions between those incurred in retail and at other stages of the supply chain could fragment the accountability for carbon footprint, where accounting standards dictate that disclosure and value co-creation are partitioned between different organisations and practices. Yet the supermarket firms have multiple channels through which to express their legitimacy, as they have become increasingly embedded within the economy and society. Table 2 presents summary statistics describing the scale of interaction between the FTSE62 supermarkets and their customers, employees and providers of capital.

Table 2. Influence of supermarkets on customers, financiers and employees: 2006 – 2011[20,21]

Consolidated data	2011	2006
Influence over customer stakeholders (excludes Marks and Spencer)		
Total number of retail outlets	7,817	4,427
Gross revenue (£m inc. value added tax)	108,429	73,554
Total UK household expenditure on goods (£m)	431,435	383,244
Proportion UK household expenditure spent on goods	0.25	0.19
£1 in every '£X' spent at supermarkets	**4**	**5**
Influence over financial stakeholders		
Market capitalisation	51,071	58,549
Market capitalisation FTSE	1,446,100	1,514,810
Market capitalisation (% FTSE100)	**3.5%**	**3.9%**
Borrowings (£m)	17,066	11,325
Influence over employee stakeholders		
Number of UK employees	642,309	616,566
Total number people in work (millions - UK)	29.146	29.088
% Total UK people in work employed	1.4%	1.3%

Source: Author, using data obtained from corporate annual reports, Office for National Statistics (2013a, 2013b), FTSE Client Services (2012), Google Finance (2013).

[20] These data describe consolidations of Tesco, J Sainsbury, Wm. Morrison Supermarkets, and Marks and Spencer unless otherwise stated.
[21] For a breakdown of the calculations supporting Table 2, refer to Appendix J.

For the most part, consumer expenditure is transacted through personal visits to the 9,000 stores in the combined property portfolio of these four retailers, where customers interact with employees and engage with the corporate image created by in-store media. Many customers are also employees, as more than 1 in every 100 working people in the United Kingdom work either full-time or part-time for one of these four companies. As employees, members of the public become intermediaries in the legitimisation of retail culture as they engage with others in the course of their duties. In fact, the permeating effect of supermarket employment may be even greater than these numbers suggest, given estimates of 35% staff turnover in the industry (Paton, 2005). Lastly, these four retailers have a significant interaction with providers of finance, accounting for 3.5% of total FTSE 100 market capitalisation and over £18 billion in loan finance. The significance of these intensive and varied stakeholder interactions has been incorporated by other scholars into an articulation of how businesses create and capture value within their respective business models, as will be revealed in the next section.

6.4 The supermarket business model

It is helpful here to recall that business models provide a means of conceptualising the way in which product and information flows are organised around the strategic purpose of a firm, including the specification of the actors involved and the description and sources of revenues (Timmers *et al.*, 1988). Business models provide a useful framework with which to understand the workings of the supermarkets and the nature and effect of their interactions with other stakeholders. According to Steeneken and Ackley (2012: p.2):

> "A supermarket is a business enterprise that provides a service. It does not produce a physical product of its own in the usual sense. Instead, it adds value by acquiring existing products from remotely-located suppliers, assembling them in regional warehouses, distributing them to local stores, and finally selling the supplier's products to local customers".

Haslam *et al.* (2012: p.39) construct a business model thesis around the notion that a focal firm:

> "leverage(s) return on capital from interventions in the value chain, exploit(s) intangible assets and execute(s) interventions in the capital markets … fundamentally driven by the need to generate liquidity and solvency to maintain a going concern".

This business model framework is located in accounting, and the authors argue that:

> "Stakeholder interventions generate information genotypes which capture focal firms within loosely described business models … The financial numbers can be used to construct alternative critical narratives about the nature of specific business models in terms of their capacity to generate economic and financial transformation" (Haslam *et al*. 2012: p.54).

Thus supermarkets are identified as focal firms in the mixed-retail business model around which various stakeholders are arranged. These comprise an extended supply chain of customers, employees, investors and institutions. Haslam *et al*. describe the pattern of generic information that arises out of focal firm interactions with stakeholders in a business model. These information flows effectively create the reality of the mixed-retail business model (see also Hines, 1988), as set out in Table 3.

Table 3. Information content governing the mixed-retail business model

Stakeholders	Information
Households and other customers	Number of households, active and retired and size, products and services consumed and expenditure trends. Patterns of income distribution and employment, savings
Suppliers	Capital equipment, materials, and food suppliers.
Employees	Age distribution, population, workforce, educational attainments, wages, salaries, social charges and hours worked.
Investors	Retail banks, business angels, venture capital, private equity, investment banks, government agencies, households.
Institutional and regulatory	Corporate governance arrangements, rules and routines, accounting standards, financial regulations, health and safety, legal frameworks, government regulatory agencies and institutions governing food and health related issues.

Source: Adapted from Haslam *et al*. (2012: p.56).

The sources of business intelligence described in Table 3 are used by supermarket firms to arbitrage financial gains from their various stakeholders as they renegotiate existing arrangements (Haslam *et al*., 2012). The financial numbers generated by the United Kingdom mixed-retail business model closely resemble those of their United States counterparts inasmuch as cash margins are slim relative to total income, where external purchases account for up to 80% of food sales revenue. After deducting employee compensation, the average US supermarket cash margin is in the region of 6-7% (Haslam *et al*., 2012). Table 4 demonstrates that these observations apply equally to the United Kingdom mixed-retail sector.

Table 4 is compiled from the annual reports of the four case study firms, and represents a composite of FTSE100 mixed-retail sector accounting numbers. The data from which these composites are calculated are shown Appendix J. These data include certain non-financial numbers that describe the available selling space in each year - a measure indicative of information exchange between the firms and their customers.

Table 4. The United Kingdom mixed-retail business model in accounting numbers: 2006-2011

Consolidation: Tesco, J. Sainsbury, Wm Morrison, Marks and Spencer (£ millions unless otherwise stated)	**2011**	**2006**
Group revenue	98,512	67,630
Gross profit	13,384	10,059
Gross margin (%)	**13.6%**	**14.9%**
Taxation	1,475	983
Profit for the year	4,542	2,566
Profit for the year (%)	**4.6%**	**3.8%**
Employment costs	11,989	8,852
Depreciation	2,237	1,492
EBIT	6,520	3,170
Value added	**20,746**	**13,514**
Value added % group revenue	**21%**	**20%**
Cash generated from operations	6,944	4,608
Net Cash generated from operations (% group revenue)	**7.0%**	**6.8%**
Inventory turnover	**16.4**	**20.5**
Trade payables days	**45**	**37**
Total number of retail outlets	**7,817**	**4,427**
Total retail space (thousand sq. ft)	**154,769**	**97,704**
Group revenue per square foot (£)	**637**	**692**

Source: Author, using data from corporate annual reports (2006 – 2011)

Significantly, the business model revenue per square foot of retail space has deteriorated from nearly £700 to £637 between 2006-2011. In an attempt to counteract this trend and generate more cash, the case study firms have increased their store count by 75% while boosting selling space by 60% over the same period. The obvious gap between the increase in store numbers and associated space can be partly explained by the strategy of opening smaller – and incidentally more carbon-intensive – stores in dense urban centres. These convenience locations are usually sited in legacy premises in high streets and neighbourhood shopping parades. Unlike larger store formats, which are built for purpose, these smaller stores vary widely in character and specification. Thus while larger formats benefit from a standardised architectural approach to energy management design, with corresponding efficiencies of

scale, small-format stores incur a reactive and less designed-in approach to energy management. Table 5 profiles the increase in convenience locations as a proportion of total store portfolio for J Sainsbury and Wm. Morrison Supermarkets, the two firms for which consistent annual data are publicly available.

Table 5. J. Sainsbury & Wm. Morrison Supermarkets - convenience locations as a proportion of total store portfolio: 2006-2011

J Sainsbury	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**
Number of supermarkets	456	441	425	439	432	422
Number of convenience locations	478	431	367	384	356	330
Total number of retail outlets	**934**	**872**	**792**	**823**	**788**	**752**
Wm. Morrison Supermarkets						
Number of supermarkets	394	383	363	369	355	364
Number of convenience locations	45	42	12	13	13	14
Total number of retail outlets	**439**	**425**	**375**	**382**	**368**	**378**
Convenience locations % total outlets	**38%**	**36%**	**32%**	**33%**	**32%**	**30%**

Source: Author, using data from corporate annual reports (2006 – 2011)

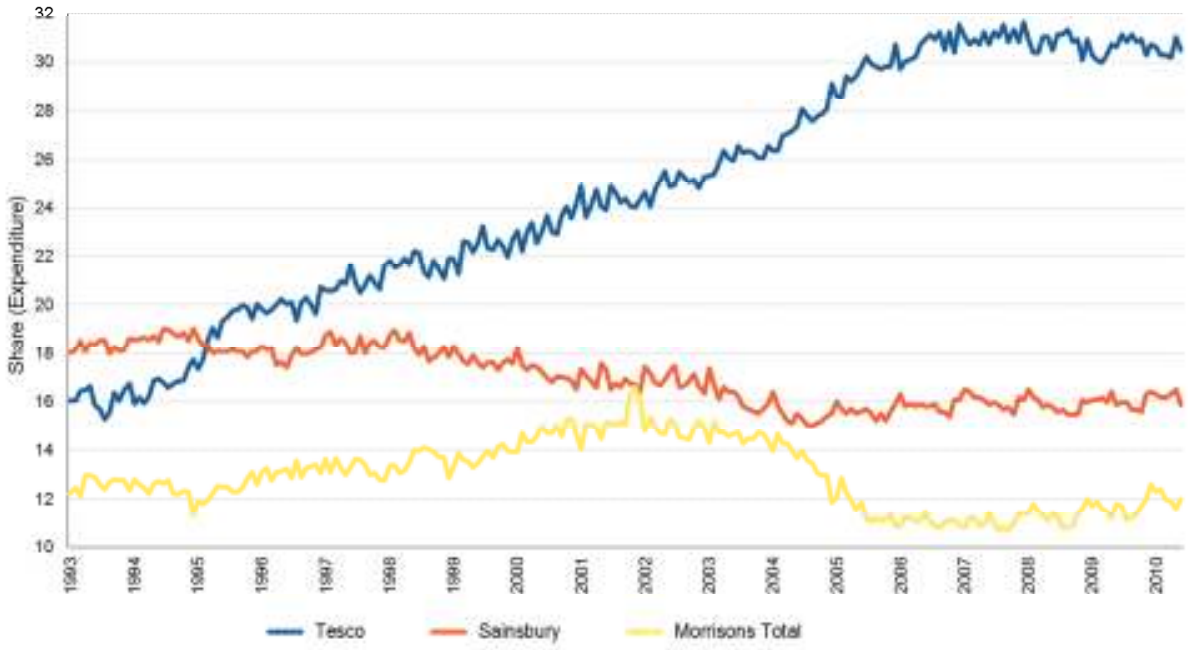
The main grocery retailers have expanded sales and cash generated from operations by growing their physical supermarket networks, comprising out of town superstores and in-town smaller retail units. The top-three grocery retailers now account for roughly 60 percent of this business model's sales share in the United Kingdom grocery market, as shown when combining curve-heights in Figure 1.

The horizontal axis in Figure 1 approximates the twenty-year study period of this thesis. Figure 1 displays the market shares of only three firms: Marks and Spencer are categorised by Kantar Worldpanel as belonging to a smaller group of 'other multiples', whose share of the grocery market is limited to approximately 2%[22]. Since 1993, Tesco has increased its market share almost twofold to around 31%, overtaking J. Sainsbury to become the clear market leader by 1995.

[22] Although, as Table 1 reveals, the market shares of the low-cost recent entrants and the 'upmarket' grocers have increased in recent years, mostly at the expense of Tesco.

There are clear carbon footprint consequences accruing to business models whose revenue and cash objectives depend upon a relentless expansion of its built estate. This theme is revisited later in this section. However, the basis of the case study requires some further theoretical development, for which one must consider an earlier period in the history of the United Kingdom grocery market.

Figure 1. Long-term share of United Kingdom grocery market: 1993 – 2010

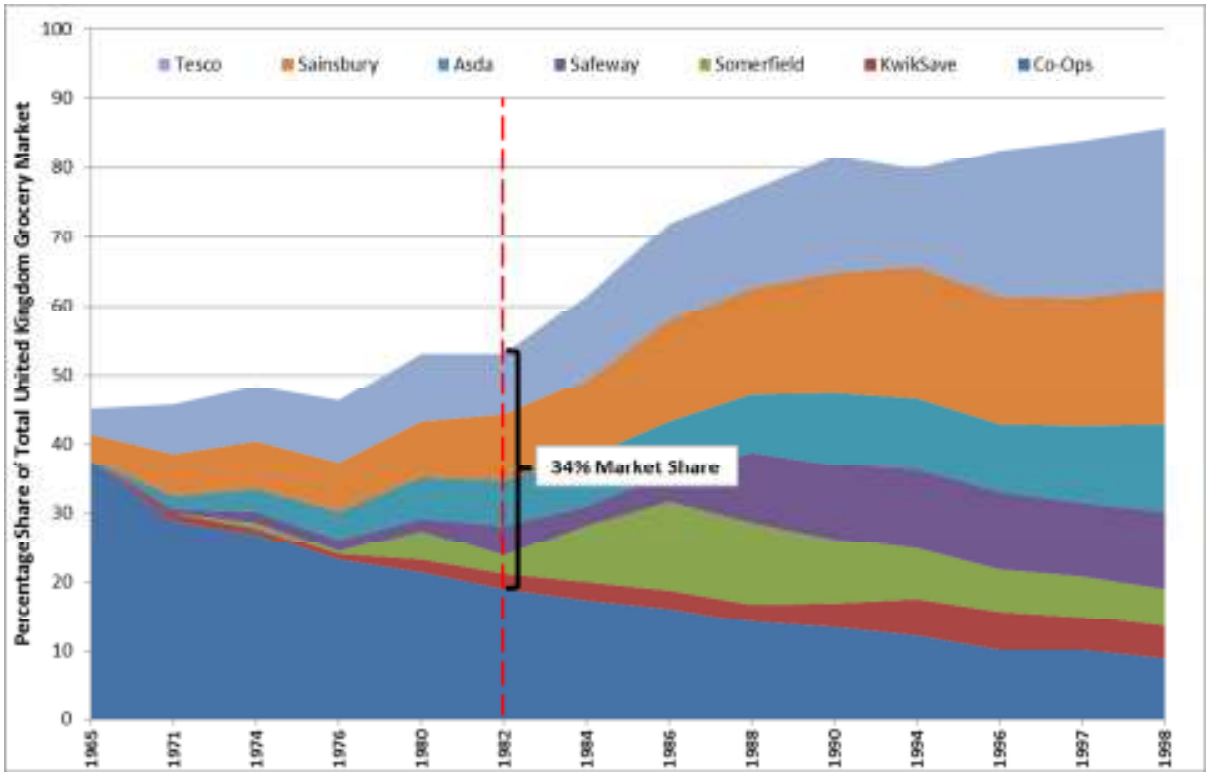


Source: Adapted from Kantar Worldpanel (2013) and reproduced with the kind permission of the authors.

6.5 The sociology of supermarkets

Figure 2 presents a panorama of changing market shares in the grocery market from 1965–1998. The dynamics of the chart are complex. However, the period is marked by the inexorable march of the supermarket groups towards a combined market share approaching 75% - a tenfold rise in 33 years. Almost one-third of this gain in share has been at the expense of the Co-operative stores, while the remaining two-thirds represent the displacement of traditional smaller shops.

Figure 2. United Kingdom grocery market - the growth in supermarket share: 1965 – 1998



Source: Adapted from Seth & Randall (1999: p.19)

Figure 2 indicates the existence of a 'tipping point', after the concept established in sociology by Grodzin (1969) and later popularised by Gladwell (2000), by which a gradually accumulating phenomenon reaches a point beyond which it ceases to be rare, and assumes a dominance which overwhelms the status quo. Tipping points are also applied in the context of new technologies, such as smart phones, which surpass the stage of emergence to assume the status of the new 'paradigm' (Eagle & Pentland, 2005). Figure 2 provides a visual fix on the tipping point of supermarket expansion in the United Kingdom. The dotted red line marks 1982 as the beginning of a sustained period of steep growth, following more gradual accretion and a temporary lull in progress. Moreover, the market share in 1982 had assumed a critical mass of around one-third of the national grocery market; beyond the 25% threshold at which business combinations qualify for investigation by the Office of Fair Trading (United Kingdom Parliament, 2002). If it can be established that the supermarkets had reached a tipping point by 1982, then the social, economic and environmental impacts that have resulted from passing this threshold have important implications for this thesis; for once the tipping point has been breached,

consumers are left with very limited options to purchase their goods from competing retail formats and this places the supermarkets in a position of undisputable social influence.

Moving beyond the graphical depiction in Figure 2, a confluence of social developments supports the timing of the 1982 tipping point. In the first instance, Seth and Randall (1999: p.19) report a significant loss of supermarket competitors:

> "Over the period 1971-79, the total number of grocery shops fell from 105,283 to 68,567, a decline of 35%; for multiples, the decrease was 45 per cent".

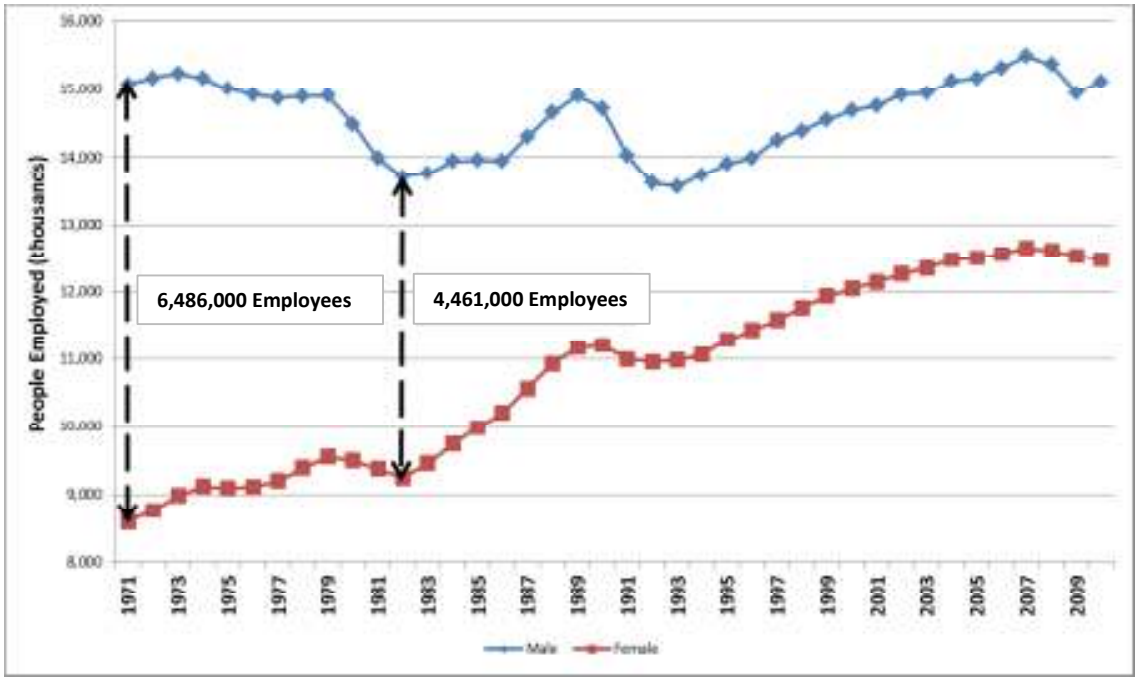
Simultaneously, structural changes in the labour market had sharply reduced the gender gap in employment. Between 1971 -1982, the disparity between male and female employment had fallen by 2 million employees – a narrowing that was to continue for another decade (Figure 3). The data imply that after these changes, shopping would be shared more evenly between male and female household members as domestic roles are reassigned to fit the time available. Thus for busy people – some newly employed and others new to shopping – supermarkets offered the facility to complete a tiresome task all under one roof, with ample and convenient parking.

These economic and demographic changes coincided with a period of liberal government planning policies:

> "The answer of the government on the 1980s and early 1990s was to let development take its course, with most planning applications for large edge-of-town superstores granted, either initially or on appeal. As we have seen, the big four made the most of their opportunities, opening as many new stores as they could finance and find sites for" (Seth & Randall, 1999: p.271).

The construction of these out- of-town facilities could hardly have been better timed, for 1982 was the first year in which the number of households with cars became the majority. Thereafter, in a trend reflecting rising female employment, car ownership continued to grow as many households began to own their second and third cars, as shown in Figure 4.

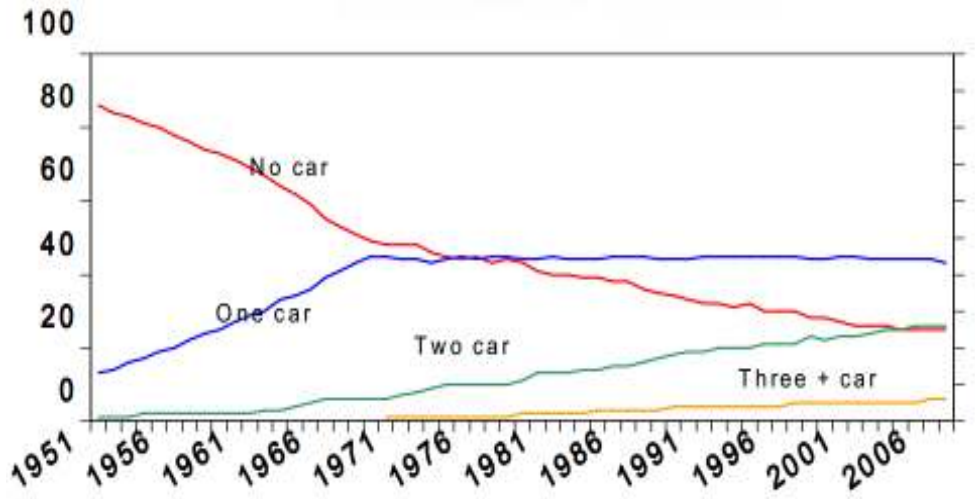
Figure 3. United Kingdom employment by gender: 1971-2010



Source: Author, using data obtained from Office for National Statistics (2013c).

The location of the tipping point is relevant because it establishes a moment – 1982 – at which supermarkets became the only viable option for family grocery shopping. By cleverly aligning the business strategy with converging demographic changes, supermarkets were able to establish a resilient platform on which to take market share from a critical mass to virtual domination. In this sense, it will be useful to consider whether supermarket growth has reflected and responded to society's needs, or whether it has shaped and altered collective desires and behaviour. The outcome of this reflection may be useful when framing regulation that is intended to modify the carbon footprint of supermarkets. This thesis argues that after 1982, supermarkets exercised the power to shape and change society, with harmful carbon consequences. The practical and theoretical basis for this argument will now be developed in more detail.

Figure 4: United Kingdom car ownership by household: 1951-2010



Source: Leibling (2008: p.4)

According to Ritzer (2004: p.149):

> "McDonaldization implies a search for maximum efficiency in increasingly numerous and diverse social settings. *Efficiency* means choosing the optimum means to a given end. … In a McDonaldized society, people rarely search for the best means to an end on their own. Rather, they rely on the optimum means that have been previously discovered and institutionalized in a variety of social settings. ... It would be inefficient if people always had to discover for themselves the optimum means to ends….".

Ritzer's thesis presents standardised models of consumption as being part of a wider process of rationalisation. Where rationalisation makes alternative channels of consumption redundant, supermarkets become the default option, or 'path of least resistance' towards consumption. It therefore follows that the management of externalities, which are perceived by the consumer to have secondary importance, is delegated to the supermarket firm. The likelihood that consumers in such situations might act in ways that fail to anticipate other consequences of their actions was articulated by Merton (1936: p.900):

> ".. even when immediate action is not exacted, there is the economic problem of distributing our fundamental resources, time and energy. Time and energy are scarce means and economic behavior is concerned with the rational allocation of these means among alternative wants, only one of which is the anticipation of consequences of action. In our present economic order, it is manifestly uneconomic behavior to concern ourselves

> with attempts to obtain knowledge for predicting the outcomes of action to such an extent that we have practically no time or energy for other pursuits".

The way in which constraints play out in consumer decision-making, according to Merton, is entirely consistent with the notion of bounded rationality (Simon, 1955). Both Merton and Simon's conceptualisations appear relevant to the behaviour exhibited by supermarket customers in the decades that followed their work:

> "Moreover, it is not assumed that in fact social action always involves clear-cut, explicit purpose. It may well be that such awareness of purpose is unusual, that the aim of action is more often than not nebulous and hazy. This is certainly the case with habitual action which, though it may originally have been induced by conscious purpose, is characteristically performed without such awareness (Merton 1936: p.896)".

Therefore, once the supermarkets have breached the tipping point and displaced the competition, customers are led through a rationalised process using the default channel to source an increasing range of their everyday needs. Shoppers ration their energies in a way that prioritises consumption over second-order concerns that demand too much of their limited resources to justify proper investigation. Moreover, the concentration of the grocery market into the network of mixed-retail superstores enables supermarket groups to use their considerable resources to shape, rather than simply reflect, the reality of society. Supermarket groups have effectively 'acquired' reality: by expending resources, they have won control over certain aspects of social development. This phenomenon resembles the manner by which a corporation may 'acquire' control over the policies and strategy of another company; either by purchasing shares above a numerical threshold, or by having effective control of the board.

By leveraging their financial and physical resources, supermarkets can uniquely influence and change public expectations and behaviour; encouraging greater consumption and changing the manner in which everyday life is lived. Some of these changes are likely to have material carbon consequences if the use of fossil fuels increases in the manufacture and distribution of goods and services. Thus society changes as the supermarket firms dismantle the barriers to increased consumption at a potential cost of carbon externalities:

> "Just as rigidities in social organization often balk and block the satisfaction of new wants, so rigidities in individual behavior may block the satisfaction of old wants in a changing social environment" (Merton 1936: p.901).

There is some evidence to suggest that supermarket executives have been comfortable to assume the role of social modernisers alongside more traditional business goals. David Sainsbury, former Chairman of the supermarket that bears his name, has a well-known history of social, philanthropic and political activity in the United Kingdom. Furthermore, in a reflective interview, Sir Terry Leahy, by then the former chief executive of Tesco, implied that he was comfortable for his work to be interpreted as being instrumental to social progress:

> "It is part of progress. People are not made to shop in supermarkets, they choose to shop there. High streets - some of them are medieval and the way that we live our lives now is very different, so what you have to do is make sure the benefits do outweigh the costs, and I think that they do" (Leahy, 2013).

Sir Terry's remarks can be interpreted as a willingness to play an active part in reshaping society. They are also distinctive, for there are arguably few other industries in which chief executives might include the 'progress' of society among their responsibilities.

If one accepts that supermarkets have acquired a constitutive function in society, it is useful to consider whether they use accounting and disclosure to create or control reality by using them to leverage legitimacy with customers, suppliers and government. It has been argued here that supermarkets have become able to leverage their physical and financial resources with the bounded rationality of the public in a way that shapes and changes reality, to suit the interests of their particular business model.

The remainder of this chapter examines practical examples of accounting and disclosure among the four mixed-retail firms for evidence to support or challenge this argument. In particular it is concerned with whether accounting and disclosure are deployed to create a favourable impression of corporate carbon reduction strategy that supports the present business model, and maintains legitimacy of the supermarket firms.

6.6 Framing carbon accounting in the mixed-retail sector

Callon (1998) states that economic agents create calculative spaces through the process of framing. In this way, boundaries are designated in order to determine which items are counted and included in optimising calculations, and which are omitted from the reckoning of accounting. Chapter 5, which

considered carbon accounting at the meso level, explained how carbon footprint calculations are inherently malleable, due to a combination of political and practical difficulties associated with the selection and application of reporting boundaries. This section begins by looking at how the case study firms have designated their reporting boundaries and the implications of these decisions for carbon footprint accounting.

According to the Greenhouse Gas Protocol (GHG Protocol):

> "The choice of the inventory boundary is dependent on the characteristics of the company, the intended purpose of information, and the needs of the users" (WRI & WBCSD, 2001: p.8).

Furthermore, the determination of emission scopes is potentially complicated by judgements regarding ownership and control of tangible assets:

> "Emissions from leased facilities and vehicles (leased assets) may be classified as Scope 1, Scope 2, or Scope 3, depending on the source of emissions, which approach a company uses to establish its organizational boundary, and which type of leasing arrangement is in place. Leased assets that fall within a company's organizational boundary should be classified as Scope 1 or 2 (depending on whether they are direct emissions or indirect emissions from electricity), while those that do not fall within a company's organizational boundary should be classified as Scope 3" (WRI & WBCSD, 2012).

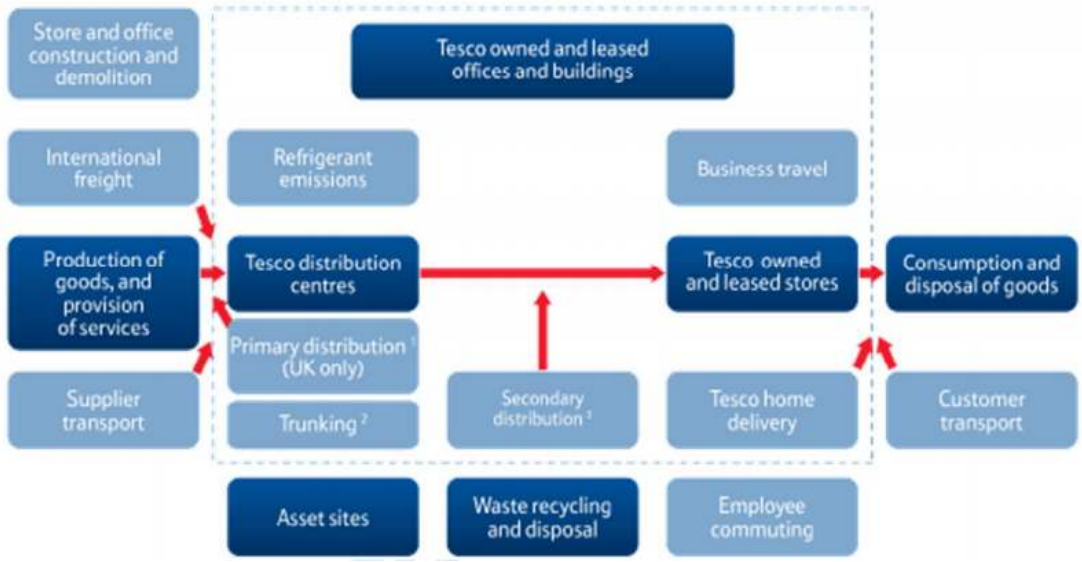
Thus, where companies report voluntarily, and their carbon footprint calculation can be framed according to management discretion, the opportunity exists for variation in interpretation. Consider the case of Tesco, which employs a complex set of criteria to partition carbon footprint measurements in order to create a reporting boundary for scope 1 carbon emissions. Figure 5 illustrates Tesco's reporting boundary using dotted lines.

As stated earlier, the process of partitioning boundaries between the reporting entity and the outside world is malleable and can affect the estimation of carbon footprint because the positioning of the boundary depends on whether Tesco considers it has financial or operating control:

> "We have followed an 'operational control approach' to help us determine when to include emissions within our direct carbon footprint-reporting emissions from operations where we have full authority to introduce and implement operating policies. In the case of distribution we

have gone beyond this operational control approach, including emissions from distribution provided by third party contractors, where this has been arranged by Tesco" (Tesco plc, 2012).

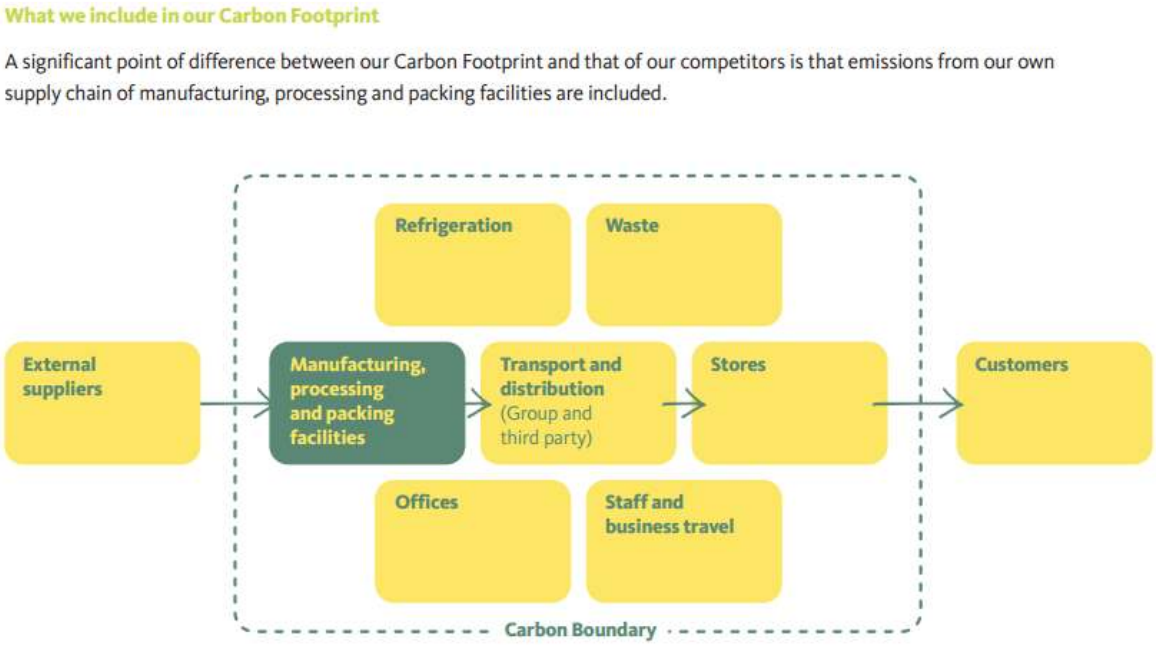
Figure 5. Tesco plc. carbon reporting boundary



Source: Reproduced from Tesco plc (2012)

Inter-firm comparison may also be impaired where boundaries must be flexed to accommodate differences between business models of firms in the same sector. Wm. Morrison Supermarkets, for example, owns a greater proportion of its manufacturing, processing and packing supply chain than its FTSE100 competitors. Accordingly Wm. Morrison frames a broader operating base, and reports proportionately higher emissions than its comparator group, within the dotted line boundary indicated in Figure 6.

Figure 6. Wm. Morrison Supermarkets carbon reporting boundary



Source: Wm. Morrison Supermarkets plc (2008: p.20)

These two examples demonstrate how divisions between operational and financial control can become blurred, enabling the significant exercise of discretion and judgement which can affect reported carbon footprint outcomes; and that that intra-sectoral comparisons may be impaired because boundaries flex to accommodate variations in business models. Another FTSE100 retailer, Kingfisher plc, has executed the sale and leaseback of its B&Q stores. While this transaction is financially-motivated, it also has carbon reporting consequences as emissions can be variously classified within scopes 1, 2 or 3 which determines whether they are located within or outside the entity's reporting boundary.

These concerns potentially affect estimates of the absolute quantity of greenhouse emissions generated and reported by supermarket firms. However, using an odd combination of metric and imperial units, some mixed-retail firms additionally report greenhouse emissions relative to selling space, expressed in kg CO_2e per square foot. This style of reporting can be justified where it expresses one aspect of performance relative to a defining aspect of the business model, such as selling space. However, this approach should be regarded with caution; where numbers are used to distil information into the fundamental attributes of reality, those numbers can subsequently be "manipulated via mathematical operations and the results assigned back to the measured phenomena" (Lynch, 1991 cited in Suzuki,

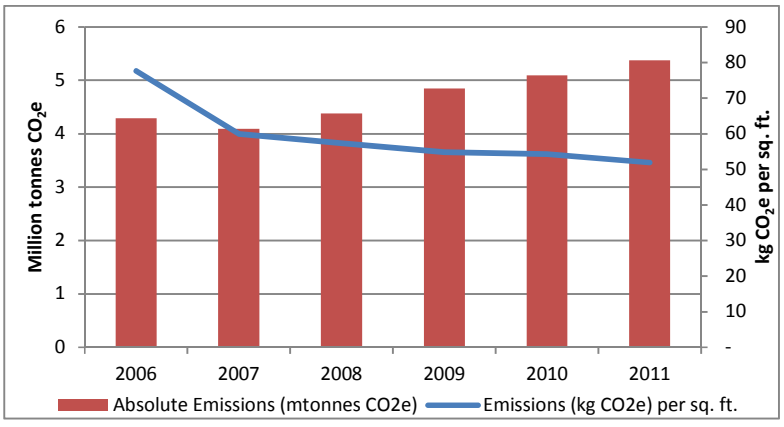
2003). In the case presented by the supermarkets, the practice of reporting carbon emissions per square foot is misleading because it conceals what is happening to the overall carbon footprint. While United Kingdom retailers routinely report reductions in relative emissions, absolute emissions are rising as the expansion of selling space outstrips efficiency gains (Mintel, 2009 cited in Hodge, 2009). Consider again the case of Tesco, as shown in Figure 7.

The data in Figure 7 reveal that Tesco's relative emissions have fallen from around 80 to 50 kg per square foot during 2006 – 2011, while its absolute carbon footprint has increased from 4.3 to 5.4 million tonnes per annum. The repackaging of carbon footprint into alternative metrics in company accounts in order to present a different and more complimentary interpretation represents a form of impression management, by which firms may seek to secure legitimacy for their mode of operation (see Merkl-Davies & Brennan, 2007). As others have commented:

> "Within this realm of financial numbers and perspectives the analogy we make is with the *hall of mirrors* where ambiguity and contradiction are in play frustrating straightforward narratives about strategic purpose and (financial) outcome" (Andersson *et al.*, 2010: p.220).

The sense of this statement applies equally to carbon accounting, as it does to financial accounting where it was originally used. In the next section, the theory of impression management is set out briefly to provide the basis for more closely evaluating the disclosure practice of the case study firms.

Figure 7. Tesco plc. carbon footprint expressed using absolute and relative measurements



Source: Author, using data extracted from company annual reports, social responsibility reports and corporate websites

6.7 Theory of impression management, and alternative metrics

Jones provides the following definition of impression management:

> "This annual report provides ample opportunity for management to package the numbers and to present them in a way that gives users a particularly favourable impression of the firms'(*sic*) results. This management of the presentational aspects of the annual report (such as accounting narratives, graphs and photographs) is called impression management" (Jones, 2011a: p97).

Where managers use corporate reports for impression management, their motives have been interpreted as "strategically … to manipulate the perceptions and decisions of shareholders" (Yuthas *et al.*, 2002: p.144). Moreover, where inconsistency is found between narratives and numbers in financial reports, "preparers are likely to have used the narratives to influence the perceptions and decisions of users" (Merkl-Davies & Brennan, 2007: p.8). It is further assumed that managers indulge in impression management in order to deter the loss of legitimacy which can undermine the firm's prospects of survival (Deegan & Unerman, 2006; Merkl-Davies *et al.*, 2011).

Impression management manifests in various ways. 'Concealment' acts to suppress bad news by introducing positive bias; by emphasising the positive aspects of performance while suppressing shortfalls (Jones, 2011a; Merkl-Davies & Brennan, 2007). Jones (2011a, 2011b) writes extensively on the use graphs in impression management, and in a similar vein Merkl-Davies & Brennan (2007) consider the manipulation of presentation of data. These arguments apply equally well when accounting ratios are substituted for graphs. In this sense, it is logical to treat carbon metrics such as emissions per square foot as though simply another accounting ratio and to apply Jones' critique to their application. Company managers can 'conceal' absolute emissions by calculating emissions per square foot because ratios cleverly remove absolute measures of footprint from the reporting arena. As Whittington (1980: p.226) observes:

> "One common reason for using ratios, which has not been explicitly discussed so far, is as a method of reducing variables to similar scale. … [An] example is the use of growth rates rather than absolute amounts of growth [where] the denominator acts as a size deflator, to remove the effects of scale from the comparison".

Like graphs, ratios tend to 'isolate' a measure of performance, thereby stripping it of the context of other performance measures, which become concealed by this method of presentation. The use of

industry-specific ratios, which embed key operational drivers, such as square feet of selling space, may be used to promote an unquestioning reception among users of accounting reports. This technique is deployed to 'lead' users, as it 'makes sense' to shareholders and others that a supermarket will evaluate its carbon performance against criteria commonly used to rank other activities. At the same time, the power of those reporting the information is protected by the acceptance of sectoral hegemony:

> "The taking-for-granted of "what is" mitigates against the questioning and investigation of the socio-political processes whereby "what is" *comes to be*. When the *status quo* is seen as natural, and as the result of a play of impersonal forces, such as market forces, questions of the *status quo* arose, and the power relations which created and sustain it, do not present themselves as topics of enquiry" (Hines, 1989: p.57).

Selectivity is another manifestation of impression management, by which some indicators are chosen while others are omitted according to whether they reflect company performance in a favourable light (Jones, 2011a; Merkl-Davies & Brennan, 2007). In the mixed-retail carbon reduction case study, selectivity is apparent where managers in the reporting firm choose between different metrics to explain or justify subsidiary aspects of performance. Selectivity can also be observed where key indicators used for external reporting purposes differ from those used for operational monitoring. Specifically, Jones (2011a) describes examples of selectivity where indicators or measures are used inconsistently from one year to the next, A measure will be reported when it brings credit to the organisation and omitted when it lends a less favourable impression. Instances of selectivity are explored later in this section, using examples from individual company reports.

Selectivity can pervade narrative as well as graphical or numerical disclosures. In a related sense, Frankfurt distinguishes 'bullshit' from lying on the basis of its regard for truth:

> "When an honest man speaks, he says only what he believes to be true; and for the liar, it is correspondingly indispensable that he considers his statements to be false. For the bullshitter, however, all these bets are off: he is neither on the side of the true nor on the side of the false. His eye is not on the facts at all, as the eyes of the honest man and of the liar are, except insofar as they may be pertinent to his interest in getting away with what he says. He does not care whether the things he says describe reality correctly. He just picks them out, or makes them up, to suit his purpose" (Frankfurt, 2005).

Bullshit is used to further some form of self-interest and may make selective use of 'truth' in order to protect the user from the more serious charge of lying. Narratives that operate along these lines may be

considered elements of an impression management strategy. It is another specific example of selectivity, and its purpose is to impress the reader. It is not illegal and can be defended, for example, by arguing that a broad statement is true in certain circumstances if not in all.

Lastly, 'measurement distortion' refers to the manipulation of dimensions within graphs and diagrams, in such a way that the underlying data is not accurately represented (Jones, 2011a; Merkl-Davies & Brennan, 2007). Typically, companies may alter the relative size of images use to depict changes in data, or alter the scale; for example, by using an axis which begins at a value higher than zero to exaggerate the extent of change from one year to the next.

The analysis now returns to the case study firms, where it examines the numbers and narratives that describe the delivery against carbon reduction objectives.

6.8 Carbon disclosures in the mixed-retail sector

Tables 6 and 7 reveal the absolute emissions and emissions per square foot, for each case study firm. Table 6 demonstrates how the absolute emissions increase for each company and also for the aggregated group.

Table 6. FTSE100 mixed-retail sector – increasing absolute emissions: 2006 – 2011

Company	2006	2007	2008	2009	2010	2011
Marks and Spencer Group	404,000	517,000	469,000	710,000	652,000	641,000
Wm. Morrison Supermarkets	1,283,050	1,137,532	1,162,981	1,136,899	1,332,333	1,287,259
J Sainsbury	726,398	658,186	700,147	724,000	711,000	856,000
Tesco	4,289,670	4,088,700	4,380,600	4,851,000	5,097,620	5,377,984
Total emissions	**6,703,118**	**6,401,418**	**6,712,728**	**7,421,899**	**7,792,953**	**8,162,243**
Aggregate increase in reported emissions		**-5%**	**5%**	**11%**	**5%**	**5%**

Increasing Absolute Emissions 

All data in tonnes CO2e unless stated otherwise

Source: Author, using data from annual and corporate social reports

Table 7. FTSE100 mixed-retail Sector – declining relative emissions: 2006 – 2011

Company	2006	2007	2008	2009	2010	2011
Wm. Morrison Supermarkets	121	108	107	102	112	105
J. Sainsbury	43	38	39	43	40	45
Tesco	78	60	57	55	54	52
Marks and Spencer	27	33	27	39	34	32
Average emissions	**69**	**57**	**55**	**55**	**55**	**53**

All data in kg CO2e per square foot. Differences in average attributable to rounding.

Declining Relative Emissions 

Source: Author, using data from annual and corporate social reports

Table 7 shows that emissions per square foot decline over the period of study, and that Tesco and Morrison's exhibit comparable patterns of reduction. In the case of J Sainsbury there is an uplift in 2011 that breaks the sequence, and for Marks and Spencer the trend is more variable.

In the section that follows, the disclosures described in Tables 6 and 7 are explored in greater detail for each case study firm. In order to analyse each firm, use is made of other supporting information extracted from the company's annual and CSR reports. This includes narrative evidence, where the term 'narrative statement' is used more loosely to describe any relevant direct quotation comprising a statement made on behalf for the reporting firm. It also includes graphs and data disclosures, where these contribute to the appraisal of impression management as articulated by Jones (2011a, 2011b) and Merkl-Davies & Brennan (2007).

6.9 Marks and Spencer plc

Table 8 replicates Marks and Spencer carbon emissions data previously included in Tables 6 and 7.

Table 8. Marks and Spencer- absolute and relative carbon emissions: 2006-2011

Marks and Spencer	2006	2007	2008	2009	2010	2011
Absolute emissions (tonnes CO_2e)	404,000	517,000	469,000	710,000	652,000	641,000
Relative emissions (kg CO_2/ sq. ft)	27	33	27	39	34	32

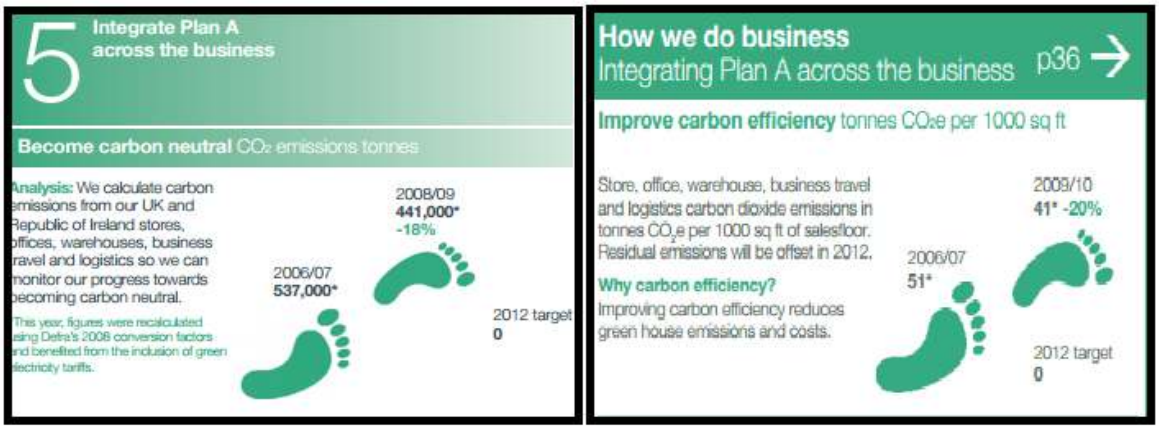
Source: Author, using data from annual and corporate social reports

Marks and Spencer's absolute data series reflects the company's learning and adaptation to carbon footprint reporting. It suggests that the company initially sought to manage impressions when presenting its scope 2 emissions on a net basis (rather than gross) thereby recognising (and reporting) the impact of notional reductions due to renewable electricity tariffs. In 2009, the company responded to changes recommended by DEFRA to rebase its footprint calculations at gross values – hence the data for 2009-2011 are prepared and reported on a different basis.

> "In July 2008, the UK Government published revised guidelines on calculating and reporting greenhouse gas emissions. These are very different to when we launched Plan A and require all electricity consumption to be calculated as grid average with no allowance made for renewable tariffs" (Marks and Spencer plc, 2010a).

As a result of this change in carbon accounting policy, Marks and Spencer continued to disclose the absolute emissions in their annual reports but, from 2010, they altered the presentation of the carbon footprint graph in their annual report to show *relative* emissions in tonnes per 1000 square feet, instead of absolute emissions as depicted in the previous year's chart. This important change was masked from users of the report by the use of identical graphics from one year to the next (Figure 8).

Figure 8. Marks & Spencer- change in graphical presentation of carbon footprint in annual reports



Annual Report 2009 **Annual Report 2010**

Sources: Marks and Spencer plc (2009: p.19, 2010b: p.11)

This presentational change is an example of selectivity (Jones, 2011a), as Marks and Spencer has changed the indicator to reflect a more favourable impression of its performance. This is evident as the

absolute annual reduction between 2009 – 2010 is around 8% (per Table 8), while the annual reduction in emissions per thousand square feet is in the order of 19% (Figure 8). In 2011, Marks and Spencer continue to report relative emissions. Moreover, they maintain an impression management strategy by 'baffling' readers with technical language (Jones, 2011a) contained in their annual report narrative statements:

> "Why carbon efficiency [as an objective]? Improving carbon efficiency reduces greenhouse gas emissions and costs" (Marks and Spencer plc, 2011a: p.30).

This narrative statement represents a form of impression management, to the extent that it combines selectivity with Frankfurt's thesis. The statement suits the purpose of an expanding retail corporation, whose 30% increase in store space over the six year period is a source of increased emissions. Yet the statement is not a lie: it is conditionally true, *ceteris paribus*. Tables 6 and 7 show how, for the industry, greenhouse gas emissions are not reducing as a result of increased efficiency because the rate of space expansion overwhelms the positive benefits of improved technology in building and refitting. So the narrative serves to justify Marks and Spencer's account of its own performance, by selectively focusing on the outcomes of activities that they are prepared to undertake and concealing the effects of other activities that are core to the growth of their business model.

The statement is consistent with Marks and Spencer's 2011 account of their own performance, which reveals a reduction in emissions from 697,000 tonnes in 2007 to 603,000 tonnes in 2011 (Figure 9). However, the narrative statement accompanying the data in Figure 9 asserts:

> "Data for 2006/07 has been re-stated using the latest conversion factors which are generally higher than earlier versions" (Marks and Spencer plc, 2011b).

The restatement increases 2007 reported emissions by 180,000 tonnes; an increase of around 35%. This is a very wide margin of adjustment, of sufficient materiality to warrant further disclosure. Presumably the numbers are also affected by the notional savings attributed to renewable tariffs, which the company was persuaded to disregard from 2009. Ironically, Marks and Spencer benefitted from this change in the method of calculation by being able to present its performance in the best possible light. The company benefitted not once but twice: firstly by reporting a lower figure (537,000 tonnes) in their original 2007 corporate social responsibility report; and secondly by using the revised figure (697,000 tonnes) to claim a larger carbon footprint reduction over 2007-2011 in the 2011 report.

Figure 9 offers a closer examination of the claimed reduction in footprint for 2007 - 2011. The data show that Marks and Spencer has included its scope 3 emissions within its global footprint. Of the 90,000 tonnes claimed saving, around 59% (53,000 tonnes) are attributed to reductions in waste. According to the company's CSR report:

> "We've used the October 2010 DEFRA/DECC greenhouse gas reporting guidelines to calculate carbon emissions from our waste recycling and disposal. This figure is listed under our carbon emissions for commitment 10.4, showing that our recycling activities (including coat hanger reuse and recycling) created a saving of carbon equivalent to around 53,000 tonnes CO_2e" (Marks and Spencer plc, 2011b: p.32).

Yet the company claims, in its annual report of the same year that "Much of this [reduction] is down to a 23% improvement in store and warehouse energy efficiency" (Marks and Spencer plc, 2011a: p.30). Figure 9 shows operational savings to be equivalent to 51,000 tonnes CO_2e:

2011 Scopes 1&2 (223+418) – 2007 Scopes 1&2 (246+446) = 51 (All data in '000 tonnes CO_2e)

These reductions are substantial, but by stressing operational savings over those attributed to waste management – when both are almost equal – demonstrates selectivity directed towards creating a desired impression of performance.

However, the practice of reporting carbon savings from the recycling of operational waste is no longer supported by the GHG Protocol, and it seems likely that the DEFRA guidelines, to which Marks and Spencer adhere, will substantially follow the form of the Protocol as they have done since first publication.

> "Companies should not report negative or avoided emissions associated with recycling in category 5 or category 12. Any claims of avoided emissions associated with recycling should not be included in, or deducted from, the scope 3 inventory, but may instead be reported separately from scope 1, scope 2, and scope 3 emissions. Companies that report avoided emissions should also provide data to support the claim that emissions are avoided (e.g., that recycled materials are collected, recycled, and used) and report the methodology, data sources, system boundary, time period, and other assumptions used to calculate avoided emissions." (WRI & WBCSD, 2013: p.46).

Figure 9. Marks and Spencer – comparative carbon emissions in 2007 and 2011

Total CO_2e emissions tonnes

603,000 -13%

2006/07: 697,000

Total CO_2e emissions/1000 sq ft of sales floor tonnes

38 -25%

2006/07: 51

Operational CO_2e (000) tonnes

Direct emissions from M&S operations (scope 1) -8%

10/11 223

06/07 246

	06/07	10/11	% change
Store/office refrigeration/ air conditioning gases	129	**103**	-20
Logistics transport/home deliveries	63	**64**	+2
Warehouse refrigeration gases	6	**3**	-50
Stores offices/warehouse on-site fuel usage	48	**53**	+10

In-direct emissions from M&S energy usage (scope 2) -6%

10/11 418

06/07 446

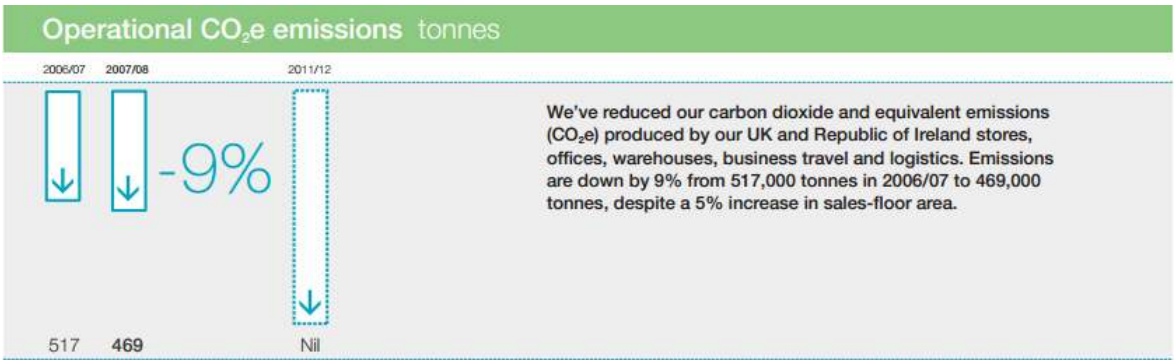
	06/07	10/11	% change
Store/office energy usage	407	**381**	-6
Warehouse energy usage	39	**37**	-5

Source: Marks and Spencer plc (2011b: p.28)

Before moving on from Marks and Spencer, consider the chart displayed in Figure 10, which purports to show the scale of progressive carbon footprint reduction in 2007 and 2008 alongside the objective for 2012. The company claims a reduction of 9% in 2008, which is marginally higher than that achieved in 2007. However the scale of this achievement is grossly exaggerated by comparison with carbon neutrality (equivalent to 100% reduction) targeted for 2012. Applying a pixel ruler to the diagram in Figure 10 demonstrates that the height of the bar representing the 2008 reduction (9%) is over 50% of the height of the 2012 target (100%). Despite the fact that the 2012 bar is drawn with a dotted perimeter, the chart gives the visual impression that the company is halfway towards the achievement of carbon neutrality. Instead, Marks and Spencer – according to its own data – still has over 90% of the target to achieve within a period of four years. Once again, Figure 10 reveals evidence of impression management: this time using 'measurement distortion' in charts.

The carbon footprint reporting of Marks and Spencer represents an interesting case because the evolution of its reporting strategy has been repeatedly interrupted by developments in, and changes to, reporting standards. These standards matter to large reporting companies because voluntary compliance confers legitimacy on their carbon accounting. It is a company whose attempts at impression management have, at times, been thwarted by changes in the voluntary reporting 'regime'. However, over the period of study in which its absolute emissions have increased by around 58%, Marks and Spencer has employed strategies identified by Jones (2011a) and Merkl-Davies & Brennan (2007) as being consistent with impression management. These include selectivity, both within data and narratives, 'baffling' readers with technical information and measurement distortion. Comparison between reported numbers and narratives highlights contradictions and reveals a disparity between what Marks and Spencer's Plan A document describes as 'commitments' and performance delivery. In the case of Marks and Spencer, the use of impression management detracts from the credibility of its carbon footprint reporting.

Figure 10. Marks and Spencer – measurement distortion of carbon footprint reduction



Source: Marks and Spencer plc (2008: p.8)

6.10 Tesco plc

Tesco is the largest supermarket group in the United Kingdom, and the fourth largest in the world when ranked by retail sales (Deloitte, 2010). During 2006-2011, Tesco has achieved the largest growth in selling space among the case study firms, adding 48 million square feet and increasing its built estate by 88%. While emissions per square foot have fallen by one-third, absolute emissions have increased by 25%.

Table 9. Tesco- absolute and relative carbon emissions: 2006-2011

Tesco	2006	2007	2008	2009	2010	2011
Absolute emissions (tonnes CO_2e)	4,289,670	4,088,700	4,380,600	4,851,000	5,097,620	5,377,984
Relative emissions (kg CO_2/ sq. ft)	78	60	57	55	54	52

Source: Author, using data from annual and corporate social reports

In 2009, Tesco began to include an explanatory – and mostly narrative – note to present a version of its carbon footprint journey throughout the course of the accounting year. Figure 11 reproduces this note for 2011, and includes comparative data beginning in 2008.

Figure 11. Tesco – carbon footprint reduction: explanatory note (2011)

REDUCTION IN CO_2 EMISSIONS

Definition

This measure shows the overall year-on-year reduction in greenhouse gas emissions from existing stores and distribution centres built before 2006/7, adjusted to exclude emissions from acquisitions and extensions.

2008	2009	2010	2011
4.6%	4.8%	7.8%	**7.7%**

REDUCTION IN CO_2 EMISSIONS INTENSITY OF NEW STORES AND DISTRIBUTION CENTRES

Definition

Intensity is measured as greenhouse gas emissions/sq ft. The measure indicates the average reduction in emissions intensity of all new stores and distribution centres built since 2006/7 (the base year).

2008	2009	2010	2011
14.7%	25.3%	28.8%	**28.8%**

Source: Reproduced from Tesco plc (2011a: p.48)

The panel displayed in Figure 11 is a clever example of impression management by Tesco. While the company's absolute emissions have risen significantly over the period of study, driven by the rate of space expansion, Tesco has split its emissions performance into two components in order to give a favourable impression of its performance. By making selective use of performance indicators, Tesco has presented a reduction in absolute emissions because it has restricted its measurement to a fixed stock of 'legacy' buildings. This has the effect of removing – or 'concealing' – the impact of added carbon-generating capacity over the reporting timescale. It has then separately attributed a degree of carbon efficiency to its newly-built estate. Managers have segregated the two main drivers of the business – and of carbon footprint – and have used different performance metrics to describe each. The choice of metrics has been made according to their ability to complement performance, rather than to draw criticism or invite further analysis.

This strategy deflects attention from the contrary measurements of performance in Table 9. Instead, managers have selected indicators designed to flatter each aspect of performance, and which enable complimentary patterns of 'improvement' to be presented to users of financial statements. In this way, Tesco managers have used accounting data to reinforce the carbon-reduction credentials of the company. They have used accounting to conceal the contradiction between a business model predicated on the expansion of carbon-generating premises; and the need to achieve legitimacy by being seen to be supportive of the national carbon reduction objective[23].

Closer inspection of the narrative statements employed in Figure 11 reveals further evidence of impression management. The descriptions of each measure are ambiguous and may potentially baffle readers. For example, the percentage reductions in the annual carbon emissions of pre-2007 buildings have been adjusted to exclude additions and extensions. However, the statement does not disclose whether the reductions take account of disposal, and sale and leaseback of facilities; and from the discontinuation of overseas operations such as Tesco Japan which accounted for 6% of the company's carbon footprint. In relation to the second indicator of carbon efficiency among newly-built facilities, the statement is worded in a vague manner which leaves the reader uncertain of whether the intensity is measured as an annual reduction, or a reduction compared to base year 2007. Presumably it is the latter. If so, the data reveal little improvement over 2009-2011. However, the alternative view, arising from the inherent ambiguity in the narrative statement is quite different and suggests double-digit improvements in carbon intensity over successive years.

[23] "A way of seeing, is also a way of not seeing" (Poggi, 1965: p.248).

Tesco's style of reporting is noticeably different to that of Marks and Spencer. However, it employs a clever form of impression management which deflects critical attention away from contradictions between the demands of its business model and its need to be seen to be engaged with carbon reduction. Chief among its impression management strategies are selectivity and baffling with technical language. Recently, Tesco has attracted unfavourable attention in relation to its financial accounting, and this criticism accords with the characterisation of impression management as developed in this chapter:

> "A top 10 Tesco shareholder said the company's accounting methods were a "frustration" as "a big chunk of the market just looks at the headline numbers". "It is symbolic of what Tesco is all about at the moment, which is trying to make itself look better than it is because it's in a weak place" (Shah, 2013).

6.11 J. Sainsbury plc

The performance of Sainsbury, in common with other case study firms, presents opposing trends in absolute and relative performance (Table 10).

Table 10. J. Sainsbury- absolute and relative carbon emissions: 2006-2011

J Sainsbury	2006	2007	2008	2009	2010	2011
Absolute emissions (tonnes CO_2e)	726,398	658,186	700,147	724,000	711,000	856,000
Relative emissions (kg CO_2/ sq. ft)	48	42	43	43	40	45

Source: Author, using data from annual and corporate social reports

The company's 2011 annual report states that executive remuneration will be assessed according to a range of criteria, including 'respect for the environment'. This is further subdivided to include energy consumption and carbon objectives, as shown in Figure 12.

Figure 12. J. Sainsbury – carbon reduction objective (2011)

Source: J. Sainsbury plc (2011a: p.3)

Since 2007, the objective has remained to reduce emissions by 25% against the baseline by 2012. Interestingly, the baseline has changed twice since 2007: once in 2008 and a second time in 2011. No explanation was given for the 2007 change beyond a statement in the corporate responsibility report that the target had been updated. In the absence of any explanation, one is entitled to speculate. Reasons for the change might include:

1. To conform with expectations that the company would set a five year target, consistent with framing medium-term corporate objectives, or:
2. To roll-over the old target into a new target period, thereby avoiding the need to account for achievement or non-achievement in the short term.

In each case, increasing the baseline has made the target easier to achieve. Table 11 provides the supporting numbers.

Table 11. J. Sainsbury – carbon emissions per square metre objectives: 2006 – 2011[24]

CSR reporting year	Target reduction (% CO_2 emissions/m^2)	Baseline year	Baseline value (kg CO_2e/m^2)	Reported emissions (kg CO_2e/m^2)	Target (kg CO_2e/m^2)	Achieve target by
2006	5%	2005	465	485	442	2008
2007	25%	2005	465	469	349	2012
2008	25%	2006	485	421	364	2012
2009	25%	2006	485	439	364	2012
2010	25%	2006	485	416	364	2012
2011	25%	2006	660[25]	506	495	2012

Source: Source: Author, using data from annual and corporate social reports

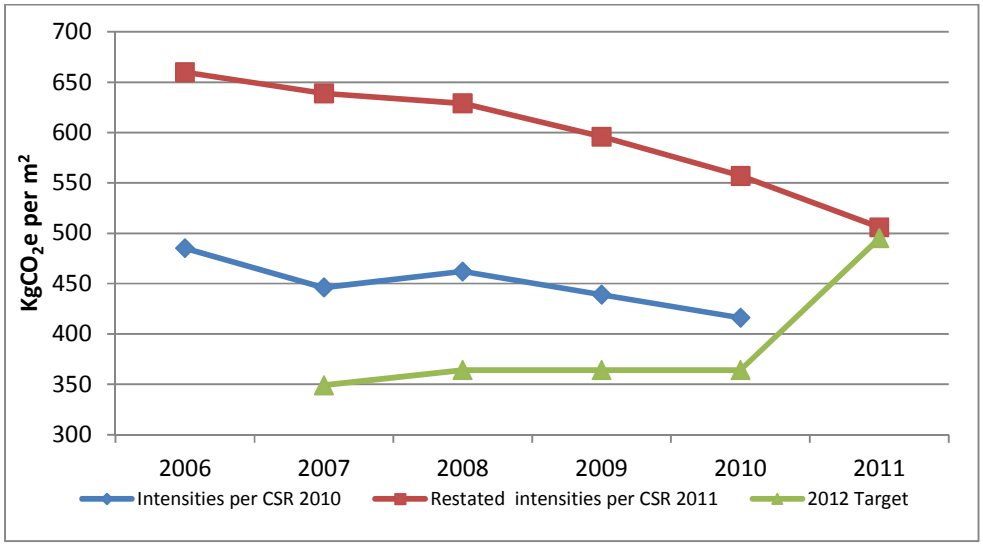
In 2011, J Sainsbury retrospectively restated its emissions data for the years 2006-2010. The corporate responsibility reports disclose that the basis of calculation changed from the GHG Protocol as at 2010 to the DEFRA 2010 Guidelines in 2011. These methods differ slightly in their definitions of direct and indirect emissions. The 2011 corporate responsibility report also states that the sales area used in the intensity calculation excludes checkout areas - something that has not been mentioned in previous

[24] Note that a factor of 10.76 is required to convert square feet into square metres.

[25] The 2005/06 baseline has been retrospectively restated in the 2011 corporate responsibility report when J. Sainsbury switched from using the GHG Protocol to the DEFRA 2010 Guidelines.

reports. The impact of this restatement exercise was not only to increase reported emissions for each year, but also the 2005/06 baseline, with interesting consequences, as shown in Figure 13.

Figure 13. J. Sainsbury – reported carbon intensity against 2012 target



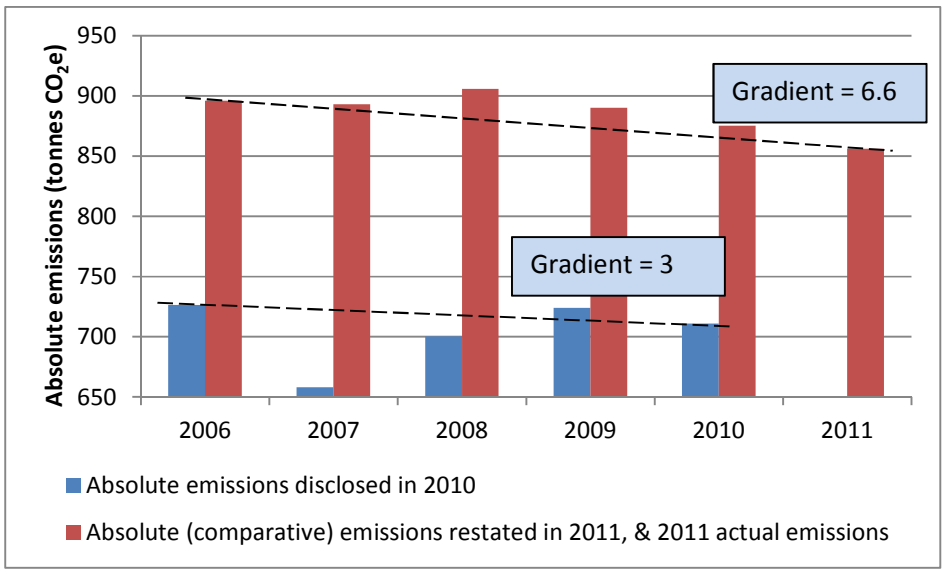
Source: Author, using data from annual and corporate social responsibility reports

Figure 13 plots the carbon intensity data reported in 2010, prior to the restatement, using diamond data points. The square data points represent the restated intensities disclosed in the 2011 corporate responsibility report. However, the main feature of Figure 13 is that it reveals the impact of the restatement on the target, which is derived from the 2005/06 baseline and which rises almost to the point at which it meets the 2011 performance. This is made possible because:

1. The entire data series is revised from 2006 – 2010, and
2. The restatement results in a progressive reduction in emissions against the baseline, and
3. The restatement presents a steeper reduction in emissions over the period that the series that it replaces, as shown in Figure 14.
4. The current year (2011) exists independently of the revisions, and has been estimated in advance.

Where conditions 1 to 4 apply, the deficit between the baseline emissions and current emissions will inevitably increase, making the target easier to achieve.

Figure 14. J. Sainsbury – restating emissions to facilitate target achievement[26]



Source: Author, using data from corporate responsibility reports

The timing of this effect may be attributed either to luck or to judgement given that it occurred only one year prior to the end of the objective period, making its achievement almost inevitable. Table 12 illustrates the effect of the restatement using numbers.

Table 12 shows that the annual reduction task has been relatively stable and consistent over the period 2006 – 2010, at around 25 kg CO_2e/ m^2 per annum, with the exception of an outlying value in 2008. If one assumes that diminishing marginal returns apply, then the task for each year after 2006 would appear relatively more challenging than the last. The restatement appears to make the completion of the objective far easier from 2011, and this confirms the impression given in Figure 13.

The evidence from the company annual reports suggests that the company's internal carbon target performance has been underwritten by clever use of the opportunity to revise the underlying basis by which the company has estimated its emissions. Once again, the evidence gathered by the research suggests an impression management strategy by which company reports provide a positive story of environmental responsibility, supported by carbon footprint disclosures which have been prepared according to recognised and respected carbon accounting guidelines.

[26] The comparative gradients, shown as dotted lines in Figure 14, illustrate that the reported rate of decline in emissions after the 2011 restatement is greater that the decline in emissions previously reported in 2010. Accordingly, as a consequence of the restatement, the impression of the company's carbon reduction track-record is enhanced.

Table 12. J. Sainsbury – annual reduction in carbon intensity required to achieve target

CSR reporting year	Annual carbon reduction objective (required annual reduction in kg CO_2/m^2)	
	Calculation – using data from Table 10	Annual reduction required (kg CO_2/m^2 per annum)
2006	(485 – 442 kg m^2)/ 2 years	21.5 kg/ m^2 per annum
2007	(469 – 349 kg m^2)/ 5 years	24 kg/ m^2 per annum
2008	(421 – 364 kg m^2)/ 4 years	14.25 kg/ m^2 per annum
2009	(439 – 364 kg m^2)/ 3 years	25 kg/ m^2 per annum
2010	(416 – 364 kg m^2)/ 2 years	26 kg/ m^2 per annum
2011	(506 – 495 kg m^2)/ 1 year	11 kg/ m^2 per annum

Source: Author, using data from corporate responsibility reports

6.12 Wm. Morrison Supermarkets

Wm. Morrison does not currently report its relative carbon emissions. Accordingly this chapter does not evaluate the use of relative emissions data by Morrisons in the case study. For completeness, however, Table 13 reveals that Morrisons' absolute emissions remain relatively static while their relative emissions, calculated in this work, decline progressively throughout the period of study.

Table 13. Wm. Morrison Supermarkets - absolute and relative carbon emissions (2006-2011)

Wm. Morrison	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Absolute emissions (tonnes CO_2e)	1,283,050	1,137,532	1,162,981	1,136,899	1,332,333	1,287,259
Relative emissions (kg CO_2/ sq. ft)	121	108	107	102	112	105

Source: Author, using data from annual and corporate social reports

6.13 Conclusions and implications for the research

This chapter introduces the case study by setting out the business model of the mixed-retail sector and locating the industry in its socio-economic context. The business model has been characterised by the rapid domination of an industry by a small number of powerful firms and the aggressive expansion of

their built estate. These attributes are highly significant in relation to the national carbon footprint. First, supermarket firms have become the default mode of retail provision in the case of one in every four pounds spent by United Kingdom consumers. Supermarkets have, in this way, become able to create new demand for carbon-intensive supply rather than simply satisfy existing demands. Second, because the business model depends on the rapid expansion of physical selling space, any improvements in carbon intensity have been outstripped by increases in capacity. In assuming the role of default provider and gaining control over the supply and distribution chains, supermarkets have incurred public expectation that they will use their expertise, power and resources to deal with the environmental impacts of increased consumption on their behalf.

The contextual setting of the mixed-retail firms is relevant because it provides a backdrop to the critical narrative of carbon reduction explored in the first research question. Here, it is necessary to consider the emissions reported by the supermarket firms against the national objective to which they claim to subscribe. The data compiled in this thesis reveals that the aggregate emissions of the four firms actually increases by almost 22% between 2006-2011, which is at odds with the direction required by the Climate Change Act objective to reduce absolute emissions. Specifically, evidence from three of the four case study firms reveals that increasing trends in absolute emissions are obscured by the reporting of relative emissions per square foot of retail space. With regard to the third research question, which considers the extent to which large firms within the FTSE100 have reduced their emissions since 2006, this research concludes that individually and in aggregate, the emissions of the case study firms have actually increased. Clearly the conclusion is drawn from case study evidence and may not be generalisable. It is, however, credible as it is based on data disclosed by the case-study firms, which represents an account of their performance using their own data. By way of caveat, the chapter explains why these data must be regarded as malleable because of the different boundary decisions made by reporting firms. Furthermore, the challenges associated with compiling the datasets for the case study firms have been evaluated in detail in Chapter 3. Presentation of these case study data also contributes to answering the second research question, because it demonstrates how physical datasets can be constructed to reveal carbon trajectory at firm level.

It is both relevant and timely to note that new regulations, introduced under the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 require, *inter alia*, that listed companies disclose at least one carbon intensity (relative) indicator in the annual report, alongside their absolute emissions. According to DEFRA (2013b) the process of 'normalising' emissions data is helpful because it

enables readers to compare data over time and across sectors and products. DEFRA argue that:

> "Normalised data can be particularly helpful in demonstrating environmental improvements in a growing organisation" (DEFRA, 2013b).

The analysis in this chapter suggests that large, growing companies already appreciate the scope to use relative data to enhance the impression of their environmental performance; and that what is needed instead are data that challenge, rather than confirm, the preferred narrative of the reporting firm. This thesis argues that, while relative KPIs can indeed be informative, permitting companies to choose a single indicator encourages selective disclosure rather than making carbon emissions more visible. A more effective approach would require the juxtaposition of multiple relative indicators to reveal trade-offs between different measures of carbon efficiency within a firm, and between financial performance and carbon efficiency. These findings, which arise from the case study evidence in this chapter, are revisited in Chapter 8 where they are used to demonstrate how innovative carbon risk benchmarking tools can be used to present multi-dimensional carbon and financial profiles for large companies.

Perhaps the main contribution of this chapter is its evaluation of the carbon performance disclosures made by Marks and Spencer, Tesco and J. Sainsbury. In each case, the research has found plausible evidence of impression management where managers use discretionary disclosures to "strategically…manipulate the perceptions and decisions of stakeholders" (Yuthas *et al*., 2002, p. 144). The research uncovered a range of strategies employed by these firms, including the manipulation of graphs to exaggerate effects or conceal changes in measurement bases from one year to the next, the use of technical language to baffle readers and the manipulation of measurement bases to facilitate the presentation of target achievement. This research has uncovered and decoded examples of attempts to gild reported carbon performance using disclosures that flatter the performance of the reporting firm. These disclosures have been cleverly (and probably expensively) drafted, and provide evidence that the supermarket firms attach considerable value to disseminating a positive impression of their strategic approach to carbon reduction.

This thesis argues that consumers expect supermarket firms to manage the environmental impact of externalities associated with consumption, on their behalf, and a perceived failure to comply with this expectation could lead to a loss of public trust.

It is likely that these disclosures were prepared by external consultancies employed by the supermarket firms. If this assumption is correct, then it is prudent to consider that the same consultants will be providing similar services to other clients, and the implication is therefore that similar disclosure practices exist among other large firms. Further research is required across a broader range of companies in order to investigate the generalisability of these findings.

These disclosure practices conform to what Jones describes as creative accounting:

> "'Using the flexibility in accounting within the regulatory framework to manage the measurement and presentation of the accounts so that they give primacy to the interests of the preparers not the users'. Creative accounting is therefore seen as working within the system. It is thus not illegal. Companies using creative accounting are not breaking the law, just using the flexibility in accounting to serve their own interests" (Jones, 2011a: p.5).

Thus while this activity is neither fraudulent, nor illegal, the effect of creativity is to reduce the credibility of accounting information once it has been discovered.

The chapter began with a version of the narrative of presumed intention to reduce collective carbon emissions in line with mandated national objectives, modified to fit the case of United Kingdom mixed-retail sector. It aims to contribute to answer the first research question, which is concerned with critical alternative narratives of carbon reduction credibility; in this case, at firm level. At this stage of the analysis it is possible to use the accounting numbers disclosed by the supermarket firms to construct a critical alternative narrative, as follows:

> 'The FTSE100 supermarket firms claim to be strategically aligned with the government's objective to reduce absolute carbon emissions as stipulated by the Climate Change Act. However, the evidence taken from accounting reports, suggests that the absolute emissions of the mixed-retail firms are set on a contrary upward trajectory. To counteract the impression given by their performance trends, at least three of these four firms have responded by using creative accounting strategies to manipulate the perceptions and decision-making of stakeholders'.

Chapter 7 conducts a more detailed analysis of the published narrative statements of mixed-retail firms. In closing, this chapter concludes that carbon footprint accounting among large corporations is made malleable by variable discretionary decisions regarding the location of the organisational and operational boundaries used to frame reported emissions. Furthermore, the carbon performance

disclosure of the FTSE100 mixed-retail firms is compromised by impression management and creative accounting; and that these practices impair its credibility. Where absolute carbon reduction conflicts with the financial purpose of the business model, the latter will clearly prevail; yet the firm will simultaneously adapt its reporting strategy to avoid incurring a cost to its legitimacy. To the extent that this strategy succeeds, it becomes more difficult to use accounting information to discern the credibility of disclosed carbon reduction strategies among the FTSE100 firms located in this sector.

Chapter Seven

Micro analysis: exploration of narrative and credibility

7.1 Introduction

This chapter continues the mixed-retail sector case study to incorporate the evaluation of carbon narrative statements. Specifically, it is directed towards the fourth research question:

> **RQ4.** Can narratives be extracted and categorised to reveal different levels of carbon reduction credibility within large corporations.

Consistent with Chapter 6, the case study bases its investigation on Tesco, J. Sainsbury, Wm. Morrison Supermarkets and Marks and Spencer. In addition, the case study introduces Associated British Foods, a major supplier of manufactured foods to the mixed-retail sector and a fellow FTSE100 constituent. The inclusion of a major stakeholder from an ancillary industry is intended to reveal similarities and contrasts in the scale and scope of carbon reduction narratives.

This chapter is organised in two main parts.

The first part constructs a structured thematic analysis of carbon narrative statements in annual and CSR reports. It investigates how firms incorporate notions carbon reduction into narrative disclosures, and sets out to determine the extent to which these statements have relevance (predictive or confirmatory value).. In this first section, the term 'narrative statement' is applied generally to disclosures made in accounting reports, because it enables an appraisal of structure, scope and scale.

The second part 'drills down' into a specific application of narratives and numbers analysis, where executive compensation schemes present an empirical site in which narrative statements (carbon reduction objectives) are confronted with numbers (bonus payments). This constitutes a 'laboratory' in which the research explores the alignment of 'saying and doing', demonstrated by the extent to which compensation schemes reflect engagement on the part of managers and shareholders.

7.2 Narratives in disclosure

In addition to numbers, general-purpose financial reports contain narrative statements that set out qualitative information. This chapter introduces the term 'narrative statements' to distinguish the form of disclosure encountered in corporate reports with the more comprehensive notion of 'narrative'. In the former case, narrative statements usually represent claims of intention, objectives or expressions of value. These are 'fragments' of narratives. Narratives, by contrast, are stories: more structured entities with a beginning, middle and end. Using a financial example:

> "the company narrative … ideally takes a before and after form: *ex ante*, the firm and its management strategy is represented by the corporate CEO as purposive action for financial results, which is then *ex post* vindicated by the achievement of positive financial numbers on earnings which are celebrated by management, analysts and business press" (Froud *et al*., 2006: p.126).

Disclosures are used to provide a complementary explanatory dimension that goes beyond what can be achieved by numbers alone. It is generally recognised that narrative statements are well-suited to providing non-financial and forward-looking information, and that they tend to feature prominently in voluntary reporting (Beattie *et al.,* 2004). Narrative statements are particularly suited to articulating conceptual matters – such as intention, or engagement – where the meaning is nuanced. Unlike conversational narrative, which may be revealing in its spontaneity, written annual report narrative statements are deliberately crafted; often by professionals from external consultancies. Often, written statements are as revealing for what they omit as for what they include.

According to the *Conceptual Framework for Financial Reporting*, the principles informing disclosure flow from the objectives of general purpose financial reporting (IFRS Foundation, 2010). While this strictly applies to company annual reports, the same principles should be applied within separate CSR reports. Therefore, disclosures should be subject to the qualitative characteristics of accounting information established in the *Conceptual Framework*. These are displayed diagrammatically in Figure 1.

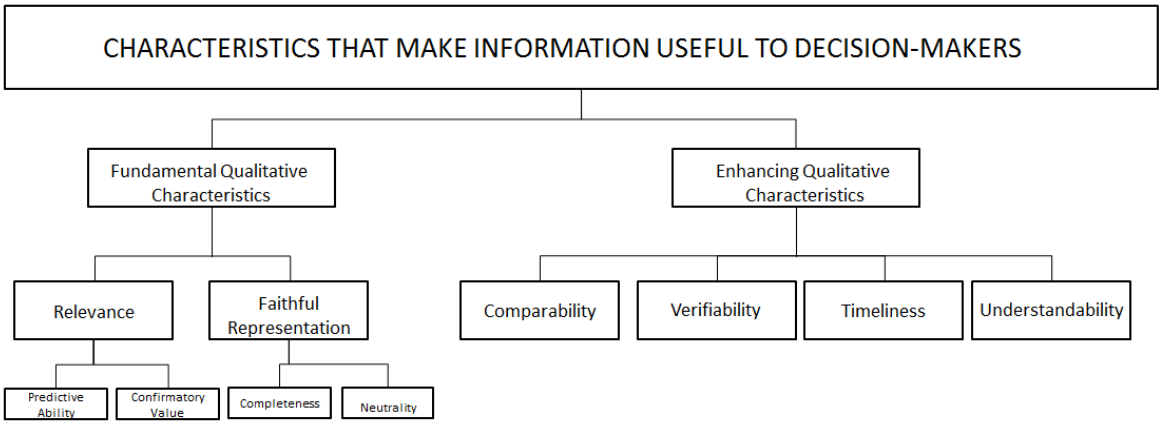
Figure 1 reveals how the qualitative characteristics of accounting support decision-usefulness. Relevance is critical to decision-usefulness, and is manifested through predictive ability and/or confirmatory value. All of these characteristics are transferable to carbon disclosure, because stakeholders will be concerned

to incorporate exposure to carbon risk within their decision-making. This is becoming more evident for those investors who wish to take account of the carbon risk of their portfolios:

> "Over the past few years, institutional investors have developed a sophisticated understanding of the implications of climate change and climate change policy for their investments. GHG emissions are relevant to investors particularly because they can be a source of two types of financial risk: i) regulatory risk, and ii) reputational risk. When analysed together, these two risk categories can be jointly referred to as 'carbon risk'.
>
> To account for carbon risk, institutional investors need to understand their overall risk exposure through ownership of investee companies and be able to assess changing conditions (for instance: regulatory, physical, demand patterns, etc.) in order to identify sources of risk for companies, sectors and geographies" (UNEP FI, 2013; p.6).

Disclosures may have confirmatory value if they support the stakeholder's previous assessment of the credibility of the firm's declared carbon reduction strategy and its performance. Alternatively, they may have predictive ability where disclosures enable the stakeholder to appraise the organisation's carbon risk.

Figure 1. Qualitative characteristics of accounting information



Source: Kothari & Barone (2011: p.48). Reproduced with kind permission of the authors.

Disclosure is not neutral because it originates from managers (and accountants) who are assumed to be motivated by self-interest. At the outset of the research, it was anticipated that managers would phrase disclosure to flatter management's carbon credentials. It was also expected that narrative statements would use imprecise language designed to frustrate accountability.

7.3 Thematic content analysis

The first part of the research constructs a database containing narrative statements stripped from the annual reports and CSR reports of the case study firms. The aim of the database is to permit the sorting of these statements into like categories that reveal the underlying structure of decision-useful carbon disclosures.

It was originally intended that the database would extract narrative statements from each company's 2006 and 2011 corporate reports in order to observe inter and intra-thematic shifts over time. These reports were accessed in the case of Tesco, J. Sainsbury and Marks and Spencer. However, as at 2006 neither Associated British Foods nor Wm. Morrison Supermarkets produced CSR reports. Unusually, Associated British Foods publishes CSR reports on a three-year cycle. Accordingly, the database accesses only the 2010 and 2011 CSR reports for Associated British Foods and Wm. Morrison respectively.

The dataset was compiled using a Microsoft Excel spreadsheet. On completion, it held 713 narrative statements, stripped from 18 corporate reports. A number was assigned to each, to facilitate counting and identification, and as each narrative statement was categorised, it was assigned a signifier of '1' to enable sorting, and counting by category. The database eventually comprised 173 pages, and was therefore too large to append to this thesis. A copy has been retained and is available for inspection on request. However, for practical purposes, a sample page is located in Appendix K, and the totals of each category extracted from the database are presented later in this section in Table 3.

Using pdf copies of annual and CSR reports, the researcher used the 'Ctrl + F' facility to perform a keyword search for appropriate carbon-related narrative statements. 32 keywords were chosen that directly describe carbon footprint, or that refer to environmental themes that encompass carbon reduction, and these are listed in Table 1.

Table 1. Keywords used as search terms for carbon-related narrative statements

Commit	Committed	Commitment	Environment
Environmental	Environmentally	Stakeholder	Sustainable
Sustainably	Sustainability	Greenhouse	Emissions
Carbon	CO_2	Methane	CH_4
Nitrous	N_2O	Responsibility	Responsible
Responsibly	Climate	Engage	Engages
Engagement	Energy	Refrigeration	Refrigerant
Refrigerator	Refrigerators	Refrigerated	Footprint

Source: Author

713 Narrative statements containing keywords were extracted and recorded verbatim on the database spreadsheet. Then, each of these statements was categorised using a thematic structure designed by this researcher. Using an adaptation of Omanson's (1982) analysis of the structure of narratives, the database is organised around a core of three main categories of central, supportive and distracting content.

> "Central content is judged as more important, and is better recalled, than Noncentral content, and its recall is enhanced by Supportive, but impaired by Distracting, content" (Omanson, 1982: p.195).

Supportive content is secondary and subsidiary to central content:

> "Supportive content includes … characterizing units describing the main characteristics or the setting of Central or Supportive units" (Omanson, 1982: p.206).

Beyond central and supportive content, all other narratives belong to a residual category which Omanson describes as 'Distracting', and which tends to disrupt rather than enhance decision-usefulness. This research adapts Omanson's characterisation by subdividing distracting narrative content into six sub-categories; 'Vague Statements', 'Hollow Statements', 'Badge Collecting', 'Reflected Glory', 'Deflectors' and 'Immaterial'. Table 2 complies these content categories and subcategories into a taxonomy.

Table 2. Taxonomy of carbon reduction narrative statements

Central content	**Definition**
Past	Memorable, active narrative statements describing past actions
Present	Memorable, active narrative statements describing present actions
Future	Memorable, active narrative statements describing intended future actions
Supportive Content	**Definition**
Legitimacy	Narrative statements that support central narratives, describing or confirming a minimalist environmental strategy.
Competitive advantage	Narrative statements that support central narratives, describing or confirming a strategy that attempts to improve the firm's economic position as a result of its environmental actions.
Enlightened management	Narrative statements that support central narratives, describing or confirming a strategy in which the firm is an ecologically sustaining entity; not merely an economic unit.
Distracting Content	**Definition**
Vague statement	A statement of desire or general intent which is unspecific in terms of quality or extent, which by its nature cannot be used to commit the actor to following through.
Badge collecting	Claimed recognition by a named organisation, from which the reader is expected to infer a commitment to a virtuous cause.
Hollow statement	Usually a statement of fact, or a description of a state of being which does not connect with any intention, objective or past action.
Reflected glory	Often takes the form of a case study, in which a third party supplier is held up as a leader or innovator. In using the case study, the story-teller hopes that the reader will infer an association which may not exist.
Deflector	A statement which implies a meaning to a phenomenon or behaviour, which cannot be justified. Deflectors are of questionable relevance.
Immaterial	A 'grand statement', or 'grand claim', which on further investigation is shown to have insignificant impact.

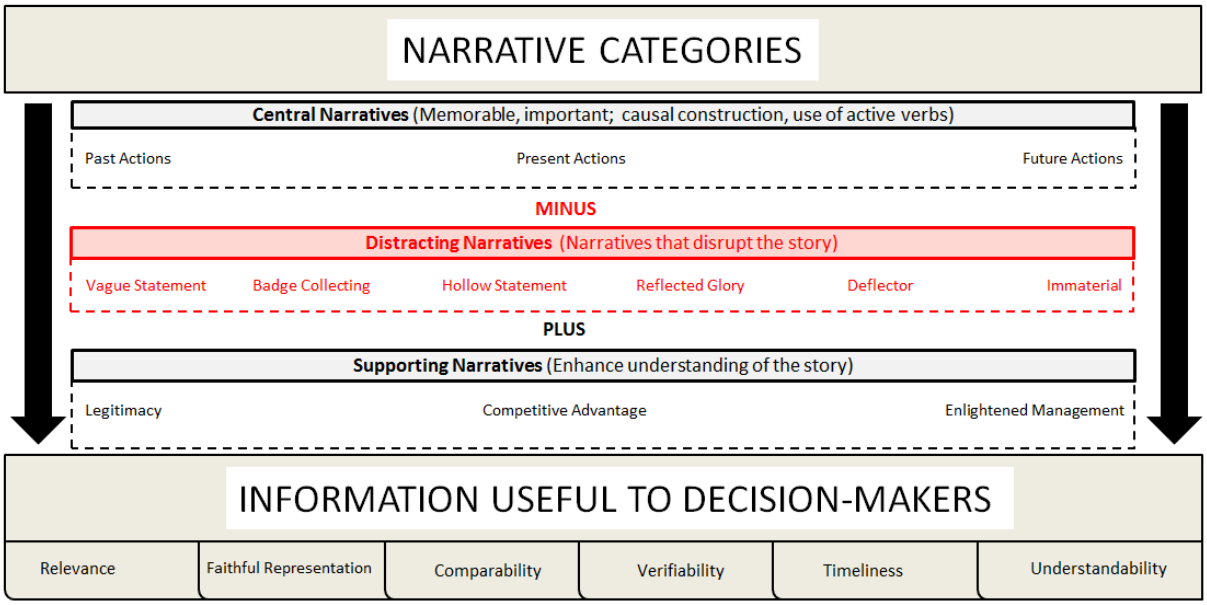
Source: Author, using original categories alongside others identified by Omanson (1982), Dillard *et al.* (2005)

7.4 Theoretical application of the taxonomy

The taxonomy allows one to explore how narrative statements may be structured and organised if they are to satisfy the criteria of decision-usefulness established in the *Conceptual Framework*.

Figure 2 resembles a 'sandwich' in which the constituent layers of filling (content categories) determine the flavour (decision-usefulness of information). It illustrates how central and supportive content contribute to decision usefulness, when information possesses the qualitative characteristics of accounting information. These are displayed as 'index tabs' to signify that the presentation of decision-usefulness is complete, exclusive and non-redundant. Additionally, Figure 2 also shows how distracting content detracts from decision-usefulness, by counteracting the positive characteristics of central and supportive content. Thus, decision-useful information combines central and supportive with minimal distracting content.

Figure 2. The structure of narrative statements and decision-usefulness



Source: Author, adapted from Omanson (1982); Dillard *et al*. (2005)

7.5 The taxonomy observed

The taxonomy is used to evaluate the decision-usefulness of carbon-related disclosures by counting the frequency with which different narrative categories arise in the 2006 and 2011 company reports. But first, it is necessary to demonstrate the application of the taxonomy in the narrative statements of the case study firms.

'Central content' has causal construction, indicated by active verbs, which can describe past, present or future actions. Central content has a high degree of relevance. Its memorability is enhanced by the inclusion of specific features such as numerical measurements:

> "On Climate change, we've improved energy efficiency in our stores by 23% (after weather adjustment) and warehouses by 24% against 2006/07. We've also met our target to improve the fuel efficiency of our delivery fleets by 20%. Our total carbon emissions have been reduced by 13%, down by over 90,000 tonnes CO_2e from 2006/07 whilst our sales floor footage has continued to grow" (Marks and Spencer plc., 2011b: p.2).

'Supportive content' is complementary to central content and contributes to our understanding of the nature of environmental strategy. Supportive content is relevant, and may also contribute to faithful representation, where it describes the nature of disclosed strategies. Dillard *et al.* (2005) describe three strategic specifications – legitimacy, competitive advantage and enlightened commitment.

Legitimacy refers to a compliance-based approach at the minimalist end of the environmental strategy continuum:

> "We had no environmental prosecutions in 2005/06" (Marks and Spencer plc., 2006: p.28).

> "Why energy efficiency? Improving energy efficiency reduces costs and helps to meet the requirements of new legislation effective from 2011" (Marks and Spencer plc., 2011a: p.11).

The mid-range of the strategic continuum is described as 'competitive advantage' where improved access to markets and profits motivates environmental behaviour:

> "This Review is a summary of some of the work we undertake to ensure that in going about our business, we meet our customers' expectations of corporate responsibility. We see the commitments we have made as an investment in our future" (Wm. Morrison Supermarkets plc., 2011b. p.1).

Ultimate environmental strategy resides in the state of 'enlightened management', where managers construe the firm to be primarily an ecologically sustaining unit, above being an economic entity:

> "Critically, our wider carbon emissions programme is part of a recognised collective response to the global issue of climate change" (Wm. Morrison Supermarkets plc., 2011b: p.25).
>
> "Being closer to source means we are well placed to ensure these products are responsibly produced. This means that their environmental impact is properly managed, workers' rights are upheld, animal welfare standards are maintained and suppliers are treated as partners" (Wm. Morrison Supermarkets plc., 2011b. p.4).

Distracting content is neither relevant, nor does it contribute to faithful representation. Its effect is to dilute relevance and faithful representation of aggregated disclosure. Within this category, 'vague statements' attempt to convey an impression without being sufficiently specific to make the statement credible. In a sense, they appear to try and obtain 'something for nothing' by expressing intent without substance, making it difficult to follow up these statements in future and frustrating comparability and verifiability:

> "We are showing leadership, sharing our knowledge, learning from others and taking practical steps to reduce our energy use and greenhouse gas emissions" (Tesco plc., 2006a: p.52).
>
> "We're already thinking hard about what our aim to become the world's most sustainable major retailer means. Thankfully, in our external advisory board, we've secured the help of an impressive group of people who can assist us on the journey ahead" (Marks and Spencer plc., 2011b: p.3).

In a similar vein some firms include 'hollow statements' in their reports. Rather like 'motherhood and apple pie', such narratives make uncontroversial statements which remain disconnected from specific activities or attributes of the firm. While conveying an impression, hollow statements lack relevance:

> "Climate change, water scarcity, over-exploitation of resources and unsustainable farming practices all seriously threaten our food security and the long-term sustainability of agricultural production" (J Sainsbury plc., 2011b: p.44).
>
> "A brand is a promise, a set of fundamental principles that define a product or business. It is an intangible representation of what a company stands for in the minds of its customers and other stakeholders" (Tesco plc., 2011a: p.38).

Distraction is also encountered in 'badge collecting', where a reporting firm declares that it has been recognised by a prestigious or worthy organisation. This is an attempt to exploit the power of association, aimed at prompting an unquestioning attitude by the public towards the 'halo' organisation:

> "As a responsible company, Tesco works hard to bring real benefits to the communities we serve, the environment and the economy. This is recognised through our inclusion in the FTSE4Good and Dow Jones Sustainability indices" (Tesco plc., 2006b: p.12).
>
> "We were the leading supermarket in the ENDS Carbon FTSE CDP Index for Carbon Management and received four Cooling Industry Awards for our refrigeration programme" (Wm. Morrison Supermarkets plc 2011b: p.1).

Similar to badge collecting, 'reflected glory' appropriates reputational benefits from case studies that describe the achievements of other parties. In these cases, narrative statements are often silent on whether the reporting firm has made specific and tangible contributions to these achievements. Depending on the circumstances, silence may be tactical:

> "Nature's Choice gold standard growers, A Pearson & Sons have supplied Tesco with tomatoes since 1992. Their innovative combined heat and power unit heats the greenhouses and surplus electricity is sold to the National Grid. The CO_2 emissions are recycled into the greenhouses and are absorbed by the crop reducing overall emissions by 3,000 tonnes CO_2 a year" (Tesco plc., 2006a: p.61).
>
> "Neos Estate, South Africa, has supplied Tesco with grapefruits for over five years. The farm is Nature's Choice certified and has worked hard to reduce its impact on the environment by using power from its own hydro-electric power plant, rehabilitating wetland and setting up an indigenous tree nursery to grow and plant native trees" (Tesco plc., 2006a: p.61).

The use of 'deflectors' in carbon reporting resembles the tactic of 'changing the subject' in a conversation. Deflectors detract from relevance. They may be striking, or they may 'twist' the facts in order to reorient the argument:

> "In the UK, our Greener Living products help our customers make greener choices, and the Greener Living website provides advice on how customers can cut their carbon footprint. 37% of visitors to the website say they have changed their behaviour as a result, and 28% say they have purchased a green product after visiting the site" (Tesco plc. 2011b: p.29).
>
> "Reduction in CO_2 emissions … shows the overall year-on-year reduction in greenhouse gas emissions from existing stores and distribution centres built before 2006/7, adjusted to exclude emissions from acquisitions and extensions" (Tesco plc., 2011a: p.48).

The final sub-category of distracting content is the 'immaterial statement'. In some cases, an impressive-sounding initiative yields an outcome that is simultaneously opaque and modest.

> "Additionally, we are donating 'Acre in a box' packs to Sainsbury's Dairy Development Group farmers, providing enough saplings in each box to plant an acre of trees. Over 30 farms have taken up this offer this year, enhancing biodiversity and improving the carbon footprint of their farm. This initiative complements the tree planting commitments of our Woodland chicken and egg farmers, who have already planted over 500,000 trees on farms all over the UK" (J Sainsbury plc., 2011b: p.47).

While the previous statement sounds impressive, the Forestry Commission (2013) estimates that one tree can sequester up to 2 kg CO_2 per annum. Thus 500,000 trees would absorb no more than 1,000 tonnes of CO_2 per year.

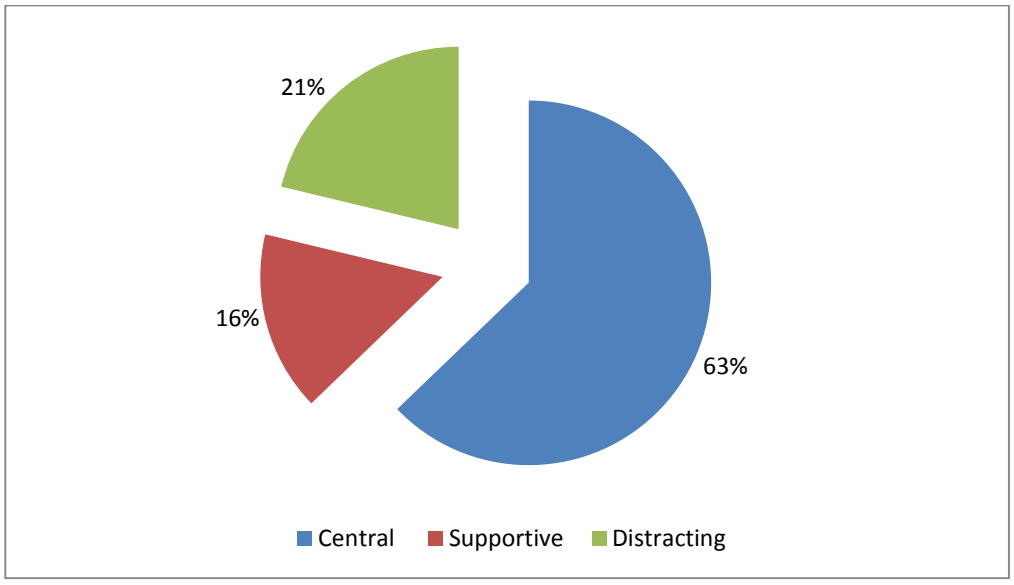
7.6 Thematic content analysis

On completion, the database enables the researcher to count narrative statements by category and to evaluate the decision-usefulness of the carbon-related disclosures. Narrative statement frequencies are listed in Table 3, which is prepared from the large database spreadsheet represented in extract by Appendix K. It is clear from these data that the CSR report is the more favoured vehicle for carbon reporting, accounting for 72% of aggregated carbon-related disclosures with only 28% featuring in the annual report. There is also considerable variation between firms, with Tesco making the most numerous disclosures. Associated British Foods makes relatively few disclosures. This is unsurprising as Associated British Foods is not a supermarket operator and does not deal with retail customers. It is therefore less directly exposed to public opinion[27].

Turning to the three primary disclosure categories, Figure 3 reveals how almost two-thirds are 'central', and nearly 80% are potentially decision-useful, being either 'central' or 'supportive'. Depending on their quality, these disclosure categories can contribute to relevance by revealing actions (past, present or future) and may aid faithful representation by describing the rationale for these actions. Conversely, it is concerning that more than one-fifth of disclosures are distracting and potentially disruptive to decision-usefulness.

[27] This statement should be qualified in that Associated British Foods operates the British clothing retailer Primark. However, the clothing business arguably has a different relationship with the public to supermarkets; its offering is distinctly value-oriented and its trading style is distinct from the name of its corporate owner.

Figure 3. Tesco, J. Sainsbury & Marks and Spencer, Wm. Morrison and ABF – carbon related narratives by mix (%)



Source: Author, using data obtained from annual reports and CSR reports.

Table 3. Summary of carbon-related disclosures by narrative statement category (Total: 198 + 515 = 713)

Report Type		Company					Year			Narrative Category			Narrative Sub-Category					
AR = 1	CSR = 1	Tesco	Sainsbury	Wm. Morrison	M&S	ABF	2006	2010	2011	Central	Supportive	Distracting	Present	Future	Past	Legitimacy	Competitive	Enlightened
198	515	225	161	75	155	97	251	65	397	461	117	157	354	59	48	19	40	19

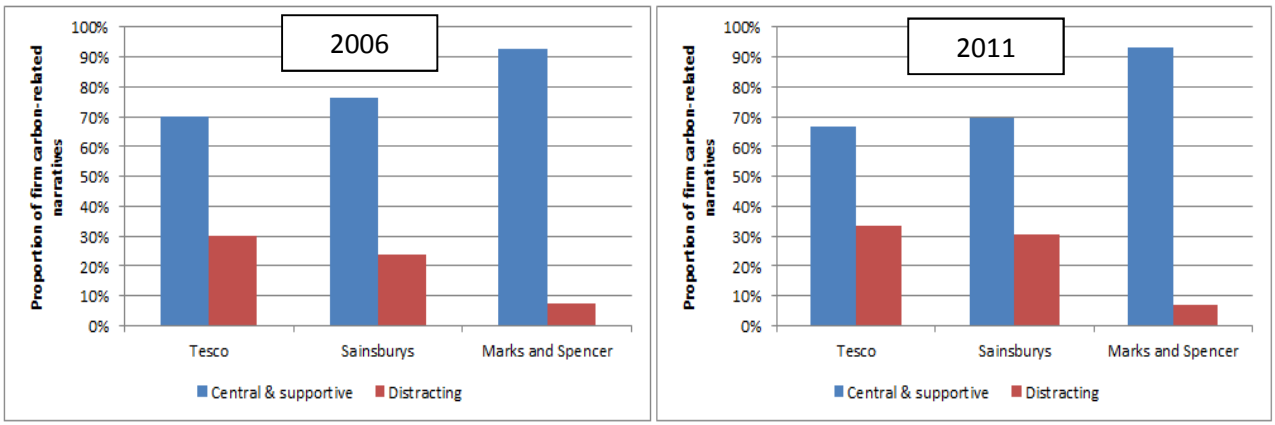
Issues																					
Stakeholder Engagement	Take Responsibility	Public Target	L-Term Planning	S-Term Planning	Refrigeration	Renewable Energy	Energy Efficiency	Transport Efficiency	Balancing Priorities	Accounting	Accountability	Policy	Governance	Pledge	Investment	Performance	Industry Collaboration	Product	Research	Process
173	17	33	65	38	26	44	77	38	17	80	8	25	54	7	31	57	4	83	31	136

Source: Author, using annual reports and corporate responsibility reports

Note: Differences when totalling may arise where more than one issue is attributed to a single narrative statement

For Tesco, J. Sainsbury and Marks and Spencer, the database contains 541 disclosures in the central, supportive and distracting categories, and these are subdivided into 217 narrative statements in 2006, and 324 in 2011. These data are analysed and presented in Figure 4, to determine whether the narrative statements reveal any differences in disclosure practices between firms and for individual firms over time. The charts combine central and supportive disclosures, which are potentially decision-useful, plotting them alongside distracting disclosures for each firm. The values are calculated as percentages; for example, 70% of Tesco's 2006 carbon-related disclosures were either central or supportive while the remaining 30% were distracting. In 2011, Tesco's central and supportive disclosures had fallen slightly to 67% and its distracting disclosures increased to 33%.

Figure 4. Tesco, J. Sainsbury and Marks and Spencer - variation in disclosure content over time



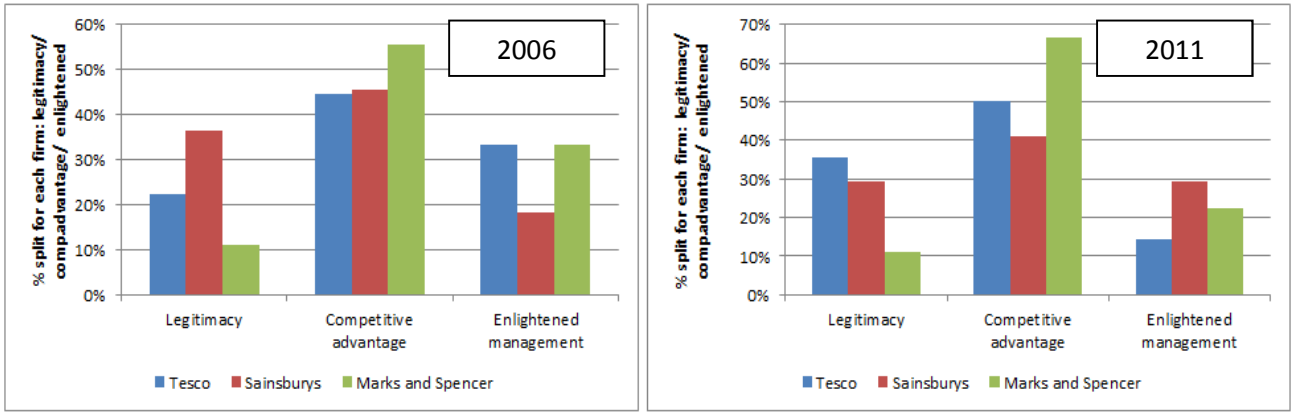
Source: Author, using data from annual reports and corporate responsibility reports

Figure 4 shows how individual firms present reasonably consistent disclosure profiles over successive periods. These profiles, each described by a characteristic proportion of central/supportive and distracting content, imply the existence of individual disclosure strategies among firms.

If carbon narrative statements can be analysed to reveal distinct disclosure strategies, then this opens up the possibility of using disclosures to distinguish between different levels of carbon reduction credibility among different firms. Although categorising disclosures is subjective, the number of narrative statements in the sample is large and the taxonomy contributes structure to the process. This provides some reassurance that the patterns exhibited in the data are reliable rather than being attributable to chance. However, further interpretation of these patterns requires caution because the quality of disclosures has yet to be determined.

Continuing the structural analysis, Figure 5 separates supportive narrative statements into 'legitimacy', 'competitive analysis' and 'enlightened management' subcategories for each of the three supermarket firms. In this case, there are fewer narrative statements than before, with only 78 supporting disclosures (29 in 2006, 49 in 2011). However, once again, the chart reveals a reasonably consistent pattern of individual disclosure among individual firms in 2006 and 2011. Each firm makes a higher proportion of competitive advantage disclosures relative to the other supportive subcategories. J. Sainsbury has shifted its disclosure style towards competitive advantage and enlightened management, and away from legitimacy. Tesco appears to be shifting slightly in the opposite direction, increasing the proportion of legitimacy and competitive advantage disclosures at the expense of enlightened management, while Marks and Spencer has converged around competitive advantage disclosure, reducing its claims to enlightened management. These observations provide initial indications that each company is staking its claim to an individual stance on environmental strategy, which differs from those claimed by its peers. However, additional qualitative narrative analysis is required in order to support these findings.

Figure 5. Tesco, J. Sainsbury and Marks and Spencer - variation in supportive content over time

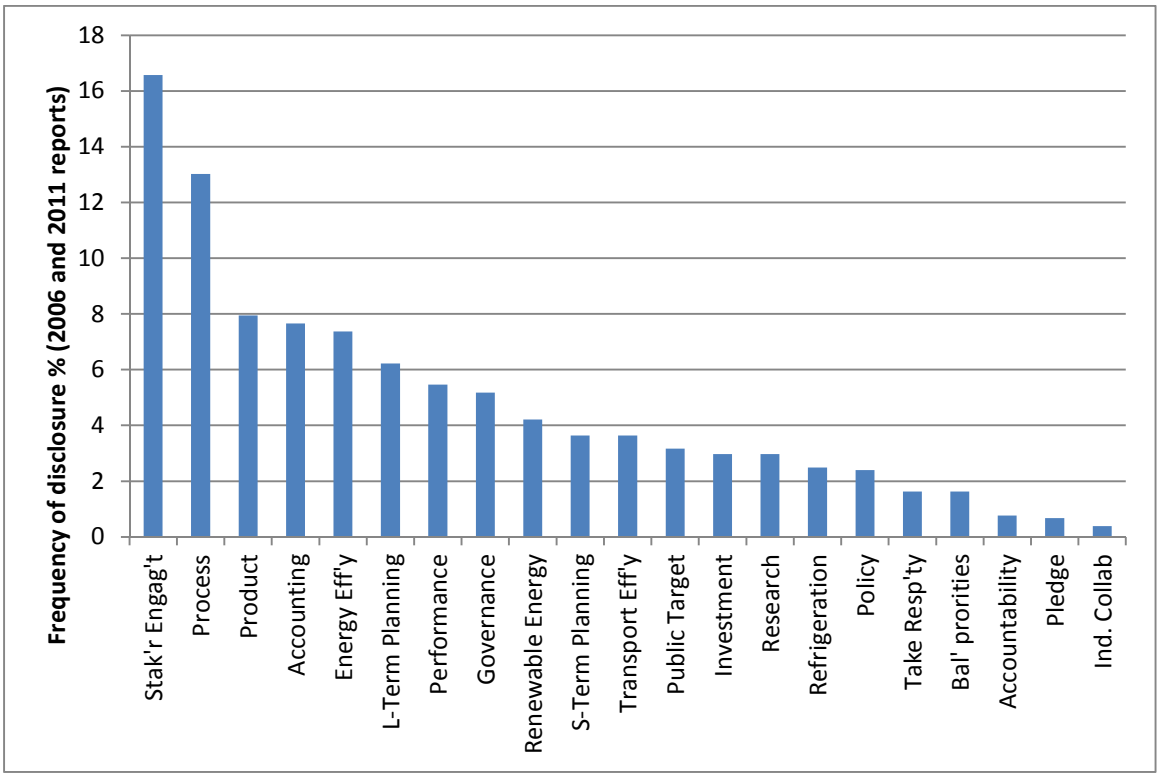


Source: Author, using data from annual and CSR reports.

In addition to the above, the researcher has grouped the 713 narrative statements from Table 3 into 21 separate issues associated with corporate climate change policy. These are quantified in Table 3, and charted in Figure 6 which shows that stakeholder engagement and processes linked to carbon generation and reduction dominate disclosure, making up 16% and 13% of total narrative statements respectively.

Other themes feature with diminishing frequency. The disclosure of carbon-related themes is therefore typically broad and shallow, which limits the information content of a given field of disclosure.

Figure 6. Frequency of carbon-related issues within case study narrative statements



Source: Author, using data from annual reports and CSR reports

So far, the research has used thematic content analysis to establish the scope and scale of narrative disclosures used by each of three FTSE100 mixed-retail firms. However, while this provides useful insight into the way in which content is organised, it cannot be used to decode the text of narrative statements or to expose their richness, nuance and texture. Categorising and counting indicates that differences exist between these firms at the strategic level, and it then becomes necessary to determine whether this translates in differences in the quality of strategic intent. The next section adopts a semantic approach as the investigation of narrative statements enters the qualitative phase.

7.7 A semantic analysis of carbon-related narrative statements

The aim of research question (RQ4) is to investigate the credibility of carbon reduction within large firms. The study must be further refined to meet this purpose, and the researcher has chosen to revisit the 713 disclosures and locate carbon-specific narrative statements in the present tense that include the stem ‘commit-’ within their syntax. For obvious reasons, the word ‘committee’ is excluded. The purpose of this focused keyword search, and the subsequent analysis, is to assess the credibility of statements of intent that have been declared as commitments.

The logic of this approach is that managers are likely to use 'commit- words' when they wish to emphasise the credibility of their carbon reduction strategy in the clearest and most direct way. However, because the word 'commitment' is ambiguous, and describes many possible states of mind, it will be necessary to interpret the way in which 'commit- words' are employed in the narrative disclosures. This involves interpreting the nuances in narrative statements and their effect on meaning, where the verbatim quote lays bare the richness and texture of expression. Some narrative statements reproduced in this section lack 'commit-words' because, in the interests of economy, lengthy statements have been shortened into relevant extracts. However, to ensure that the investigation is not unduly restrictive, it is first necessary to consider whether it is necessary to widen the search criteria to take account of synonyms used in place of 'commit' in the corporate reports.

Roget's Thesaurus offers three first-level synonyms for 'commit'; each accompanies by a selection of second-level synonyms, as shown in Table 4. Roget preferred the descriptor 'correlative terms' in place of 'synonyms'. Although this research refers to 'synonyms' for simplicity, Roget's meaning is relevant because it implies similarity in use rather than identical meaning:

> "The study of correlative terms existing in a particular language may often throw valuable light on the manners and customs of the nation using it" (Roget [1852] 1966: p.xix)

Table 4. Commitment synonyms

First-level synonym	***Second-level synonyms***
Affirm	*Endorse, commit oneself*
Promise	*Undertaking, engagement*
Incur a duty	*Make it one's duty, take on oneself, commit oneself, pledge oneself*

Source: (Roget [1852] 1966: pp.204, 303, 368, 452)

Among the second-level synonyms shown in Table 4, 'engagement' is instantly recognisable as a commonly used term in contemporary corporate reports, which is also well-used in the context of environmental reporting. Accordingly, the researcher rechecked the original 713 narrative statements and isolated all that contained words with the stem 'engag-'. There were 29 such statements. Of these, only one specifically addressed carbon reduction. On this basis, it was decided to restrict the narrative statement analysis to those disclosures that are carbon-specific, in the present tense and which feature 'commit-' words (excluding 'committee').

Sifting these statements yielded very few results, with only 19 instances meeting these criteria. These are distributed between the case study firms, and over time, as shown in Table 5.

Table 5. Number of carbon-specific commitment narrative statements by firm and over time

Case study firm	2006	2010	2011
Tesco	3		0
J. Sainsbury	1		4
Marks and Spencer	2		3
Wm. Morrison Supermarkets	1		4
Associated British Foods	0	1	
GRAND TOTAL	**7**	**1**	**11**

Source: Author, using data obtained from annual reports and corporate responsibility reports

Table 5 reveals that the case study firms made increasing use of the word 'commitment', in relation to carbon reduction over the two comparison periods. However, the small size of the sample makes it impossible to generalise from these findings. Once again, Associated British Foods is noticeable for making the least use of carbon commitment statements.

Reporting firms vary in the degree to which they specify their intentions. Similar in style to 'badge-collecting', 'boilerplate' disclosures state the firm's subscription to an industry-wide covenant such as the Courtauld Commitment:

> "In 2010, we signed up to the second phase of the Courtauld Commitment, alongside other retailers, collectively to reduce the carbon impact of packaging in the food retail sector, by 10% by the end of 2012. This means we have committed to reducing our packaging by weight, increasing the amount of packaging that can be recycled and increasing the recycled content" (Wm. Morrison Supermarkets plc., 2011b: p.20).

Such declarations are meaningful where they demonstrate a willingness on the part of management to risk reputation against non-fulfilment. But these disclosures also serve to 'buy time' for the firm, in the absence of more demonstrative statements of credibility. They are also difficult for stakeholders to follow up and judge the effectiveness of the individual firm's actions, and the credibility of management where the outcome of the covenant is pooled among many collaborating

firms. This criticism detracts from the decision-usefulness criteria of comparability and verifiability. Some disclosures appear to exploit this ambiguity:

> "In September 2010, WRAP [Waste and Resources Action Programme] announced that the first and third of these targets had been achieved, with total packaging remaining constant rather than showing absolute reductions. *The group is pleased to have contributed to this achievement*" (Associated British Foods plc., 2010: p.19) [emphasis added].

On the other hand, some firms add considerable specific detail to support their claimed intentions. While Suzuki (2003) argues that the aggregation of emissions data at firm level loses considerable information, some narrative statements have the effect of fragmenting information. Fragmentation is evident where the information content is increased, but the absence of numbers makes it difficult to appreciate the materiality or significance of a strategy, which once again detracts from comparability and verifiability:

> "Since July 2005, we've been working with WRAP to help reduce the amount of packaging and food waste produced in UK households… Projects include:
>
> - We developed a new lightweight foamed plastic tray technology to reduce the amount of packaging we use for our ready meals.
> - Preventing wastage by improving the way we seal plastic and foil film packaging.
> - We are considering how to help improve the quality and consistency of our environmental labelling but have not yet started this project" (Marks and Spencer plc., 2006: p.16).

Fragmentation can also occur either when presenting measurable data in isolation, where it loses context with the whole; or when presenting more than one instance of data while using different and irreconcilable units of measurement. Once again this makes verifiability more difficult:

> "[KPI for 2007] To reduce energy consumption per square foot by 12% as part of our long-term commitment to reduce energy use per square foot by 50% between 2000-2010" (Tesco plc., 2006a: p.73).
>
> "[KPI for 2007] To decrease the amount of CO_2 we produce per case of product delivered by 10% as part of our long-term commitment to reduce CO_2 produced per case delivered by 30% over the next three years" (Tesco plc., 2006a: p.73).

On occasion, the nuanced use of language provides interesting clues that challenge the credibility of carbon reduction statements. Where numbers attached to the carbon-reduction pledge suggest that the management knows how it will achieve the promised outcome, and has the means at its disposal to measure its achievement. By contrast, where the outcome is more difficult to measure, or the

means of achieving it uncertain, the declaration of intent takes on the sense of 'doing whatever it takes' to achieve the objective.

> "We will reduce our CO_2 emissions per m^2 by 25% by 2012, against a 2005/6 baseline" (J. Sainsbury plc., 2011b: p.51).
>
> "We commit to ensuring effective action is taken in all premises to reduce and prevent under-age sales of alcohol" (J. Sainsbury plc., 2011b: p.12).

In other cases, the language is less nuanced and credibility is undermined because the narrative fails to provide a sense of closure:

> "Separately, Stratas Foods in the US, a joint venture between ourselves and Archer Daniels Midland, also purchases a small volume of palm oil. *Stratas management is aware of the concerns as to the future sourcing of palm oil*" (Associated British Foods plc., 2010: p.24) [emphasis added].

Looking beyond the 19 narrative statements that utilise the 'commit-' stem (Table 5), the researcher has examined some additional disclosures, which provide insight into the credibility, or otherwise, of carbon reduction. For example, sustainability reports for the case study firms also feature disclosures of how new technologies have contributed to carbon reduction targets:

> "Practical steps to tackle climate change: Establishing a £100 million fund for investment in sustainable environmental technology such as wind turbines, solar panels, combined heat and power and gasification. Reducing our energy use per square foot by 50% by 2010. Reducing use of greenhouse gases in refrigeration. Increasing the efficiency of our distribution fleet and moving from air to sea freight for products wherever possible. Encouraging customers to use biofuels and helping them to save energy in their homes. Encouraging our staff to use cars less and save energy at work and home" (Tesco plc., 2006a: p.52).

Statements of this type can make a striking impact in the year of disclosure. However, they are not often made consistently from one year to the next, making it difficult for stakeholders to compare across periods and verify achievements and contributions accruing to these investments and initiatives. In the case of Tesco's investment, the researcher could not locate any further reference to the £100m fund or its application beyond 2007 in the firm's published corporate reports.

The semantic analysis reveals how the examination of individual narrative statements provides an intimate insight into the credibility of carbon reduction and disclosure practice within the firm, and its findings suggest that the information content of these disclosures falls short of the standards

expected in respect of the enhancing criteria of decision-usefulness. In particular, instances have been observed where disclosures make it difficult for readers to compare aspects of carbon reduction strategy within and across periods and to verify the subsequent fulfilment of promises. Unfortunately, the small number of 'commit-' narrative statements unearthed by the search makes it difficult to generalise from these findings, or to differentiate meaningfully between the credibility of carbon reduction at each of the case study firms. However, the quality of individual findings supports the use of semantic interpretation where there is sufficient quantity of disclosure.

In the next section the narrative statements review takes on a more narrow approach, focusing on the reporting of executive compensation schemes. Specifically, the study isolates aspects of incentive schemes that apply to environmental and carbon issues. These represent a unique opportunity to compare narrative statements with numbers, where incentive scheme objectives are a formalised carbon reduction narrative statement and the bonus earnings are financial numbers from which to evaluate the credibility of the narratives. Where bonus schemes underwrite the achievement of challenging carbon reduction objectives with significant financial rewards, credibility is enhanced because managers and shareholders' interests are aligned and behaviour modification will follow.

7.8 Shareholder engagement with carbon reduction

According to Lazonick and O'Sullivan (2000: p.13):

> "Over the past two decades the ideology of shareholder value has become entrenched as a principle of corporate governance among companies based in the United States and Britain".

The statement is essentially reflexive. On the one hand shareholders expect positive value management in one form or another. On the other, the statement indicates the character of leadership that one might expect directors to pursue. If shareholders are motivated to reduce their corporate carbon footprint, the source of their motivation is likely to be the reduction of risk, which reduces firm value by increasing the rate at which future income streams are discounted. The relevance of risk to shareholders is explained in the recommendations of the Financial Reporting Council in the United Kingdom, which laid down its recommendation of how risk should be communicated in the Business Review within the annual report:

> "The risks and uncertainties described in the business review are genuinely the principal risks and uncertainties that the Board are concerned about. The descriptions are sufficiently specific that the reader can understand why they are important to the company. The

> business review also describes the mitigating actions taken by the Board to manage the impact of its principal risk and uncertainties. The links to accounting estimates and judgements are clear" (Financial Reporting Council, 2012).

The statement underlines the sensitivity of shareholder value to variation in risk, and the role of accounting in communicating risk to investors. Yet the Business Reviews (or Corporate Governance Reports) of the case study firms do little to specify the potential impact of climate change risk on the company over the period of study, and none specify the potential financial impact of these risks. Instead the companies refer to 'type' rather than 'extent' of risk; for example to the reputation of the company:

> "Our key environmental risks are related to minimising energy usage in stores and transportation, waste management and our ability to respond to consumer concerns in this area" (Tesco plc, 2007a: p.17).

The protection of reputation is also a key premise underlining the development of Marks and Spencer's Plan A initiative. While climate change is only one component of Plan A, risk of conflicts between short-term cost pressures and social responsibility has the potential to damage shareholder value:

> "Risks - We fail to maintain momentum for Plan A in the face of current trading priorities and cost efficiencies. Our suppliers fail to meet our ethical standards. Impact - Adverse effect on stakeholder trust and confidence. Adverse effect on brand reputation. Adverse effect on financial performance" (Marks and Spencer plc., 2009: p.57).

Other types of risk were linked with the firm's ability to carry on 'business as usual'. However, the effect on shareholder value and other financial metrics is difficult for firms to quantify:

> "Issue - Climate change. Risk - Long-term increase in energy prices. Physical threats to operations from climate change e.g. flooding. Altered weather patterns affecting crop productivity" (Associated British Foods, 2011: p.47).

The evidence from the case study shows that the firms are meeting the requirements set out by the Financial Reporting Council, in relation to carbon risks, in all but one respect: making clear 'the links to accounting estimates and judgments'. This is not surprising, given that "any simple assessment of the relationship between a single organisation and planetary sustainability is virtually impossible" (Gray, 2010: p.48). Accounting has proved itself incapable of reconciling the physical emissions of a business with their associated damage to the ecosystem, and of quantifying the reciprocal impact on

shareholder value that arises from operating in an impaired environment. Thus, to commit to carbon reduction, shareholders need to be motivated primarily by faith or ethics, rather than rationality. It is appropriate to recall at this point that Hume once observed (originally in 1742):

> "Avarice, the spur of industry, is so obstinate a passion, and works its way through so many real dangers and difficulties, that it is not likely to be scared by an imaginary danger, which is so small, that it scarcely admits of calculation" (Hume [1742] 2006: p.46).

Contemporary research has shown that analysts generally disregard annual report environmental disclosures as being 'immaterial and irrelevant'. In their study of bank sell-side analysts, Campbell and Slack (2011: p.59) quote one analyst who describes environmental disclosures as being:

> "not material at all. There might be analysts out there who sit and read this from cover to cover but is there anything in here [the environmental report] material that's going to affect the share price? No."

The subtext of this statement reveals the weakness of accounting. The analyst is not denying that environmental damage may harm shareholder value: what [s]he is saying is that there is no accounting information within the report that makes an adequate case for any such impact. In other words, the information lacks relevance. Where analysts are intermediaries between large corporations and major institutional investors, their impressions can be expected to influence those of their clients.

In short, initial evidence suggests that accounting is having little positive impact on shareholder engagement with carbon reduction. This is because it is failing to make a relevant case that demonstrates and quantifies the adverse impact of the firm's carbon emissions shareholder value. It follows that if shareholders' interests are not aligned with carbon reduction, then they are unlikely to demand adjustments in in behaviour from the directors whose responsibility it is to lead the firm.

Management incentives represent the conditional transfer of resources between shareholders and executives. By underwriting a carbon objective, shareholders demonstrate that they have accepted financial responsibility for its fulfilment. Here, the maximum incentive payment payable in exchange for carbon reduction provides an appropriate 'measurement' of the price that shareholders are prepared to pay to reduce carbon risk to an 'acceptable' level. By deduction, the same payment represents the extent of the executive's financial interest in reducing the company's carbon risk. For

the purpose of the remaining analysis, directors' incentive schemes have been categorised into a framework of narrow and broad incentive schemes.

7.9 Narrow incentive schemes

Agency theory describes the conflict that arises between business owners (principals) and employed managers (agents), as a result of divergent interests and the existence of asymmetric information. According to the theory:

> "The principal can limit divergences from his interest by establishing appropriate incentives for the agent and by incurring monitoring costs designed to limit the aberrant activities of the agent" (Jensen & Meckling, 1976: p.5).

Thus incentives exist to 'narrow' the range of objectives held by managers and directors, bringing them into alignment with the shareholder value objective held by the principals. This position was subsequently adapted to take account of externalities such as carbon footprint:

> "Those who care about resolving monopoly and externality issues will not succeed if they look to corporations to resolve these issues voluntarily. Companies that try to do so either will be eliminated by competitors who choose not to be so civic minded, or will survive only by consuming their economic rents in this manner" (Jensen, 2002: p.16).

According to this logic, government regulation is the appropriate route for carbon reduction. The counter-argument holds that a level playing-field cannot be achieved without international agreement on regulation. The narrow approach therefore regards environmental goals as being 'private passions' of directors, which divert resources from the organisation and increase agency costs (Jensen, 2002). Narrow incentives – If effective – would dissuade directors from carbon footprint reduction unless achieved as a by-product of another action that is pursued in compliance with the law, or can be wholly justified on the grounds of 'value seeking'.

There is evidence to suggest that some of the case study firms have adopted the narrow incentive approach:

> "Performance under the plan is measured over three years. As was the case in 2010/11, the performance measures for 2011/12 awards will be 75% based on earnings per share (EPS) and 25% based on like-for-like non-fuel sales growth as measured against the IGD (Institute of Grocery Distribution) Index. These performance metrics were selected for the following reasons:

- they are directly linked to the objectives set out in the Group's strategy – improving EPS and sales performance reflects the need for basic profit growth and should flow through to increased shareholder value;
- there is a clear line of sight between performance and reward; and
- they are relatively easy to understand and communicate"
(Wm. Morrison Supermarkets plc., 2011c: p.42)

Here, simplicity, connectivity and clarity are hardwired into the incentive scheme with the intention of reducing ambiguity and restricting the reward criteria to those activities that have a visible connection to shareholder value. In a similar vein:

> "Executive directors and other senior executives are eligible to participate in an annual cash-based bonus scheme with payments based on the achievement of stretching financial targets and personal performance assessed against individual short and medium-term objectives. Financial targets for all executives are set on a business-by-business basis and reflect what can be directly influenced and the area of work for which each executive is accountable. Adjusted operating profit and working capital were chosen as the prime financial measures as they are common metrics which are used on a day-to-day basis to drive and monitor performance within the group" (Associated British Foods, 2011: p.49).

Once again, the incentive scheme is used to leverage management focus on those areas that directly impact on financial outcomes and ultimately benefit shareholder value. The emphasis on financial measures of performance is so clearly stated as to exclude the legitimisation of non-financial objectives for directors, beyond those mandated in law. This latter point is reinforced by the way in which same company describes its stance towards pollution risk:

> "Risk: Unacceptable impact on environment and offence caused to local communities by emissions to air. Mitigation: Plant and process changes assessed in advance before authorization sought. As a minimum, comply with emission standards in country of operation" (Associated British Foods, 2011: p.47).

Given the obvious requirement on a company to comply with the law, the statement of intention to comply would be unnecessary unless its inclusion were material. Here legal compliance is the prominent motive, for it is the only type of objective statement that can be verified using publicly-available information. The case of Associated British Foods presents an overt example of a compliance-oriented carbon strategy. According to Dillard *et al.*, a compliance or legitimacy approach towards environmental management resides at the lower end of the strategic spectrum:

> "Legitimacy reflects a minimalist environmental strategy. If the organization adopts a legitimacy strategy, the objective is to maintain its position in the industry and the referent community, situating it such that environmental-related actions will not negatively effect

> [sic] the firm's operations … The ultimate decision criteria is [sic] to enhance the input-output ratio by balancing the organizational costs and benefits of externalizing transformational costs" (Dillard *et al*., 2005: p.86).

The alternative to narrow incentives is the broad incentive approach, which is more inclusive and embraces a wider range of director incentives. It is the broad incentive scheme to which the next section turns.

7.10 Broad incentive schemes

In contrast to the narrow incentive approach, broad incentive schemes reflect a different perspective, which departs from the neoclassical view of managerial utility maximisation crystallised within a single financial goal. It also recognises the transition of business into a more complex world, where the demands made on firms and their managers are more diverse, involving trade-off and compromise.

In a survey drawn from earlier academic studies, Oliver Williamson documented a range of management motivations from which he observed a significant weighting of non-financial drivers alongside the traditional criteria of remuneration and other sources of individual reward (Table 6).

Table 6: Constituents of management motivation – a survey of academic opinion

Study	Salary	Security	Status	Power	Prestige	Social service	Professional excellence
Barnard (1962)	✓	✓	✓	✓	✓	✓	✓
Cole (1959)		✓		✓	✓	✓	
Gordon (1961)	✓	✓	✓	✓	✓	✓	✓
Simon (1961)	✓		✓	✓	✓		
Thompson (1961)	✓	✓	✓	✓	✓		

Source: Reproduced from Williamson (1974: p.30)

The spread of motivations beyond financial rewards shown in Table 6 is plausible in situations where a director may already be financially wealthy, as a result of several years in high-profile positions. In such cases, motivation may encompass broader objectives, which yield intrinsic satisfaction consistent with decreasing marginal utility of extrinsic financial rewards. The inclusion of social service among Williamson's managerial incentives opens the way for the consideration of carbon reduction among management objectives. Where directors do have diverse objectives, they may be attracted to work for companies that share their values. The case study presents some evidence that

broad incentive schemes are being used, and that directors are being tasked and rewarded on both financial and non-financial criteria:

> "Incentive plans should be linked to stretching performance measures and targets, covering a mix of financial and non-financial measures. The measures are reviewed and monitored to ensure that they do not drive unacceptable behaviours or encourage excessive risk-taking" (J. Sainsbury plc., 2011a: p.39).

This statement implies that 'balance' contributes towards risk-reduction by helping to prevent the pursuit of narrow financial objectives through dysfunctional means. Yet despite the inclusion of 'other' objectives, it is clear that broad incentive schemes still prioritise the achievement of shareholder value above all other criteria:

> "A significant proportion of the total remuneration package is performance-related, aligning management's and shareholders' interests. Exceptional levels of performance will be rewarded with exceptional levels of total reward" (J. Sainsbury plc., 2011a: p.39).

Within broad schemes, individual objectives are often rewarded alongside company-wide objectives. Where these individual objectives are measured by discrete, non-financial criteria, they allow a company to reach a negotiated settlement with an individual director, which may appeal to those motivated by social or environmental agendas:

> "All bonus plans across the Company are aligned under a set of common principles. For 2010/11, Board and management plans retained the same key metrics based on profit and sales growth, product availability, plus an element for individual performance. Bonus awards are weighted to the achievement of profit, and it continues to act as the overall "gateway" measure for the plan reflecting the emphasis on growing profit. For Executive Directors, at least half of the bonus is based on profit, and the remainder is based on sales, product availability and the achievement of individual objectives" (J. Sainsbury plc., 2011a: p.40).

The 'gateway' referred to in the statement indicates that the payment of awards in respect of 'individual' objectives is conditional on the achievement of Group profit. By making individual awards conditional on profit, the incentive payment no longer represents an opportunity cost to shareholders, as it is not necessary to forego profit in order to achieve the non-financial objective, such as a measure of carbon reduction. The incorporation of conditionality therefore reduces the credibility of shareholders' responsibility towards the non-financial objective. Moreover, the extent to which these schemes purport to align the interest of individual managers with specific causes is not clearly stated in the annual reports. Personal objectives are typically vaguely stated, reflecting

reluctance by companies to report details of the personal objectives incorporated into broad incentive schemes:

> "Individual performance objectives are set annually for each Executive Director and are reviewed by the Committee. These objectives cover a variety of financial and operational targets that contribute to the achievement of longer-term strategic goals; some of these objectives relate, either directly or indirectly, to the Company's corporate values" (J. Sainsbury plc., 2011a: p.40).

> "As in prior years, specific performance targets have not been disclosed as they are considered to be commercially confidential, but they will be demanding" (Wm. Morrison Supermarkets plc., 2011c: p.41).

Where confidentiality is invoked, the intention may be to conceal the particulars of incentive schemes to deter other firms from 'poaching' key managers from the firm. From the perspective of this study, however, limited disclosure makes it difficult to distinguish between financial and non-financial personal objectives within an incentive scheme. Table 7 presents the case study firms according to their use of narrow or broad incentive schemes.

Table 7: Case study companies using narrow and broad incentive schemes (2011)

Company	Incentive Approach	Conditional on Profit
J. Sainsbury	Broad	Yes
Tesco	Broad	Yes
Marks and Spencer	Broad	Yes
Wm. Morrison Supermarkets	Narrow	N/A
Associated British Foods	Narrow	N/A

Source: Author, using information from corporate annual reports.

Table 7 also shows that in 2011, all case study firms with broad incentive schemes stipulated that rewards against non-financial are conditional on profit thresholds. Thus while broad incentive schemes can demonstrate shareholder commitment to non-financial objectives, including carbon reduction; evidence from the case study firms does not support this happening in practice.

Managers are often presumed to give priority to self-interest. Where this translates to maximising their financial interests, executives enrolled in broad incentive schemes will follow the 'line of least

resistance' towards the maximisation of personal earnings. This is likely to result in managers performing their own optimising calculations and trading off one set of objectives against another. The pathway taken by managers, specifying the objectives that they intend to achieve, will depend in part on the perceived connectivity between activity and measurement of reward criteria. Managers can track their progress against profit objectives, monitor variances and plan remedial action on a monthly basis in order to safeguard achievement of the annual objective, and realisation of their profit-related bonus. Carbon accounting is typically an annual exercise, with only indirect means of estimating the efficacy of targeted activities and little opportunity for interim periodic review. In these respects carbon reduction is arguably less tractable than financial performance, and managers may be less confident in their ability to manage by objectives[28].

The final part of this chapter examines data extracted from annual reports of case study firms, which reveal the compensation paid under broad incentive schemes towards the achievement of carbon reduction objectives. Thus for those cases where managers are able to achieve both profit and carbon objectives, the case study reveals the extent to which incentives contribute to total executive rewards and the credibility of corporate carbon reduction.

7.11 Financial impact of incentives on manager commitment

The final part of this analysis introduces accounting numbers alongside the earlier evaluation of annual report narrative statements. So far the investigation has not encountered evidence of carbon reduction credibility among shareholders and managers in the case study firm. As Froud *et al.* observe:

> "If the numbers are independent of the narrative, promises can be checked against outcomes in a way that opens new complexities … Discrepancy and corroboration between narrative and numbers are both objects of research and the starting points for historical case exploration" (Froud *et al*. 2006: p.135).

The numbers used in this part of the analysis are extracted from the remuneration reports, contained within the annual reports of the case study firms. Only two companies – Tesco and J. Sainsbury - were found to incentivise environmental objectives within directors' compensation. Neither firm reveals the amount of incentives paid in respect of environmental performance; nor do

[28] Although this is rarely done in practice, monthly carbon monitoring can be achieved by plotting the monthly energy consumption (KwH) for an entire estate against degree days (a measure of heating or cooling) to establish a line of best fit. This is then analysed using parametric CUSUM (see Chapter 4) to measure energy savings that can be converted into carbon reductions. Degree day statistics are available at http://www.eci.ox.ac.uk/research/energy/degreedays.php#degreedays from the University of Oxford Environmental Change Institute.

they specify the weighting given to environmental goals within the bonus structure. It has therefore been necessary to estimate the amounts paid for environmental performance by simply dividing the applicable element of the incentive scheme by the number of contributing criteria to estimate the amount of the environmental payment. In the case of J. Sainsbury, where the environmental objective includes a subsidiary goal of quantified carbon reduction, it has been necessary to further subdivide the environmental payment by the number of sub-goals to estimate the carbon reduction award.

The need for crude estimates of this kind arises because company disclosure is broad, rather than specific, regarding individual components of incentive schemes. This may indicate reluctance to disclose information that may be interesting to competitors; a desire to impede further evaluation of the intention and functioning of schemes, or the need to balance a requirement for disclosure with the need to avoid cluttering the remuneration report with excessive detail. The estimates derived in this part represent the best information that can be gathered from publicly available sources.

In 2011, Tesco and J. Sainsbury paid environmental bonuses to their directors. Marks and Spencer only incorporated climate change objectives into their directors reward programme after 2011. This is surprising, given the high public profile of their flagship 'Plan A' strategy, which defines Marks and Spencer's approach to corporate citizenship. Wm. Morrison Supermarkets and Associated British Foods both operate narrow incentive schemes, which solely reward financial performance.

Table 8 summarises the climate change and environmental incentives paid by Tesco and J. Sainsbury in 2011. Neither company included environmental performance in its incentive programmes in 2006, the base year for this thesis, preventing meaningful comparative analysis of these incentive payments. Greater detail, including the sums paid to individual directors, is included in Appendix L.

The data presented in Table 8 describe the aggregated remuneration of the directors of both Tesco and J. Sainsbury. They exclude awards under the long-term incentive schemes, both of which reward financial performance only. The long-term reward is paid in the form of shares, which vest after a period of several years depending on whether performance has been sustained. At the time of writing, it is not known how many of these shares will vest; therefore it has proved necessary to restrict the scope of the evaluation to short-term compensation only.

Table 8: Tesco & J. Sainsbury 2011 – analysis of environmental/carbon reduction directors' incentives (All data in £'000s unless otherwise stated)

Elements of directors' remuneration	Tesco	J. Sainsbury
Basic salaries	7,134	2,740
Annual incentives	12,440	2,783
Total remuneration (Exc. long-term incentives [29])	**19,574**	**5,523**
Included within annual incentives:		
Incentive payment - environmental performance	567	123
% Total remuneration (Exc. long-term incentives [1])	**2.9%**	**2.2%**
Included within environmental performance element:		
Incentive payment - carbon reduction objective [30]	-	31
% Total remuneration (Exc. long-term incentives [1])	**-**	**0.6%**

Source: Author, using data from corporate annual reports.

Neither report stipulates the maximum award payable in respect of environmental performance; instead listing environmental performance as a category, or sub-category, within its short-term incentive scheme. In the case of Tesco, the company rewards the achievement of corporate objectives within its short-term incentive plan, which include an environmental component:

> "The corporate objectives are based on our balanced scorecard, known as the steering wheel. Corporate objectives for the awards made in respect of the financial year 2010/11 were:
> • increasing sales from new space; specific profit targets for international businesses and for retailing services;
> • like-for-like sales growth and the development of the non-food business;
> • focus on productivity improvements and developing trading models internationally;
> • enhancing talent management and capability;
> • embedding the new international Community Plans and Community Promises; and
> • reducing our environmental impact" (Tesco plc., 2011a: p.80).

On this basis, and in the absence of specific disclosure, the environmental reward has been estimated for the purpose of this research at one-sixth of the short-term incentive paid and disclosed in the 2011 remuneration report.

[29] Long-term incentives are excluded, as they are paid in shares whose vesting is conditional on sustained performance over several years, which prevents the estimation of amounts actually paid over.

[30] Tesco did not disclose the reward criteria for the element 'reducing our environmental impact' in the remuneration report. Therefore, it is not possible to estimate a carbon-specific reward payment.

At J. Sainsbury, four subsidiary strategic goals account for one of the four main reward criteria making up the short-term 'deferred share' award. One of these subsidiary strategic goals is 'respect for our environment'. Accordingly, the reward for environmental performance is estimated as one-sixteenth of the actual deferred share award disclosed in the 2011 remuneration report.

Actual awards were relatively consistent for both companies, where environmental awards comprised 2-3% total directors' remuneration. As previously stated, these awards were conditional on satisfying a profit threshold; moreover they represent a very modest proportion – and amount – of directors' emoluments. By way of illustration, the chief executives of Tesco and J. Sainsbury respectively received £63,000 and £58,000 in respect of their environmental leadership, as elements of remuneration packages totalling £2.2m and £2.3m (Note: Philip Clarke of Tesco assumed the role of Chief Executive part way through 2011). These environmental rewards are small when judged by the standards of top executive pay, and are unlikely to exert much leverage over managerial behaviour, if we can assume that directors are primarily motivated by personal gain. Moreover, directors can be expected to balance the probability of success against the size of the environmental award; where achievement involves trade-off against other incentive criteria.

Interestingly, in a 'twist' on agency theory, the concept of risk as a component of shareholder value can be reintroduced at this stage of the analysis. It can be assumed that shareholders' interests are served by minimising the risk associated with a given level of return. Therefore, agency theory can be re-presented where shareholders are prepared to incentivise managers to manage risk relative to shareholder return, where managers may be otherwise inclined e.g. to pursue easier routes to maximising personal earnings. Retaining the framework established by Jensen and Meckling (1976), shareholders would be prepared to incentivise directors to reduce risk: in this case, the risk associated with carbon emissions. If it is assumed that shareholders' objectives are fairly represented by the maximum levels of achievement specified by an incentive programme, then the agency of cost of carbon may be estimated as the incentive payable for achieving the maximum carbon reduction specified under the plan.

According to the J. Sainsbury 2011 annual reports, the strategic goal 'respect for the environment' includes the following measurable carbon reduction goal:

> "We will reduce our CO_2 emissions per m^2 by 25% by 2012, against a 2005/06 baseline" (J. Sainsbury plc., 2011a: p.3).

Given that J. Sainsbury does not disclose ***annual*** carbon emissions per m^2 against target metrics in its annual reports, equivalent data have been estimated using information obtained from the annual reports 2006-2011. Table 9 presents these estimates against the criteria set for carbon reduction over the period of this study:

Table 9. J. Sainsbury – carbon emissions per square metre objectives: 2006 – 2011[31]

CSR reporting year	Target reduction (% CO_2 emissions/m^2)	Baseline year	Baseline value (kg CO_2e/m^2)	Reported emissions (kg CO_2e/ m^2)	Target (kg CO_2e/m^2)	Achieve target by
2006	5%	2005	465	485	442	2008
2007	25%	2005	465	469	349	2012
2008	25%	2006	485	421	364	2012
2009	25%	2006	485	439	364	2012
2010	25%	2006	485	416	364	2012
2011	25%	2006	660[32]	506	495	2012

Source: Source: Author, using data from annual and corporate social reports

As reported in Chapter 6, J. Sainsbury's absolute carbon emissions increased from 726,398 to 856,000 tonnes during 2006 – 2011 as a result of an aggressive store expansion programme. Table 9 reveals that between 2006 and 2010, reported emissions per m^2 declined by 14%, which is less than might be expected if the 25% reduction were to be achieved by 2012. In 2011, there is a 'spike' in emissions per m^2 as store expansion outstrips savings in carbon efficiency, yet a small aggregated directors' bonus of £31,000 has been estimated in respect of carbon reduction criteria (Appendix L). It is further estimated in Appendix L that the maximum aggregate directors' award for achieving the 2011 carbon reduction goal would be around £41,000. This value can be interpreted as being J. Sainsbury's agency cost of carbon in 2011.

At this point in the analysis, it should be recognised that the estimated aggregate incentives are very small relative to overall compensation, and the limits of the assumptions used to calculate them – in the absence of more detailed disclosure – are being tested. It is likely that the precise basis of calculation differs from the simple proportions assumed in this study. However, it is worth summarising what can be reasonably inferred from these data:

[31] Note that a factor of 10.76 is required to convert square feet into square metres.

[32] The 2005/06 baseline has been retrospectively restated in the 2011 corporate responsibility report when J. Sainsbury switched from using the GHG Protocol to the DEFRA 2010 Guidelines.

- J. Sainsbury is struggling to achieve its carbon reduction objectives[33], which are incorporated in the directors' incentive programme.
- There is an apparent conflict between the expansion of store selling space, to drive the achievement of financial objectives, and the reduction of carbon emissions. Absolute carbon emissions are increasing because the rate of store expansion is outstripping the capacity to realise carbon efficiency gains of new design and build.
- Where there is conflict, financial objectives will displace the environmental objectives, partly because directors are financially motivated and the payment of environmental incentives is conditional on achieving a profit threshold.

Importantly, this study has established the principle that carbon incentive payments can be used to calculate an 'agency cost of carbon' at which the interests of shareholders and directors to carbon reduction are aligned, or in equilibrium. By establishing an agency cost of carbon, carbon reduction may be ranked alongside other objectives that also have financial dimensions. The case study has established that the agency cost of carbon is either zero, or very low, for FTSE100 firms engaged in and supplying the United Kingdom mixed-retail sector. Accordingly, the credibility of carbon reduction is diminished by these findings, for neither the shareholders nor directors of the case study firms are prepared to stake a meaningful financial claim on its achievement.

7.12 Conclusions and implications for the research

This chapter has taken a multi-layered approach to the analysis of narratives, and narrative statements and numbers. The level of detail has necessarily made the work laborious and time-consuming, compounded by the need to develop system and structure in the approach. Accordingly, considerable space has been dedicated to setting out the methodology and advancing the findings, as each phase of analysis offers new discovery. The methods employed, findings and limitations encountered in this work are summarised in Table 11.

The research question (RQ4) is concerned with whether narratives can be extracted and categorised to differentiate between the credibility of carbon reduction among FTSE100 firms. The research has created a suitable narrative database using its own taxonomy of carbon-related disclosures, which is organised around decision-usefulness criteria. By blending different proportions of potentially

[33] See Chapter 6 for further detail, including the basis on which these figures are stated and the creative carbon accounting techniques employed by J. Sainsbury.

decision-useful and distracting content into their report narrative statements, each firm reveals the existence of an individual disclosure strategy that differentiates its position from that of its peers. Each firm adjusts its mix of supportive disclosures over the period to incorporate different blends of legitimacy, competitive advantage and enlightened management within their declared strategies. While these firms inhabit the same industrial sector, each has set out a different strategic stance through the medium of narrative disclosure.

Other conclusions focus on the similarity among the case study firms. The existence of disclosure strategies implies that favourable impressions of carbon commitment matter to company management. All firms are reluctant to set out their carbon reduction intentions using direct and unambiguous language as evidenced by the avoidance of 'commit-' words within their published disclosures. Published narrative statements are deliberately crafted by professionals, and are honed to achieve specific purpose. Just as Chapter 6 revealed the existence of creative carbon accounting among mixed-retail firms, this chapter has uncovered the existence of complementary creative disclosure.

The categorisation of carbon disclosures revealed a broad spread of 21 issues that feature in the narrative statements. Typically each issue arises between 2 – 8 times per individual corporate report. Breadth is achieved at the expense of detail, depth and focus. The most numerous category of disclosure is 'engagement', which arises 10 times, on average, per report.

The carbon reduction credibility of case study firms is diminished by the review of their executive compensation schemes, where these include carbon objectives. This research recasts incentive payments as agency costs, incurred by shareholders to reduce carbon risk; and opportunity costs to managers, of pursuing conflicting bonus opportunities. Only two firms were found to offer carbon performance bonuses and both were conditional on profit thresholds. Where carbon bonuses were paid, they were minimal relative to total compensation, the scale of the business and represented minimal agency and opportunity costs. In summary, the evaluation of executive carbon rewards revealed that carbon objectives are entirely subsidiary because managers are actively incentivised to choose profit over carbon reduction where these come into conflict. These findings have important implications for the remainder of the research. This thesis argues that the credibility of carbon reduction should be enhanced by providing meaningful incentives that align the interests of shareholders and senior executives around challenging carbon reduction objectives, and reward behaviour modification that leads to sustained reduction in emissions. Furthermore, the mode of

carbon disclosure needs to be revised in order to enhance its credibility. By providing information that is 'worthy of trust' carbon accounting and disclosure can become decision-useful when stakeholders incorporate it into their calculation of whether or not to trust potential partners in carbon reduction.

The theme of stakeholder collaboration, through the provision of credible carbon accounting information is continued in the next chapter. Chapter 8 considers how carbon performance metrics can be utilised in concert with financial metrics, using innovative benchmarking tools to make carbon risk visible to investment analysts in ways that may influence the recalibration of client portfolios. This proposal has the potential to act as a catalyst in changing the behaviour of shareholders and managers of large corporations if they perceive that their company has become more, or less, investable relative to other large companies because analysts are presented with the means of monetising carbon risk.

Chapter Eight

Accounting for carbon risk: towards a stakeholder approach

8.1 Introduction

This chapter revisits the issue of firm reporting boundaries and the difficulty of matching physical and financial boundaries to assess carbon risk and intensities. Specifically, it investigates the extent to which one might design innovative carbon reporting and performance evaluation tools with the potential to better inform financial intermediaries and investors about carbon-risk exposure. This approach is justified by recent observations made by David Pitt-Watson, of the United Nations Environment Programme Finance Initiative (UNEPFI), which suggest that major financial industry players are failing to adequately align investment with carbon risk:

> "The world's financial institutions are there to finance a growing, sustainable economy, but the evidence suggests that, today, the industry performs that task poorly" (UNEP, 2014).

The analysis in this chapter aligns with the fifth research question.

> **RQ5.** How can the narratives about the credibility of carbon emissions reduction be challenged by the imaginative use of numbers that help formulate critical interventions and frame new policy initiatives?

This chapter begins by introducing the concept of value added, or value retained, which is a financial measure of a firm's own share of its value chain. This financial value is the outcome of subtracting bought-in services and materials from total revenues, and this measure more closely aligns a reporting entity's financial performance with its scope 1 and 2 carbon emissions. Despite this, it remains difficult to align financial performance with physical carbon emissions where managers are able to shift the carbon-reporting boundary by manipulating assets held on the balance sheet and exercising judgement to determine which emissions are deemed to be inside or outside of the firm's operating control. The second part of the chapter illustrates the malleable character of boundaries, using the example of Tesco. Noting these caveats, the chapter moves on to consider how physical and financial numbers describing the relative carbon intensity of a focal firm might be used to

capture its carbon performance and risk development. For this purpose, the chapter proposes experimentation with a bespoke spreadsheet carbon database tool developed collaboratively as part of this thesis. The database tool is designed to construct relative carbon performance metrics that reveal whether a firm is embarked on a more – or less – carbon-intensive trajectory than its peers. This might provide a useful technique for investors looking to relocate their equity and debt funding into relatively less carbon intensive firms within and across sectors (see call from UNEP above). The final part of the chapter contains a second proposal that a supplementary stream of carbon accounting and disclosure, grounded in the business models concept, would provide an innovative additional dimension to a reporting entity's carbon disclosure. The literature on business models is generally located within the strategy and economics literature, but there is also a growing literature located in accounting and financial disclosure. Using the framing device developed by Haslam *et al.* (2012, 2014a, 2014b), which structures a business model out of stakeholder relations that have a material impact on reported financials, this proposal responds to Gray's (2010) and Gray *et al.*'s (2014) calls for a plural sustainability accounting intended to reveal tension and contradiction, and promote dialogue between stakeholders (Freeman, 1984; Senge, 1990).

8. 2 Accounting for value added and carbon emissions

International Accounting Standard 1 (IAS1) is concerned with the presentation of a reporting entity's financial statements and the disclosure of relevant information. The normal practice for companies is to report their comprehensive income using the 'function of expense' format which aggregates individual expense lines into functional categories such as cost of sales, selling and administrative expenses. However IAS1 requires that if a reporting entity chooses to report expenses by function it should also disclose sufficient information to enable the user of the accounts to reconstruct a functional comprehensive income statement into one that is formatted using the 'nature of expenses' format:

> "An entity shall present an analysis of expenses recognised in profit or loss using a classification based on either their nature or their function within the entity, whichever provides information that is reliable and more relevant" (IFRS Foundation, 2011: p.A540 para.99).
>
> "An entity classifying expenses by function shall disclose additional information on the nature of expenses, including depreciation and amortisation expense and employee benefits expense" (IFRS Foundation, 2011: p.A540.104).

In 2007, the Chartered Financial Analysts (CFA) Insitute called for the disclosure of financial information by its nature because this would enhance comparability; and because aggregating expenses by function congealed information with variable properties, thus limiting its interpretative and decision-making quality:

> "By 'nature', we mean that items should be reported by the type of resource consumed, such as labor or raw materials, rather than by the function or purpose for which it is used, for example, cost of goods sold or selling, general, and administrative expense. Categorization according to nature can greatly enhance comparability across companies and consistency within the statements of a single company …
>
> The statistical distribution properties of the various resources consumed in operations behave very differently over time. Consequently, aggregation by function, the current practice, merges items with different properties, reducing the information content of the items and significantly reducing their value as decision-making factors" (CFA Institute, 2007: p.14).

The CFA report called for reporting entities to disclose their operating financials in the form of a value added income statement similar to the format previously recommended by the 'Corporate Report', as published by the Accounting Standards Steering Committee (ASSC, 1975). In the *Corporate Report* the value added format for presenting and expenses by their nature is set out in an illustration which is reproduced, with minor adaptations, in Table 1.

Table 1. Illustrative value added statement

Year to 31 December		**£ m**
Turnover		103.9
Bought in materials and services	-67.6	
Value Added or Value Retained		**36.3**
Applied in the following way		
To pay employees		
Wages, pensions and fringe benefits		25.9
To pay providers of capital		
Interest on loans	0.8	
Dividends to shareholders	0.9	1.7
To pay government		
Corporate taxes payable		3.9
To provide for maintenance and expansion of assets		
Depreciation	2.0	
Retained profits	2.8	
		4.8
Value Added or Value Retained		**36.3**

Source: Adapted from ASSC (1975: p.50)

The value of this financial statement to this thesis is that it separates out what is financially within the boundary of the reporting entity as value added (or value retained), and that this measure more closely aligns the financial performance of the firm with its physical scope 1 and 2 carbon emissions.

The data presented in Table 2 reveal the value added retained (VAR) expressed in thousands of pounds per tonne CO_2e, for the FTSE100 mixed-retail, banking and mining industries. This analysis reveals that mining generates the lowest VAR relative to CO_2e, and is therefore more carbon intensive relative to mixed-retail and then banking. There is also a reasonable degree of stability within individual sectors. Accordingly, an investor could start to use this relative information to start making judgements about asset allocations and their carbon intensity.

Table 2. VAR (£'000 per tonne CO_2e) in the FTSE100 (mixed-retail, banking and mining 2006-2011)

Company	2006	2007	2008	2009	2010	2011
Tesco	1.70	1.96	2.05	2.07	2.11	2.19
J Sainsbury	1.73	2.11	2.89	2.66	2.89	2.61
Wm. Morrison Supermarkets	1.62	1.50	2.08	2.29	2.19	2.36
Marks and Spencer	5.51	4.81	5.67	5.45	3.84	3.93
Mixed Retail Average	**1.92**	**2.13**	**2.39**	**2.37**	**2.34**	**2.40**
Barclays	33.64	25.61	19.48	17.36	19.46	21.04
Lloyds Banking Group	41.92	45.64	30.08	16.15	14.03	4.42
Standard Chartered	26.51	35.90	21.17	22.66	35.89	41.72
HSBC Holdings	33.72	32.35	26.92	18.72	27.95	33.14
Royal Bank of Scotland Group	68.49	57.09	-41.45	9.73	12.09	12.93
Banking Average	**39.70**	**36.15**	**23.76**[34]	**16.17**	**20.52**	**22.26**
Anglo American	0.23	0.57	0.98	0.34	0.63	3.54
BHP Billiton	0.19	0.24	0.40	0.33	0.39	0.67
Kazakhmys	0.53	0.14	0.13	0.07	0.06	0.06
Lonmin	0.15	0.16	1.60	0.27	0.44	0.38
Xstrata	0.41	0.57	0.46	0.32	0.27	0.61
Mining Average	**0.24**	**0.32**	**0.85**	**0.29**	**0.37**	**0.83**

Source: Author, using data extracted from annual reports and corporate responsibility reports[35].

The significant advantage of the value added (or value retained VAR) financial metric is that it provides a closer - albeit imperfect - match between the carbon and financial boundary. These boundaries are, as has been previously noted, difficult to align and this issue will be considered in the following section of this chapter.

8.3 Malleability of carbon reporting boundaries: a caveat

The data collected for carbon emissions (scopes 1 and 2) in chapter 5 will not perfectly align with the financial data of constituent firms because the physical and financial domains are not perfectly overlaid. Consider the case of Tesco and its approach to setting out its operating boundary. In the first instance, Tesco, in common with most other reporting FTSE companies, updates its carbon

[34] 2009 banking sector average excludes Royal Bank of Scotland Group due to negative value added during year.

[35] Note that Lloyds Banking Group and Royal Bank of Scotland metrics have been impacted by substantial losses on investments.

footprint estimates annually using the latest government-approved scientific conversion factors. These factors are used to convert activities and fuel use into estimates of greenhouse gas emissions:

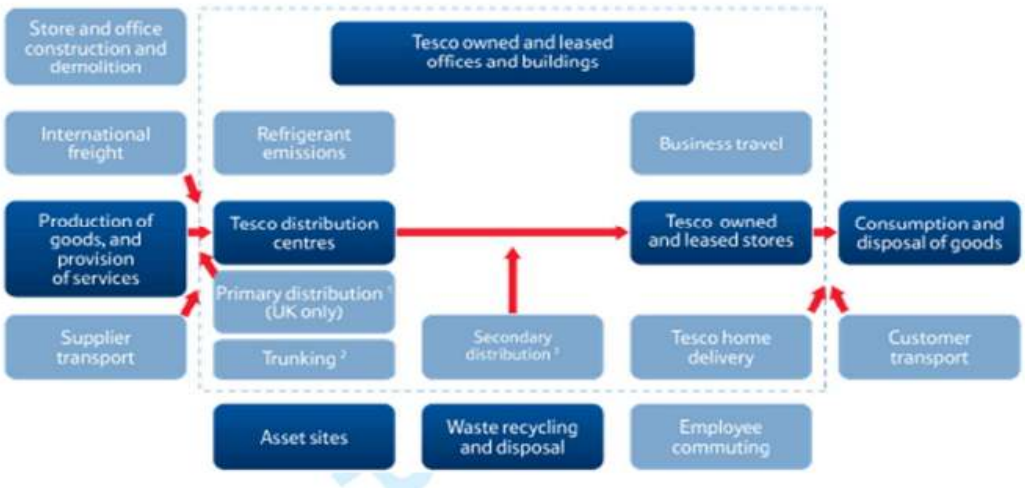
> "As in previous years, we have updated the GHG conversion factors we use to reflect the most recent UK Government guidance. We have also recalculated our emissions from previous years on the same basis so that performance from one year-to-year can be assessed on a like-for-like basis" (Tesco plc, 2012).

Corporate carbon emissions thus present an unstable time-series. This means that comparative analysis can take on different shades of interpretation over successive years, because the numerical base of estimation is constantly shifting. These factors are applied to the processes and fuel use contained within the reporting boundaries that mangers establish for the reporting firm.

The reporting boundary of the firm is established in two stages. First, the organisational boundary is determined using criteria that reflect either the firm's equity share or its control (financial or operational) over the business units that release greenhouse emissions. These options permit considerable scope for management discretion, with the consequence that boundary selection becomes complex and malleable both over time, and in comparison with other reporting firms.

Figure 1 presents a diagrammatic representation of the organisational boundary decisions made by Tesco in 2012.

Figure 1. Tesco plc. carbon footprint – organisational boundary



Source: Reproduced from Tesco plc. (2012)

As Tesco explains, in a note that accompanies Figure 1, they have exercised considerable management discretion over the setting of boundaries:

> "We have followed an 'operational control approach' to help us determine when to include emissions within our direct carbon footprint-reporting emissions from operations where we have full authority to introduce and implement operating policies. In the case of distribution we have gone beyond this operational control approach, including emissions from distribution provided by third party contractors, where this has been arranged by Tesco" (Tesco plc, 2012).

Thus the process by which boundaries are set has become pliable and can affect the estimation of carbon footprint because Tesco has set its boundary according to whether it considers it has operating or financial control; where both terms "are used interchangeably and blended with issues about ownership, physical and contractual relations where a significant degree of discretion and judgement are possible" (Haslam *et al*., 2014b). In another example, Kingfisher plc completed sale and leaseback on parts of their B&Q retail warehouse estate, as part of a balance sheet restructuring exercise to raise cash, repay debts and continue its expansion (Kingfisher plc., 2006, 2007). This financially-motivated transaction has also impacted on the allocation of carbon emissions between scopes 1, 2 and 3; transferring some emissions from inside to the outside of the firm's reporting boundary:

> "Emissions from leased facilities and vehicles (leased assets) may be classified as Scope 1, Scope 2, or Scope 3, depending on the source of emissions, which approach a company uses to establish its organizational boundary, and which type of leasing arrangement is in place. Leased assets that fall within a company's organizational boundary should be classified as Scope 1 or 2 (depending on whether they are direct emissions or indirect emissions from electricity), while those that do not fall within a company's organizational boundary should be classified as Scope 3" (WRI & WBCSD, 2001).

Once again the voluntary standard permits considerable managerial discretion in determining what lies inside the entity's reporting boundary and what is relegated to the outside. Thus the inherent limitations of setting boundaries – organisational and operational – frustrate intentions to provide complete information required to ensure faithful representation of carbon emissions, and hinder comparability of corporate carbon accounting between firms in similar sectors. As Lohmann aptly summarises:

> "Every attempt to bring something 'inside' creates new 'outsides'" resulting in porous, malleable and unstable boundaries … spaces of calculation and non-calculation cannot be walled off in rigid, mutually-exclusive spheres" (Lohmann, 2009: p.502).

However, rather than abandon the use of scope 1 and 2 disclosures, this thesis argues that it is possible to employ carbon emissions data in conjunction with reported financials to construct relative performance profiles. These data can be combined in a benchmark physical and financial

dataset, using the FTSE62 group of firms that consistently disclosure carbon emissions over the period 2006 – 2012, to produce a set of key financial metrics. The analysis that supports this argument is drawn from a small research project undertaken by the author of this thesis, in collaboration with others, for the Institute of Chartered Accountants of Scotland (ICAS) (Haslam *et al*., 2014a). The purpose of this project was to make visible carbon intensity trends and composite risk profiles for individual firms.

8.4 Carbon-financial intensity: trends and composite risk profiles

As part of the ICAS project, a pilot database reporting tool was created using the FTSE62 dataset of corporate scope 1 and 2 emissions compiled by the author for this thesis. These reported carbon emissions data were then blended with corresponding financial data obtained from ThomsonOneBanker to generate a series of key carbon-financial risk metrics. Table 3 provides a summary of these metrics together with definitions that explain their underlying calculation.

Table 3. Key metrics used to evaluate carbon and financial performance

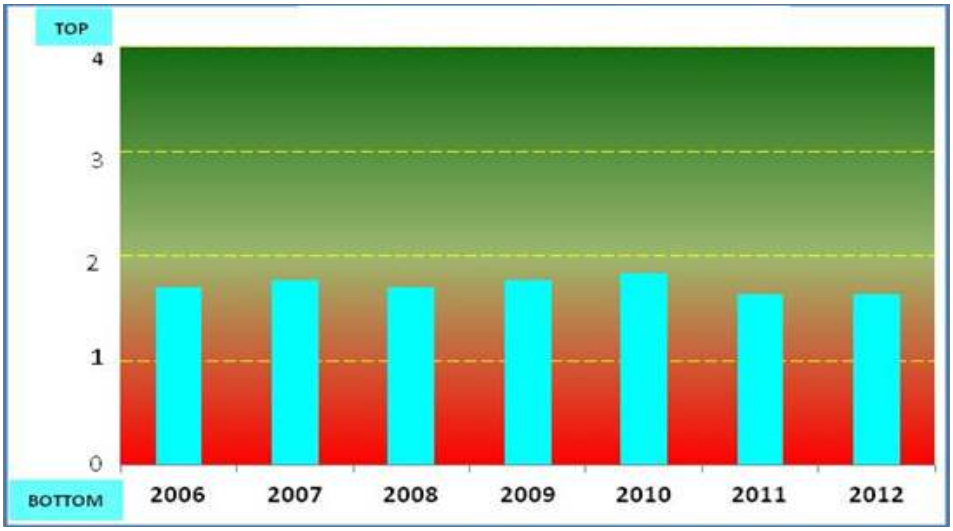
Metrics	Description of metrics
Carbon per employee	Physical carbon emissions (scope 1 and 2 emissions in tonnes CO_2e) per employee
Total income per tonne of carbon	Total sales revenue/income, divided by carbon emissions
Earnings per tonne of carbon	Profit pre-tax, divided by carbon emissions
Value retained per tonne of carbon	Sales revenue minus all external costs, divided by carbon emissions
Shareholder equity per tonne of carbon	Capital plus reserves, divided by carbon emissions
Market value/value retained	Share price multiplied by number of shares outstanding at financial year end, divided by value retained
Market value/ EBITDA	Share price multiplied by number of shares outstanding at financial year end, divided by cash earnings (Earnings before interest tax and depreciation)
Value retained per employee	Sales revenue minus all external costs, divided by employees.
EBITDA per employee	Cash earnings generated per employee

Source: ICAS research report (Haslam *et al*., 2014a)

The analysis of the combinations of physical and financial data for individual firms is then bench-marked relative to all other firms is the FTSE62 group, whose constituent firms present a continuous

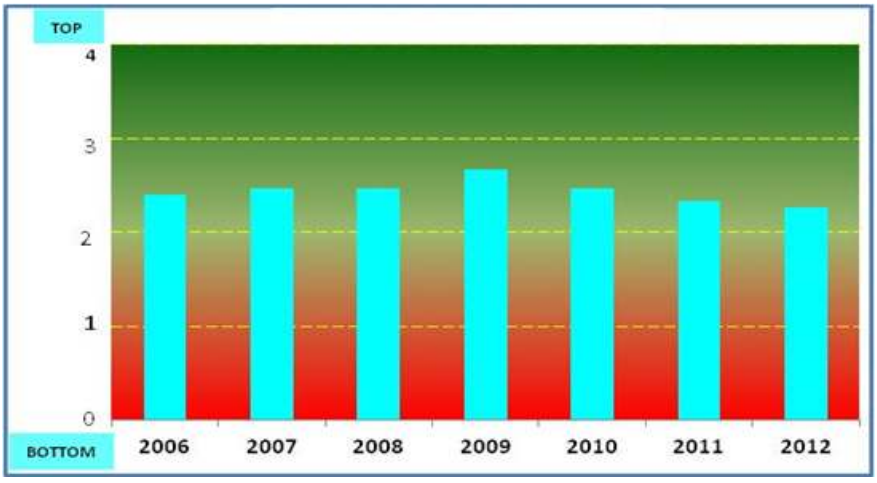
run of carbon emissions data since 2006. Using the database for this group of firms, it is possible to consider a single firm's carbon-financial risk relative to all other firms in the FTSE62 group. A firm that consistently scores 4 for the specific metrics is using less carbon per financial or physical unit relative to other firms, and is positioned in the green zone of the chart; while firms that use more carbon relative to all other firms would score near zero, and will be located in the red zone. Figure 2 plots carbon per employee for Vodafone plc relative to all other firms in the FTSE62 benchmark group; revealing that Vodafone's score places the firm in the bottom half of this benchmark range.

Figure 2. Vodafone plc – carbon emissions per employee score



Source: Author (see also ICAS research report: Haslam *et al.*, 2014a)

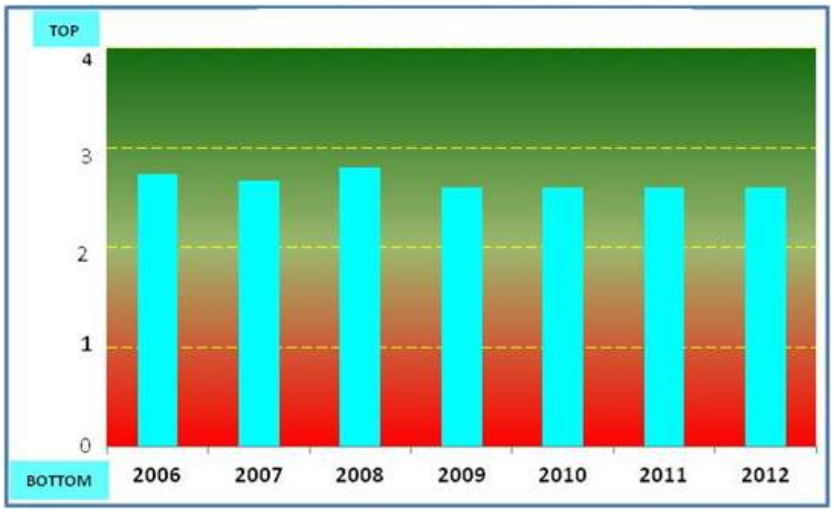
Figure 3. BT Group plc - carbon emissions per employee score



Source: Author (see also ICAS research report: Haslam *et al.*, 2014)

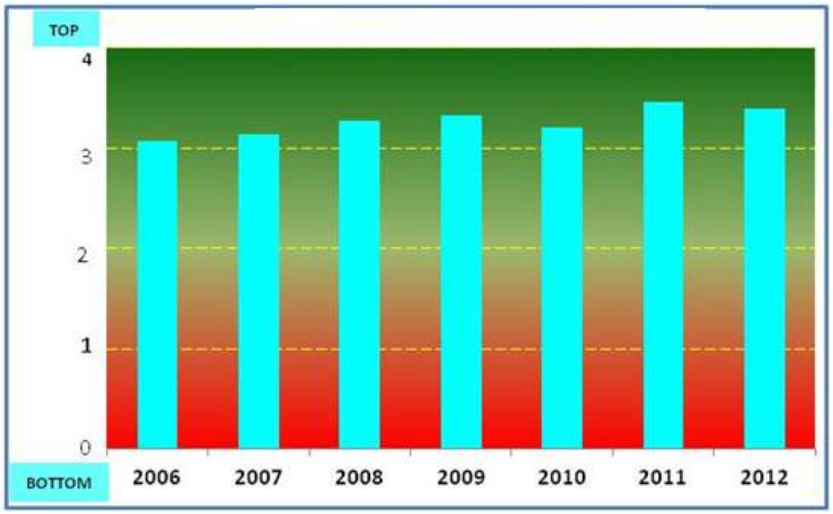
Figure 3 plots the carbon emissions per employee for BT Group plc, a company in the same industry sector as Vodafone. BT Group's emissions per employee are lower than Vodafone's relative to the FTSE62 benchmark, and this places BT Group further into the green zone of the chart. In contrast with the telecoms sector, the banking sector is less carbon-intensive industry sector when measured using carbon emissions per employee. Figures 4 and 5 reveal relatively low carbon emissions per employee relative to the FTSE62 benchmark with a consistent location within the green zone. However, as shown in Figures 4 and 5, Lloyds Banking Group generates consistently lower carbon emissions per employee than Barclays.

Figure 4. Barclays plc - Carbon emissions per employee score



Source: Author (see also ICAS research report: Haslam *et al*., 2014a)

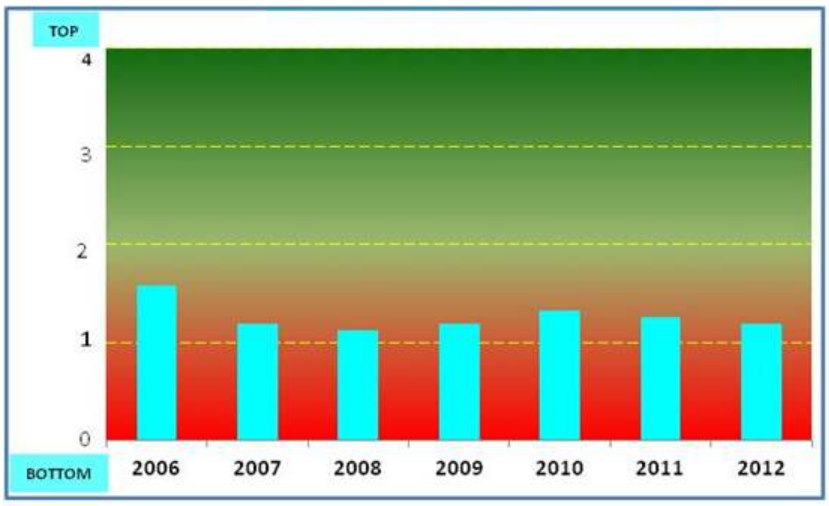
Figure 5. Lloyds Banking Group plc – carbon emissions per employee score



Source: Author (see also ICAS research report: Haslam *et al*., 2014a)

In the case of the utilities sector, Severn Trent plc operates with a relatively high level of carbon emissions per employee as expected from an energy intensive utility. Accordingly, the carbon per employee trend is situated firmly and consistently in the red zone of the chart in Figure 6.

Figure 6. Severn Trent plc – carbon emissions per employee score



Source: Author (see also ICAS research report: Haslam *et al*., 2014a)

The use of a relative trajectory profile as shown in the above figures can be supplemented with a visual tool that reveals an individual firm's relative carbon emissions across a range of metrics. This method of presentation could provide fund managers with more comprehensive information about the carbon performance of the focal firm relative to the FTSE62 benchmark group, by indicating the scope for potential trade-offs between financial performance, value creation and carbon intensity. Figure 7 charts the financial metrics shown in Table 3 for British Sky Broadcasting Group plc (BSkyB). These scores are averaged for the period 2006 – 2012. For BSkyB, Figure 7 reveals that, on average and for the period 2006-2012, the company scores highly in terms of carbon intensity per employee (CARBON/ EMPLOYEE), earnings (EARNINGS PER TONNE OF CARBON), and value retained (VALUE RTND PER TONNE OF CARBON), where it requires relatively low carbon input per unit of financial output. It also generates strong market value and market value multipliers, such as market value divided by cash earnings (MKT VAL/EBITDA), financial productivity in terms of value added (VALUE RETAINED/ EMPLOYEE) and cash earnings per employee (EBITDA/ EMPLOYEE).

Figure 7. British Sky Broadcasting Group plc – physical carbon/ financial profile

Source: Author (see also ICAS research report: Haslam *et al.*, 2014a).

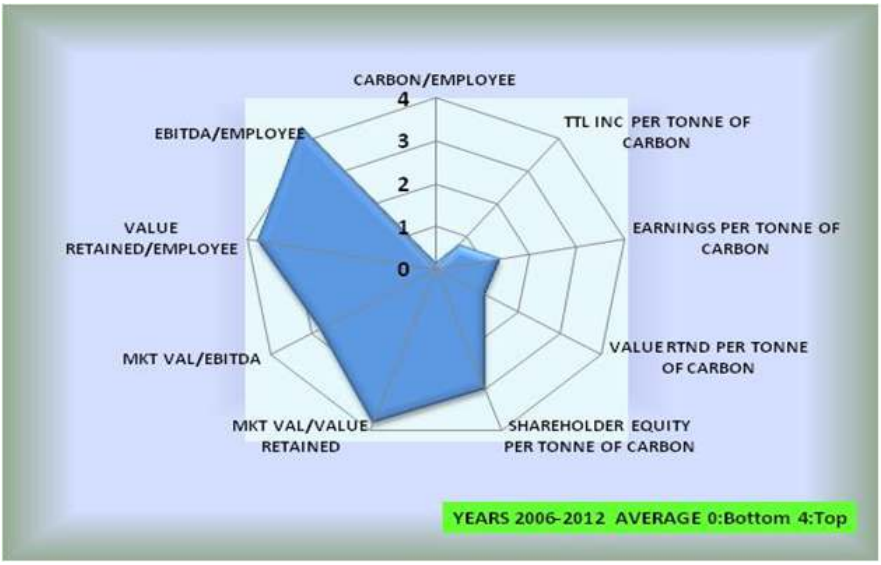
Using these radar diagrams, which reveal potential carbon/ financial trade-offs, investors can consider the relative carbon risk of investments located in different industrial sectors. Consider the case of Diageo plc, a company in the beverages sector, relative to BSkyB. Figure 8 reveals aspects of trade-off between financial and carbon performance. While Diageo has successfully generated high market value and earnings multiples, its carbon performance relative to income, earnings and value remains mid-range, and at a lower relative level than that of BSkyB. Using this information, investors and other stakeholders are able to assess the extent to which Diageo's performance reveals a conflict between carbon intensity and the breadth and depth of financial returns.

Figure 8. Diageo plc – physical carbon/ financial profile

Source: Author (see also ICAS research report: Haslam *et al.*, 2014a).

These potential investments can then be evaluated against other possibilities from more (or less) carbon-intensive sectors. BG Group plc is a company engaged in gas discovery, transmission, distribution and supply and therefore operates in a carbon-intensive industry. Figure 9 reveals carbon intensity scores reflect this reality even though it performs well in terms of market value and financial productivity multiples.

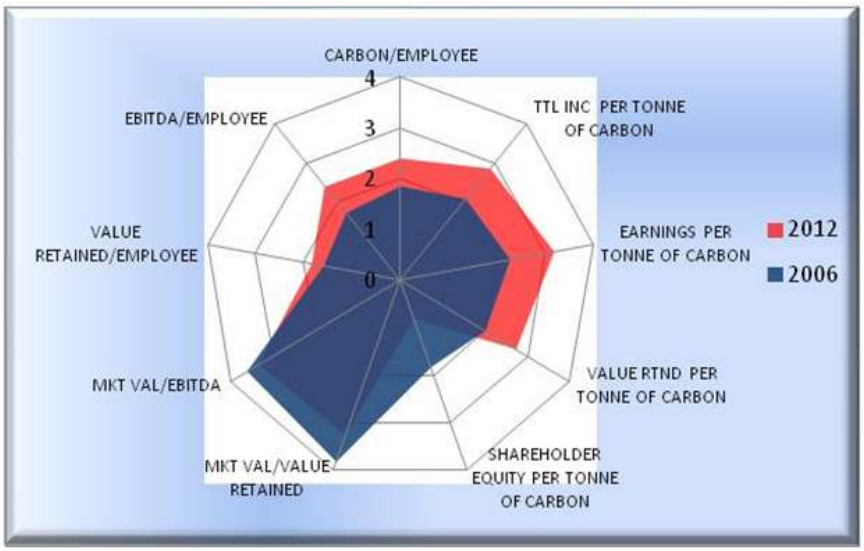
Figure 9. BG Group plc – physical carbon/ financial profile



Source: Author (see also ICAS research report: Haslam *et al.*, 2014a).

In the final example of Reckitt Benckiser Group plc, Figure 10 demonstrates how the benchmarking tool can reorganise the presentation of financial and carbon intensity metrics to show a dynamic performance over time.

Figure 10. Reckitt Benckiser Group plc – physical carbon/ financial profile



Source: Author (see also ICAS research report: Haslam *et al*., 2014a).

By plotting annual metrics for 2006 and 2012, Figure 10 provides an effective indication of how financial performance and carbon intensity have changed over time, relative to other FTSE62 firms. The chart reveals continuing strong relative financial performance by Reckitt Benckiser Group over the six year period, together with a relative strengthening of its carbon intensity performance. The benchmarking tool described in this section opens up the physical and financial numbers to greater scrutiny by converting aggregated totals into relative performance indicators. In this way, the analysis provides improved access to the trade-offs between financial performance and carbon dependence, subject to the framing limitations associated with scope 1 and 2 emissions. Additionally, where anomalies or bias exist in the data, there is a greater chance of exposing these when the carbon/financial data are 'sectioned through different planes' and are juxtaposed for comparison and investigation.

In the next section, the need to provide alternative and supplementary carbon disclosures is considered, and the argument is grounded within a business models framework of analysis. This alternative perspective would require companies to make mandatory disclosures about their carbon-material stakeholder relations. First, the analysis considers how a business models framework of analysis might inform corporate disclosures surrounding carbon emissions.

8.5 A business model approach to carbon disclosure

Haslam, *et al*. (2012) conceptualise business models within an accounting framework but take a different perspective to that formed in the strategy literature, and that of the professional accounting bodies. The strategy literature considers the allocation and deployment of resources to create and capture value, while the accounting bodies are concerned with how business models can influence financial reporting. Haslam *et al*. (2012) provide an alternative framing of a focal firm's business model that is grounded in a reporting entity's stakeholder relations. Their argument is that a focal firm's business model is structured out of stakeholder relations that materially define the value proposition of a business model. Dynamic changes in stakeholder relations structuring a business model can facilitate or disrupt its value proposition. Haslam *et al*. (2012) argue that there are three generic elements to a focal firm's business model value proposition: *Value Creation* (product and process innovation and renewal), *Value Capture* (recalibration of value chains) and *Value Manipulation* (recapitalisation and holding gains).

A significant aspect of this approach to the framing of a focal firm's business models in the business management and strategy literature is that stakeholders, whilst alluded to, are not central to the organising framework. In contrast, a common thread running through stakeholder theory as applied to corporations, is the role and contribution of management in both satisfying and reconciling the needs of a variety of stakeholders that have a legitimate interest in the organisation. This responsibility of management can be broadly specified as 'stakeholder-agency' (Hill & Jones, 1992) or more narrowly as 'shareholder-agency' (Jensen, 1986; 2002).

Evan and Freeman (1993) observe that:

> "A stakeholder theory of the firm must redefine the purpose of the firm. The very purpose of the firm is, in our view, to serve as a vehicle for coordinating stakeholder interests" (Evan and Freeman, 1993: p.102-3).

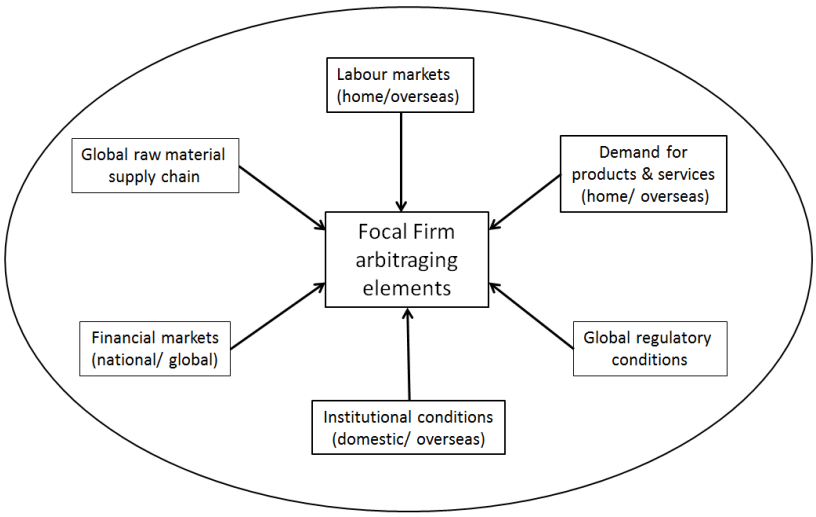
Freeman defines stakeholders in broad terms as: "any group or individual who can affect or is affected by the achievements of the organization's objective" (Freeman, 1984: p.46). Within this theoretical framework, co-ordination between stakeholders is delivered through legally binding contracts, or loose informal relationships that are structured and monitored for the mutual benefit of all parties (see Freeman & Evan, 1990; Hill & Jones, 1992). Freeman *et al*. (2004) observe that the alignment of various stakeholder interests is a primary concern for management. On the one hand the firm is a normative locus for reconciling stakeholder interests and, on the other, there is an

instrumental purpose which is to generate 'outstanding' performance. According to Freeman, stakeholder theory:

> "Encourages managers to articulate the shared sense of the value they create, and what brings its core stakeholders together. This propels the firm forward and allows it to generate outstanding performance, determined both in terms of its purpose and marketplace financial metrics" (Freeman *et al*., 2004: p.364).

A focal firm's business model, according to Haslam *et al*., is the outcome of interactions with a complex network of stakeholders; and the information that arises from these relations serves to broadly define a focal firm's business model (Haslam *et al*., 2012). These interactions generate information that congeals into, and impacts upon, reported financials; even where 'exchange transactions' or 'contracts' are absent. Haslam *et al*. additionally incorporate stakeholder interactions that may not have material value in terms of an exchange transaction into the business model framework of analysis; for example, relations with advisers, ratings agencies, analysts, consultants, regulatory and professional institutions. This is because these stakeholder relations materially help to define the nature of a focal firm's business model, and may also have a significant impact on its viability as a value proposition. Figure 11 identifies a typical arrangement of stakeholders around a focal firm; in which 'arbitrage' is the term used to describe the means by which the focal firm gathers information about its stakeholders, in order to leverage value creation and capture (Haslam *et al*., 2012).

Figure 11. The business model comprising a focal firm and its stakeholders



Source: Reproduced from Haslam *et al*. (2012: p.58)

8.6 Accounting for business models

The concept of the business model is beginning to populate new discourse spaces; with the notable inclusion of accounting. Specifically, the accounting profession and institutional bodies are concerned with providing relevant information, through accounting disclosures, to decision makers. In this regard the business model concept, it is argued, offers new possibilities for framing corporate financial disclosures. According to Beattie and Smith (2013), "the accounting literature has not forged strong linkages with either the more recent strategy literature or the business model literature, resulting in knowledge residing in disconnected silos" (Beattie & Smith, 2013: p.252). Using the Intellectual Capital (IC) debate concerning business reporting, Beattie and Smith argue that management reporting of business models could also help to frame relevant financial disclosures to inform decision makers.

In recent years, the accounting professional bodies have considered the benefits of employing a business models framework within which to structure accounting disclosures; disclosing to 'investors' rather than to a broader group of stakeholders. In their report on business models in accounting, The Institute of Chartered Accountants in England and Wales (ICAEW) suggests that the concept of the 'business model' can support the provision of relevant disclosures to those providing capital funding (ICAEW, 2010). The ICAEW report observes that the nature of a firm's business model can influence whether it may be more appropriate to use fair value (market value) or historic cost to measure assets in the reporting entity's balance sheet.

> "Assumptions about business models have always been implicit in financial reporting standards, as it has always been the case that different businesses will account for the same asset in different ways depending on what its role is within the firm's business model. Questions of cost allocation and revenue recognition for different firms and different sectors are also closely tied to the interpretation of their business models" (ICAEW, 2010: p.8).

Thus the business model is a concept that can help discriminate between methods of asset valuation because this depends upon the purpose for which these assets are to be employed. If assets are actively traded they should be 'marked to market'; and if they are held long-term, for example by insurance companies, then they may legitimately be maintained at historic cost.

The ICAEW application of a 'business model' framework for corporate disclosure is narrowly specified and remains focused on disclosure to 'investors'. In a recent European Financial Reporting Advisory Group (EFRAG) research report, a firm's business model is described by the way its

activities are configured; for example, the extent to which capital intensive activities rely on heavy research and development (R&D) expenditures.

> "Whilst there is no universal defined meaning of the term 'business model', academic literature evidences that the term is increasingly referred to in corporate reporting to describe an entity's activities, its asset configuration (for example, capital intensive or heavy reliance on R&D), and its customers, products and services" (EFRAG, 2013: p.10).

The EFRAG report focuses on how a business models framework would contribute to modifying the 'Conceptual Framework' that governs the purpose and objectives of financial disclosure. Specifically it considers how a business models approach to financial disclosure might affect the fundamental qualitative characteristics of the conceptual framework: relevance and faithful representation, and the enhancing characteristics of comparability, verifiability, timeliness and understandability. Like its predecessors, the EFRAG report focuses on how financial disclosures would enhance the way in which information is provided to investors. However, EFRAG's position is also that a business model framework would contribute towards 'cohesiveness':

> "The need to understand an entity's business model is further increased by development of integrated reporting, which suggests that investors need to rely on a cohesive set of information, encompassing more than only financial statements" (EFRAG, 2013: p.12).

The International Integrated Reporting Council (IIRC) report, entitled 'Integrated Reporting', also defines an organisation's business model; but this time as a "system of transforming inputs, through its business activities, into outputs and outcomes that aims to fulfil the organization's strategic purposes and create value over the short, medium and long term" (IIRC, 2013a: p. 25). This definition is broadly drawn from economic theory of the firm rather than accounting for stakeholders, because it frames the firm as an activity that converts inputs into outputs to create value. In contrast to the professional accounting bodies, the IIRC report does incorporate the need to report to a broader group of stakeholders. Instead IIRC takes the position that a large group of stakeholders "employees, customers, suppliers, business partners, local communities, legislators, regulators and policy-makers" are interested in the value creating capacity of an organisation to create value for investors (IIRC, 2013a: p.4).

8.7 Accounting, stakeholders and carbon emissions

It is clear from the professional accounting association reports that the 'business model', as an organising concept, is influencing thinking with regards to the disclosure of relevant information to

stakeholders, whether this is a broad or narrow group. However, these reports share a common problem in that they do not have a strong 'business model' organising framework, and do not explain how this would practically influence the reform of corporate financial disclosure.

According to Haslam *et al*. (2012), a business model can be attributed with both a structure and a purpose. The purpose of a business model is generally that of delivering financial returns on investment above the cost of capital for investors, but this could be modified or augmented by society to include a physical dimension such as the reporting and disclosure of a firm's carbon footprint within its business model. A final strand to the literature on business models emphasises the importance of 'evaluation', and how numbers and narratives can be used to critically evaluate progress and outcomes (Froud *et al*., 2006). Magretta (2002) refers to 'tying narrative to numbers' and states that there are two tests for a business model: the narrative test ('does the story make sense?') and the numbers test ('does the profit and loss add up?').

Instead of viewing stakeholders primarily as normative constituents of the firm, it is possible to 'twist' the stakeholder/firm relationship so that stakeholders are viewed as active partners in a carbon-generating matrix (Haslam *et al*., 2014b). From this perspective, the reporting entity is engaged in a series of carbon-generating stakeholder relations some of which are more 'carbon-material' than others. The nature of these carbon-intensive stakeholder relationships will vary according to the characteristics that structure a business model and within which reporting entities are subtended. Rather than try to establish reporting boundaries that attempt to partition what is 'inside' from what is 'outside' the reporting entity's control, influence and responsibility (Bowen & Wittneben, 2011), under an alternative framing, the reporting entity may disclose the material carbon counterparties involved with the firm in a chain of carbon generating activities. The use of the term of 'material' in this context contrasts with its status in the *Conceptual Framework for Financial Reporting* (2010), where materiality has become subsumed within an entity-specific aspect of relevance (IFRS Foundation, 2010: AC34). On the contrary it is necessary to reinstate the centrality of materiality, and demand that reporting entities identify and disclose carbon-material stakeholder interactions. This would complement disclosures that may, as has been argued in this thesis, employ arbitrary decisions to set operational boundaries when estimating scope 1, 2 and 3 emissions. Thus, by disclosing carbon-material stakeholders, accounting may help to transform the understanding of those emissions that lie within the organisation's realm of influence, and those that do not.

The significance of a stakeholder-carbon reporting approach is that it 'captures' a focal firm's carbon footprint within its business model, and structures disclosures in the form of carbon-material stakeholder relations. A reporting threshold could be set, for example, at disclosing the top five or ten carbon-material stakeholder interactions. These could be with specific suppliers of materials, external service providers, energy suppliers, distribution services, data warehousing, transport and leasing arrangements. Carbon-material stakeholder interactions could be situated 'inside' or 'outside' of a reporting entity's boundary, where this is defined in terms of ownership and operational control. Table 4 uses a hypothetical reporting entity to illustrate a scenario where the material-carbon stakeholder interactions totalled 90 tonnes CO_2e in 2006, reducing to 81 tonnes in 2012. This type of disclosure would be accompanied by appropriate narratives that describe interventions targeted at reducing the existing level of carbon usage. A reporting entity, in the context of its business model, would be required to disclose the carbon reducing policies associated with its carbon material stakeholders, to reveal trajectories, trade-offs and other factors that are promoting or frustrating a reduction in carbon emissions. In circumstances where carbon reduction is less tractable, within a specific business model, such disclosures would help to inform regulatory policy interventions and structure incentives to modify behaviour. Depending upon the nature of the focal firm/reporting entity business model, these recommendations would encourage varying dialogues between stakeholders, through which business may contribute towards the transition to a low carbon future.

Table 4. Hypothetical reporting entity - carbon material stakeholder relations (tonnes CO_2e)

	Total	Electricity supplier	Material supplier	Data warehousing provider	Car fleet leasing	Travel (air)
2006	90	40	30	15	5	4
2007	86	38	29	12	7	6
2008	85	37	28	12	8	5
2009	84	37	27	12	8	5
2010	84	37	27	12	8	5
2011	82	36	26	12	8	5
2012	81	36	24	12	9	6

Source: Author

This process of disclosure should capture a significant proportion of a reporting entity's carbon emissions and also provide a narrative detailing the principal actions being taken to reduce carbon risk. These disclosures would be expected to remain relatively stable from one year to the next, such that users of carbon accounting information may track elements of disclosure that indicate progress or setbacks against a backdrop of consistent disclosure. In this way, the problem of inconsistent carbon-relevant disclosure, identified in Chapter 7, may be ameliorated.

8.8 Conclusions

This chapter considers how innovative forms of analysis and new disclosure practices might improve the visibility of corporate carbon emissions. It is inspired in part by Rob Gray's call for a plural accounting that challenges the mainstream narrative of sustainability embedded in corporate reports, by setting out how an alternative stream of accounting, grounded in business models and organised around carbon-material stakeholder disclosure, may complement the existing greenhouse accounting methodology which discloses emissions by scopes. In shaping its recommendations, the author has been mindful of Gray's concern that companies may be reluctant to co-operate:

> "Would a company, however, actually want to do this? It has enough to do without looking for more work. And why should a company wash its dirty laundry in public and thereby give ammunition to social activists and pressure groups? Nevertheless it would be rather nice to hear our largest, most influential companies saying this. The sheer size and power of corporations is frequently legitimized through the maintenance of an image of corporate social responsibility. A socially benign company will not mind proving the case. On the other hand, society probably has a right to know which companies have no real intentions of adopting a more open and socially responsible attitude. It may well affect government attitudes and the behaviour of employees, shareholders and customers" (Gray, 1997: pp.206-207).

This chapter attempts to locate carbon reduction in the context of stakeholder relationships. As well as laying the foundation for the subsequent proposals set out in this chapter, the carbon contract provides a rationale for why managers might be receptive to the plural accounting that this thesis (after Gray) envisages.

Accounting alone cannot solve the problem of corporate carbon emissions. But by making emissions more visible, accounting can help to change behaviour and create the space for productive interventions. There is a presumption that business models define the stakeholder interactions that create and capture value, and that these interactions also describe the pathways through which carbon is generated. It therefore follows that the means to reduce emissions may be found by:

1. Inter-stakeholder collaboration to reduce emissions, or
2. Changing the business model, or
3. Government or regulatory intervention, where 1 and 2 (above) prove insufficient.

Management teams can be expected to engage option 1 first, progressing to option 2 if the required reductions in carbon cannot be secured by co-opting stakeholders. Increasing the visibility of emissions is further intended to challenge and frustrate creative accounting and disclosure strategies. Disaggregation into stakeholder interactions 'unpicks' aggregated numbers, and the creation of physical/ financial metrics challenges one number by comparing it with another that has been prepared using a different methodology. Where fund managers are equipped with tools that enable them to view carbon performance from a range of complementary perspectives, firm managers are expected to react by shifting away from creative accounting and disclosure towards a strategy of accountability and improvement.

The third option refers to the kind of scenario where a focal firm attempts to achieve carbon reductions by collaborating with stakeholders, or by changing its business model, yet experiences difficulty in achieving the desired level of carbon reduction. It is envisaged that such a situation might obtain where structural rigidities, or blockages, are encountered which means that the firm's efforts fall short of realising their potential. The plural accounting recommended in this chapter serves to highlight the position, for example, by drawing focus to particular focal firm/stakeholder interactions that have become blocked. In these instances, government or its regulatory agencies may wish to consider whether there is an appropriate case for intervention, or incentives, to facilitate satisfactory resolution of the impasse. Here, the reader is reminded of Milne and Grubnic's call to elevate incentives within the repertoire of climate change policy:

> "There is urgency for research on incentives that encourage actual mitigation of the effects of climate change and on accounting-related blockages that serve to impede progress" (Milne & Grubnic, 2011: p.968).

Benchmarking tools like the one illustrated in this chapter could provide fund managers with a means of incorporating carbon risk into their portfolio construction decisions. Ultimately, carbon risk will be made more relevant if this information about carbon emissions is increasingly factored into managerial incentive schemes and impacts upon asset pricing risk, such as a firm's share price. The inclusion of carbon objectives within executive compensation schemes would be a logical consequence of increased shareholder engagement with carbon reduction, and a natural reflection

of the agency cost of carbon. It is hoped that innovative use of carbon information, like that demonstrated in this chapter, will also help shareholders to understand the carbon intensity and risk of their firms' business model.

Finally, this chapter offers two practical means of supporting the provision of alternative disclosures and use of numbers to construct new narratives about the credibility of carbon reduction within large corporations. These are also faithful to the original calls of Hopwood (2009) and Gray (2010) which suggest the need for experimentation in accounting to generate insight and action towards a less intensive corporate carbon future.

Chapter Nine

Carbon emissions: policy interventions and modifying behaviour

9.1 Introduction

The United Kingdom's carbon reduction commitments are mandated under (and framed by) the Climate Change Act 2008 and the obligations under the Act represent a legacy from the previous Labour administration, headed by Prime Minister Gordon Brown. At the same time as reducing carbon emissions, the Government is concerned with generating business-friendly policies intended to encourage economic recovery.

As revealed in Chapter 4, data from the Office for National Statistics show that United Kingdom greenhouse emissions had reduced by 17.2% against the 1990 baseline by 2010; the objective being an 80% reduction by 2050. Put simply, these statistics reveal that most of the 'heavy lifting' has yet to be done; for there remain 40 years in which to achieve over 80% of the target, and significant investment in new nuclear powered electricity generation has yet to take place. Additionally, much political energy is being absorbed in responding to public resistance to renewable energy installations and the extent to which the greening of power generation will increase home energy costs.

Government, therefore, faces the considerable challenge of decoupling economic growth from carbon emissions, while securing the investment on which economic growth depends. Typically, change of this kind is managed through partnerships between government and industry. However, because the Government also has to restore the public finances, it has limited available funds to invest in the transition to a low carbon economy. At the same time, care must be taken to minimise any avoidable increases in business costs where these threaten the recovery of corporation tax receipts.

Perhaps as a consequence of these conflicting sensitivities, the Carbon Plan, published by the Government in 2011, contains a diverse range of fragmented – and sometimes speculative – activities from which to deliver the planned decarbonisation of the United Kingdom. Accounting is but one of many academic and practical disciplines at the service of society, for the process of carbon reduction occurs across four levels:

1. **Commissioning**: Installing efficient heating, refrigeration lighting and insulation. Re-engineering processes to reduce fuel consumption and emissions.
2. **Enabling**: Designing and developing appropriate technologies that form the basis of more efficient installations.
3. **Monitoring**: Reporting the outcome of carbon generating activities, usually expressed as an absolute value or as an estimate of carbon intensity.
4. **Framing**: Creating the protocols that organise and prescribe the manner by which carbon outcomes are accounted for and reported.

The research questions of this thesis are principally located within levels 3 and 4. Specifically, the approach has attempted to re-frame carbon accounting so that it makes emissions more visible, providing stakeholders and policymakers with a more effective means of assessing the credibility of corporate carbon reduction, carbon risk and incentives informing new forms of corporate governance.

Commitment and trust are preconditions to successful collaboration between the firm and its stakeholders, including government, in reducing carbon trajectories. Unless one party can reassure itself of the intentions of the other, it will not be prepared to undertake the risks inherent in collaboration. Therefore, the proposals in this chapter are divided between those concerned with the design and utility of carbon accounting, and others directed at aligning the interests of stakeholders with the Government's carbon objectives and modifying behaviour to help reduce corporate carbon footprints.

These recommendations position policy as a form of regulation specifying the default response of an individual or entity to a given situation. Typically, corporations bring expertise, flexibility, risk capital and the ability to innovate to the public policy arena. By contrast, government has the ability to proscribe, to invest in large-scale projects, to underwrite risk and to address systemic and structural impediments to the achievement of a grand policy. Good policy making ensures that the appropriate responsibilities are divided between both parties in an effective partnership.

9.2 Presentation and discussion of policy recommendations

This section presents the main policy recommendations arising out of this thesis, and organises them according to the appropriate level of analysis through which climate change policy is exercised. Each

tier is directed towards a separate stakeholder in national carbon reduction; and the aim of these recommendations is to enhance the credibility of carbon accounting and disclosure and carbon reduction policy by aligning the interests of stakeholders with the national carbon objectives and to modify the behaviour of those stakeholders with a material impact on carbon emissions.

These recommendations are highlighted in four panels, and are discussed in greater detail immediately following the presentation of each panel. In each case, the discussion is set out in key themes, with each identified in italic text. Discussion arises directly out of the research findings and is concentrated in those areas most relevant to the research questions investigated by the thesis.

9.3 Recommendations for national governments

National governments
National governments provide policy frameworks and have the power to intervene in the conduct of other stakeholders through legislation, regulation and the provision of incentives.
The research conducted for this thesis reveals that there is no single best way of accounting for carbon emissions at the national aggregate level, and that national systems of carbon disclosure should be kept separate from those used by individual firms because the different accounting methodologies applied to each cannot be easily reconciled. However, greenhouse gas inventories disclosed at the national level need to be deconstructed to reveal contradictions and anomalies, and to inform policy-making. In addition, competing carbon emissions data prepared on a consumption basis should be presented alongside national accounts estimates, which use the point of issue method, in order to highlight contradictions and generate critical insights. *Government must establish its carbon reduction credentials clearly and unambiguously with those in the corporate sector, on whose collaboration it depends if it is to deliver its obligations under the Climate Change Act. Government should be prepared to incentivise appropriate corporate action focused on specific carbon reduction initiatives. The intention must be to embed carbon reduction behaviour, and align the interests of focal firms with government carbon policy. Where appropriate, government may consider intervention and incentives to help resolve structural impediments to less carbon-intensive firm-stakeholder interactions, where these are considered to be material.*

There is no single best way of accounting for carbon emissions at the national aggregate level.

As discussed in Chapter 4, the United Kingdom Government measures the national greenhouse inventory using the 'point of issue' method, under which:

> "National inventories should include greenhouse gas emissions and removals taking place within national territory and offshore areas over which the country has jurisdiction" (IPCC, 2006: p.8.2.1).

The point of issue method is required under the Kyoto Protocol; therefore the Government has no option but to use it. However, the point of issue method calculates a far lower estimate of national emissions than the consumption method, which includes emissions embedded in imported goods and services. The resulting understatement exaggerates the contribution of United Kingdom climate change policy to the mitigation of global warming (Helm *et al.*, 2007), deflecting criticism of the Government's commitment to mitigating climate change (Monbiot, 2008). This thesis suggests that both methods of accounting are required because these establish a contested set of numbers and narratives against which to inform policy framing. Thus a discrepancy between output and consumption measures might reveal how the UK corporate sector is relying on off-shoring and out-sourcing to displace carbon. Consider the example of one such anomaly. A recent newspaper article reports that certain leading firms are repatriating elements of manufacturing to the United Kingdom (Hawkes, 2013). Because the relocated production will incur the consumption of incremental fossil fuel within the territorial United Kingdom, the national greenhouse inventory will increase, even assuming that total consumption of goods in the economy will remain unaffected. On the other hand, one would expect an accompanying reduction in real carbon emissions if finished goods no longer have to be transported from Far Eastern manufacturers to British consumers. In short, point of issue accounting will reveal an increase in national greenhouse inventory located within the specific industry classification codes, and the outcome should compare with the results obtained using the consumption method. Policymakers should conclude that relocation of manufacturing closer to the end customer helps to reduce carbon emissions incurred by United Kingdom residents, despite the absence of evidence in the National Statistics Environmental Account.

The differences between competing methodologies have provoked considerable unresolved debate among commentators. Pragmatism and political expediency appear to have gained the upper hand over completeness and faithful representation. Rather than joining the debate, this thesis prefers to exploit the contradictions it exposes to enhance critical thinking and extend the reach of policy beyond the confines of a single methodology.

National systems of carbon disclosure should be kept separate from those used by individual firms because the different accounting methodologies applied to each cannot be easily reconciled.

Research conducted in this thesis has demonstrated that national (macro), sectoral (meso) and firm-level (micro) carbon footprint estimates cannot be easily reconciled. Chapters 4 - 6 provide considerable detail to support this statement. The inability to reconcile emissions between levels may be attributed variously to the use of different methodologies, particularly the way in which they frame emissions from different sources. Additionally, firms enter and exit the FTSE100 index on which the sectoral estimates were based causing instability among meso and micro data. The compilation of meso footprint totals from firm-level data double-counts emissions embedded in electricity supply and masks considerable rich information about the changing character of emissions over time.

In contrast to national accounting estimates, which reveal a declining trend in United Kingdom business emissions, the datasets prepared for this thesis imply that the emissions of large corporations are increasing. These reconciling differences are the source of considerable ambiguity and carbon emissions are malleable in the sense that they can be readily altered by decisions concerning reporting boundaries. Moreover the credibility of carbon reporting at all levels is undermined by the difficulty in verifying emissions at one level against those of another.

Greenhouse gas inventories disclosed at the national level need to be deconstructed to reveal contradictions and anomalies, and to inform policy-making.

Data loses a considerable amount of information when aggregated. This thesis proposes that the national greenhouse inventory be deconstructed to inform interpretations because it is the occurrence of discontinuous events, which are analysed in Chapter 4, that help explain carbon emissions reduction. The deconstructed national inventory is not a homogeneous dataset, for its constituent elements differ in their character and behavioural properties. Thus policy interventions cannot be expected to exert their effect with equal force throughout the constituent elements of the dataset. These constituents include, for example, each of the six individual gases which comprise greenhouse gas inventories, as defined under the Kyoto Protocol. Alternatively, the data could be cross-sectioned according to other criteria; for example, industrial sectors.

This thesis proposes the use of univariate CUmulative SUM deviation (CUSUM) as a means of analysing the deconstructed national inventory data. As demonstrated in Chapter 4, CUSUM is an innovative and penetrating statistical technique which can be used to reveal change-points in

longitudinal datasets. Upon completion of the CUSUM calculations, the results are charted and change-points identified. These change-points indicate the precise time at which events occurred to alter the pattern of behaviour. Once these timings have been identified, they can be used in a forensic examination to determine the precise events that have coincided with changes in behaviour. This research has used CUSUM to analyse the emissions of each constituent greenhouse gas over the period 1990 – 2010. Coincident with the analysis, it has identified a number of structural changes in United Kingdom social and industrial behaviour. The analysis in this thesis reveals that both methane and nitrous oxide emissions have declined sharply during the 1990s as a result of structural changes in society and industry. However, because these events were discontinuous (i.e. significant and non-recurring), emissions of methane and nitrous oxide cannot be expected to reduce at similar rates into the future. Policymakers must therefore turn their focus on carbon dioxide emissions as the source of meaningful future reductions. Once again CUSUM helped to identify carbon dioxide as a particular challenge, for it has remained relatively resistant to carbon reduction policy (see also Helm *et al*., 2007). The analysis shows that carbon dioxide emissions respond significantly to identifiable economic events; rising and falling in the same direction as changes to consumer disposable income.

CUSUM is a particularly sensitive tool, and its use is recommended to policymakers for the analysis of disaggregated datasets. It has the advantage that it is relatively straightforward to perform the calculations and plot the data in charts using Microsoft Excel. It is also amenable to application to data in the form presented by the Office for National Statistics Environmental Accounts. Against these advantages, CUSUM data can be conceptually demanding to interpret, and the determination of behaviour-changing events requires further detailed research. This is because the identification of events using CUSUM requires a broad understanding of a range of industries over an extended historical timescale, where different science and non-science discourse can help with interpretation of change

Competing methodologies and accounting measurements should be used in tandem to encourage the construction of critical narratives that challenge anomalies and inform innovative policy interventions.

Where a party is required to account for its performance under conditions of complexity and ambiguity, rationality dictates that they will account and present information in a manner intended to demonstrate that 'everything is OK'. This thesis has previously described this type of behaviour as impression management. If a positive impression is created, the accounting party emerges with

legitimacy, and any pressure on that party to devise and execute additional remedial activity is reduced. This characterisation can be applied with equal merit to corporations or governments.

However, the problem of climate change mitigation corresponds with what West Churchman described as a 'wicked problem':

> "that class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (West Churchman, 1967: p.141).

West Churchman goes on to criticise 'attempts to tame' the wicked problem by generating 'an aura of good feeling of consensus', which he considers to be deceptive and morally repugnant:

> "Deception becomes an especially strong moral issue when one deceives people into thinking that something is safe when it is highly dangerous" (West Churchman, 1967: p.142).

This thesis proposes that national carbon accounting should be reoriented to demonstrate that 'everything is *not* OK'; because carbon emissions are currently unacceptably high and they should be the focus of policy imperatives. By juxtaposing the competing methods of inventory estimation and actively seeking to highlight and understand areas of conflict and confusion, narratives will emerge that cast performance in a critical light and open up dialogue. Climate change can only be tackled if it is viewed from a range of perspectives, deconstructed, reconstructed, argued over and stress-tested; and the process continuously repeated over multiple cycles. Critical thinking and dialogue are essential for the suppression of powerful tendencies that encourage wilful blindness, such as obedience, conformity and 'bystanding' (Heffernan, 2011). Actively seeking creative discomfort requires political courage and the creation of space in which the discussion of uncomfortable truths is encouraged. Open and critical thinking among policy makers brings them closer to discovering 'whatever it takes' to reduce the national greenhouse inventory; pre-requisite to a committed position. By being critical and seeking creative discomfort, the credibility of government carbon reduction policy is enhanced along with the prospect of a genuine United Kingdom contribution to the abatement of climate change.

Government must establish its carbon reduction credentials clearly and unambiguously with those in the corporate sector, on whose collaboration it depends if it is to deliver its obligations under the Climate Change Act.

If the government seeks to engage large corporations in a partnership of progressive and enduring carbon reduction, it must first demonstrate the credibility of its stated intentions to the satisfaction of its potential partners. This thesis argues that the mere declaration of intent is insufficient to demonstrate its authenticity.

Corporate managers are entitled to take a view on the long-term intentions of government, when they are asked to make a commitment lasting several decades. It has been argued in Chapter 2 that, in common with politicians, business leaders prize flexibility as this helps them to deliver shareholder value into an uncertain future timescale. Because risk management is a fundamental responsibility of corporate leadership, it follows that business managers seek certainty in respect of future government policy if they are to invest money, reputation and legitimacy in pursuit of a shared objective.

To some extent, the Climate Change Act has tied the hand of future administrations to a low carbon future, by imposing legal obligations upon government at specified timescales. For example, in addition to mandating an 80% reduction in national greenhouse gas inventory by 2050, an interim reduction of 34% by 2020 is also mandated by the Act. Both targets have deadlines and are 'legally binding'. However, the consequence of failure to meet these targets can appear to be opaque. Business managers cannot easily assess the credibility of government resolve under the Climate Change Act in terms that they can understand. Nor can they relate to the consequences to the Government in the event that it fails to achieve the mandatory carbon reductions.

The risk associated with declarations of intent is exacerbated by the potential for impression management by either collaborating party. The Government must be made aware of this risk and should seek to take steps to strengthen its carbon credibility, as perceived by its would-be corporate partners. The United Kingdom Foreign Secretary, at the time of writing, displayed an awareness of the need to voluntarily restrict the future flexibility of government when attempting to persuade others of the credibility of its promises. In the context of the proposed referendum on the future of Britain's membership of the European Union, William Hague responded to the charge of weakened public trust in the declarations made by politicians:

> "What we're doing here is strengthening our commitment. I think it's fair to say that across the whole of politics in this country and many countries, there is often a lack of trust. That is self-evident in the politics of our country and many countries. So when we can do something to make our commitment clearer, to entrench a commitment, then we should do so. This is one way of doing so; as I say, if we were a majority government it would be much easier to do so. We would just pass the legislation in this session of Parliament" (Hague, 2013).

By using a similar strategy, government can act to enhance the credibility of its intentions by devolving responsibility for key aspects of policy to an apolitical institution. In 1997, the Bank of England was granted independence from political control, allowing it the authority to set interest rates commensurate with achieving an inflation target of 2.5%.

Government therefore has the similar option to set up an independent body, endowed with the authority to manage specific elements of climate change strategy, conditional on other specified economic criteria. Action of this kind may have the effect described by William Hague. of reinforcing the credibility of the Government's position under the Climate Change Act If the government were to favour this option, the nominated body must possess delegated authority which must not be confused with the advisory status given to other bodies such as the Office for Budget Responsibility, or the Committee on Climate Change.

Governments should be prepared to incentivise appropriate corporate action focused on specific carbon reduction. The intention must be to modify carbon reduction behaviour by aligning the interests of focal firms with government carbon policy; and focal firms with their stakeholder networks

Governments will need to contemplate a more interventionist stance towards national carbon reduction than has been observed to date. However, an effective policy recognises that there are roles for government and different roles for corporate entities in the achievement of shared social and environmental endeavours. Government should therefore recognise those instances where it is appropriate to intervene and distinguish them from other cases where companies possess the comparative advantages of innovation or agility. The strategy of government should be to enable corporate entities to make the required reduction in carbon by creating the conditions in which the carbon reduction interests of these firms are aligned with those of government policy. This chapter later recommends that an appropriate carbon accounting framework increases the visibility of carbon emissions within the business model of a focal firm, creating an impetus for the firm to negotiate carbon reductions with its carbon material stakeholders. However, it is likely that cases will arise where there are significant cost hurdles that prevent the firm and its stakeholder(s) from

making a step change in carbon emissions. In such cases, it may be appropriate for government to consider the structuring of incentives designed to promote collaborative carbon reductions.

9.4 Recommendations for private regulatory bodies

Private regulatory bodies
These non-governmental standard setters include the World Resources Institute (WRI), World Business Council for Sustainable Development (WBCSD), Climate Disclosure Standards Board (CDSB), International Integrated Reporting Council (IIRC), Carbon Disclosure Project (CDP), Global Reporting Initiative (GRI) and Sustainability Accounting Standards Board (SASB).
Private standard setting bodies have an important contribution to make to the process of corporate carbon reduction, where they can offer innovative and imaginative solutions to carbon measurement and reporting. However, those standards currently in force prescribe reporting boundaries that are malleable and ambiguous, and which permit inconsistent carbon accounting between similar firms. This thesis recommends that the private standards bodies encourage the development and adoption of plural corporate carbon accounting methodologies.

Private standard-setting bodies should encourage the development and adoption of plural carbon accounting methodologies as a means towards overcoming the difficulties associated with carbon reporting boundaries.

This thesis has critiqued the determination of emissions into scopes 1, 2 and 3 by the GHG Protocol, and has argued that boundaries set in this way are malleable and ambiguous because they permit the exercise of managerial judgement over which emissions fall within the firm's ownership and responsibility. Callon (1998) states that the determination of boundaries is the traditional accounting approach to defining a calculative space in which economic agents can pursue their objective of optimising their returns. Private standard setters are relatively free from institutional and conceptual legacies such as those that constrain the professional accounting institutes. This freedom might allow them the liberty to experiment and innovate, rather than translating existing financial accounting frameworks into carbon accounting templates in an attempt to overlay one upon the other. However, these alternatives do not tend to focus on how disclosures should be framed to tackle the issue of reporting entity boundary and malleability.

This thesis argues the case for locating carbon disclosure within a business models framework that identifies and structures disclosure using a limited number of carbon-material stakeholder

relationships. Rather than simply overlaying complementary accounting formats, this approach sets up a plural accounting where alternative framings permit cross-comparison and the identification of discrepancy and contradiction which sets up a process of dialogue and challenge in the place of a solitary corporate carbon narrative (Froud *et al*., 2006). Additionally, presentation of disclosure within competing frames can help limit impression management in corporate reporting because these material carbon stakeholder relations are expected to remain relatively stable over time

9.5 Recommendations for financial intermediaries

Financial intermediaries
For the purpose of this analysis, financial intermediaries include those organisations that connect capital with investing opportunities; such as banks, pension funds and mutual funds. Financial intermediaries and the analyst community have a positive role to play in helping to price carbon risk into asset prices.
Analysts and financial intermediary institutions have an important role to play in pricing carbon risk into investments. In order to bring this into effect, it will be necessary to find practical means of aligning carbon risk with the interests of analysts and institutions. This thesis recommends that carbon emissions disclosures should be incorporated into innovative interpretive software tools that can increase the visibility of a corporation's carbon performance relative to a peer group of investable firms. These tools have the potential to inform stakeholders about carbon risk and the trade-offs between carbon usage and key financial performance metrics. In addition, the same tools may assist in recalibrating the aggregate 'capital stack' (combination of equity plus long-term debt) of investment sectors and portfolios according to less carbon-intensive parameters, and to help price carbon risk into investable assets. The use of these tools and techniques may potentially change behaviour if the failure of firms to reduce carbon intensity ultimately results either in capital flight towards more carbon-efficient investments, or an increasing cost of capital.

Carbon emissions disclosures should be incorporated into innovative interpretive software tools that can increase the visibility of carbon performance relative to a peer group. These tools have the potential to inform stakeholders about trade-offs between carbon usage and key financial performance metrics.

This thesis argues that carbon footprint accounting can be an effective mechanism for reducing corporate carbon emissions if it is impactful in changing behaviour. However, Campbell and Slack (2011) and Kolk *et al*., (2008) observe that sustainability reports lack value or perceived relevance to investors and analysts. In addition to the arguments made previously, in favour of a plural accounting including disclosures reframed around a business model stakeholder approach, this

thesis recommends that carbon and financial disclosures be incorporated into innovative software tools that can increase the visibility of a firm's carbon intensity over time, and relative to an investable peer group.

Chapter 8 provides examples of information extracted using a prototype software tool that was developed for an Institute of Chartered Accountants Scotland (ICAS) funded project. In its present form, such a toolkit enables the evaluation of the carbon-financial risk of an individual company over time, relative to an index of firms and in comparison with other potentially-investable individual firms. This facility makes visible the relative carbon intensity of different firms available to an investor, while simultaneously revealing trade-offs between carbon intensity and financial performance. Software tools of this kind provide analysts with the ability to make capital allocation decisions that are informed by carbon intensity constraints. Alternatively, carbon risk can be factored into the investment decision in order to leverage higher potential returns against an increased carbon risk. Where analysts employ these tools and incorporate the data into their recommendations, the behavioural consequence of carbon accounting can potentially lead to a reduction in aggregate corporate carbon emissions though a recalibration, along less carbon intensive lines, of the aggregated 'capital stack'; defined as the equity and long-term debt finance within an invested portfolio (see RVA Consulting, 2014).

9.6 Recommendations for corporate governance at firm level

Corporate governance
At the level of the individual firm, accounting can inform corporate governance when it is combined with performance metrics and material incentives
Financial carbon reduction incentives incorporated into management remuneration packages should materially encourage a reduction of absolute carbon emissions. Innovative carbon risk toolkits can be used to align corporate carbon-financial risk with the expectations of analysts and financial intermediaries. *The scope and scale of mandatory carbon disclosure should be progressively extended, and the reporting of scope 3 emissions be mandated at the earliest opportunity. In line with recommendations made to the professional accounting institutes, corporate carbon accounting and disclosure should be reoriented also towards a business models framework, where carbon reduction strategies should focus on altering behaviour between carbon-material stakeholders*

Managerial financial incentives should be adjusted to encourage reduced absolute carbon emissions and should be expanded to comprise a more significant proportion of total management compensation.

This thesis provides case study evidence that financial compensation in return for the achievement of carbon reduction objectives constitutes a minimal proportion of executive remuneration packages. A detailed case study, which comprised four FTSE100 firms in the mixed-retail sector, revealed that only two of these firms incentivised carbon performance and that, in each case, payment of carbon bonuses was conditional upon achieving a threshold financial performance. Where payable, these carbon rewards amounted to less than 3% total directors' emoluments. Whilst taking care not to extrapolate from cases, this thesis recommends that large companies in particular should rebalance executive reward schemes; transferring a meaningful proportion of total reward from financial into carbon-financial performance metrics. Rather than specifying an arbitrary proportion of compensation dedicated to carbon goals, this thesis will recommend further research in this area: for example, to what extent do senior executive remuneration packages in the FTSE 100 incorporate carbon metrics; and what is their materiality and priority? The objective of this recommendation is to reorient management compensation schemes so that the interests of managers are brought into alignment with government policy on carbon reduction; with shareholders for whom a reduction in emissions translates into a reduction in carbon risk; and with broader stakeholders when carbon emissions are reduced.

This thesis also recommends that managerial carbon incentives should not be conditional upon the achievement of profit thresholds. This recommendation is based on the argument that if managers can substitute financial rewards for carbon reduction and still earn on-target bonuses, then there is no managerial opportunity cost of carbon. Similarly, there is no agency cost of carbon because investors are not prepared to commit resources to ensure that managers avoid conflicts of interest between the achievement of financial and carbon objectives.

Innovative carbon risk toolkits should be used by managers in order to align corporate carbon risk with the expectations of analysts and financial intermediaries.

The previous section explained the potential of carbon risk toolkits to improve the visibility of carbon emissions and to reveal trade-offs between corporate carbon intensity and financial performance. These toolkits are primarily designed to embed carbon risk within the decision-making of investment analysts and others with the responsibility for incorporating carbon risk into asset pricing. However, where the objective is to modify corporate performance along less carbon-intensive lines, it makes

sense for managers to use the same or similar tools so that they may use carbon accounting data to recalibrate carbon-financial strategy and deliver performance in line with analyst expectations.

The scope and scale of mandatory carbon disclosure should be progressively extended at the earliest opportunity.

The United Kingdom has become the first country to mandate carbon disclosure for companies listed in the London Stock Exchange. Regulations contained in the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 come into effect from 1st October 2013, and apply to all companies listed on the main market of the London Stock Exchange in respect of financial years ending on or after 30th September 2013.The scope of the requirements under the Regulations is relatively modest. Eligible firms must report their aggregate emissions comprising the six greenhouse gases in one total figure, and managers are given the discretion to choose from among "robust and accepted methods" (DEFRA, 2013b: p.29). In addition to the aggregate total, companies are required to disclose 'at least one' intensity figure in their annual report.

This thesis argues that the inclusion of a single intensity figure will add little value to statutory corporate carbon reporting. Given the range of intensity figures available to managers, the freedom to choose a single indicator is likely to facilitate impression management (see Chapter 6). In the case of the supermarket sector (and two out of four FTSE100 supermarket firms), carbon emissions per square foot have declined during 2006-2011, while absolute emissions have risen over the same period. This thesis argues that intensity figures may be more usefully employed when more than one indicator is used in order to present multiple perspectives on the carbon performance of the focal firm. In this way it is possible to cross-check claims: for example, if more sales revenue is being generated from a tonne of carbon, then it is useful to determine whether this is also the case for value retained (value added) and cash earnings (EBITDA). Because the recommendations contained in the 2013 Regulations only apply to certain listed companies, they are likely to have a very limited effect. Datasets contained in Chapter 5 reveal that 84 of the FTSE100 group of leading companies already disclosed their absolute emissions as at 2011. Therefore, if the aim of policy is to use mandatory disclosure to increase the visibility of corporate carbon reductions, legislation should increase the number of companies covered by the Regulations and/or the disclosure content required of each firm. This thesis recommends policy movement in both areas: namely that emissions data disclosures be mandated for all listed companies on the London Main Markets and that the government extends the remit of the legislation to cover all large companies as soon as possible; such as extending to the London AIM market. Usefully, an extension of this nature would

cover United Kingdom registered subsidiaries of multinational companies with overseas listings and capture smaller SMEs.

The reporting of corporate scope 3 emissions should be mandated at the earliest opportunity.

This thesis reveals that only 17 companies within the FTSE100 have continuously disclosed scope 3 emissions for the period 2006-2011. Moreover, where reported, scope 3 emissions were found to vary in their completeness with most reporting firms choosing to restrict the scope of disclosure to 'business travel'. This constitutes an unduly limited representation of total scope 3 emissions, which can account for up to 80% of total organisational carbon footprint (Carbon Trust, 2013).

It is the scale of scope 3 emissions as a proportion of total footprint that makes their inclusion so urgent. At the same time, the estimation and measurement of scope 3 emissions is more complex than is the case for scopes 1 and 2. To illustrate these relative complexities, the latest version of the GHG Protocol Corporate Standard (2004), which considers scopes 1 -3, runs to a total 114 pages. In 2011, WRI & WBCSD published their Corporate Value Chain (Scope 3) Accounting and Reporting Standard, which dedicates its entire 149 pages to the treatment of scope 3 emissions (WRI & WBCSD, 2011a).

In recognition of both the importance and difficulty of mandating scope 3 disclosure, this thesis recommends a phased approach. At the earliest opportunity, scope 3 disclosure should be added to the list of mandatory disclosures under the Companies Act 2006 (Strategic and Directors' Reports) Regulations. As with scope 1 and 2 emissions, mandatory disclosure should be extended to all listed companies. In the first instance, companies would be required to report scope 3 emissions in tonnes CO_2e, specifying the sources of emissions reported as scope 3. Where the reporting entity believes that its scope 3 disclosure is incomplete, it should be required to state an estimate of the percentage of total scope 3 emissions covered by its estimate, and to disclose which additional scope 3 emissions it intends to disclose in the following annual report, together with an estimate of the additional percentage of total scope 3 emissions that this is expected to represent.

In addition to these recommendations, policymakers should consult with interested parties to determine an appropriate timescale within which all listed companies can be expected to report *complete* scope 3 inventories.

Carbon reduction strategies should focus on altering behaviour within carbon-material stakeholder relationships and modifying business models, where the intention is to create value from a reduced carbon footprint.

Using a business model framework of analysis to conceptualise disclosure, it is also argued that a reporting entity should disclose its top 5 or 10 carbon-material stakeholder relationships; providing disaggregated emissions data describing these interactions, and information about the extent and quality of collaboration between the focal firm and each of these stakeholders in reducing emissions. These disclosures should reveal trade-offs between value creation and carbon reduction, and disclose how these are being resolved. In some cases, further substantial carbon savings may be contingent upon government intervention and regulation. For example, where the focal firm is in a weak bargaining position *vis à vis* a larger and more powerful supplier, there may be an appropriate case for regulation where the resulting benefits are scalable. In other cases, there may be considerable fixed costs associated with low-carbon investments which demand external support in the form of government guarantees or licences to support the continuing adaptation and change within a carbon-dependent business model. Disclosure of carbon material stakeholder relations would reveal impediments and logjams that the focal firm and its stakeholders might not be able to resolve without national or regional government support. Thus corporate disclosures would provide information that could inform policymakers how interventions could be targeted towards the achievement of significant and sustainable reductions in carbon usage.

When considering intervention or incentives, policymakers should first consider whether the involvement of government and its agencies is appropriate. In a great many situations, firms may be better able than governments to innovate and adapt to signals in the market. Some of this thesis' proposals exploit this argument: the expectation is that firms will respond to greater visibility of corporate carbon data where disclosure alters relationships with their stakeholders. For example, where disclosure impacts on the capital allocation decisions of ethical investors, firm managers will be motivated – and will innovate to find new ways – to reduce their carbon emissions because their business models depend on achieving access to capital on satisfactory terms.

Government intervention should be reserved for those situations that cannot be resolved by businesses alone, or where government can achieve the desired goal with greater efficiency. These might include the public underwriting of risks associated with investment; where those investments have the potential to cut carbon emissions across a wide range of industries. In other cases, intervention may result in new legislation, or regulation designed to remove structural rigidities that prevent firms from achieving carbon reductions due to factors beyond their control. Lastly

government could consider making changes to the tax system; rewarding 'responsible' firms with lower corporation tax rates, which are funded by increasing the tax rates on 'irresponsible' firms (Mayer, 2013). In this way Government is employing both its capacity to underwrite risk, impose new regulations, legislation and tax incentives to modify behaviour.

Policy frameworks should shift carbon reduction focus away from industries towards business models. The key to more carbon-friendly business models may lie in simplifying supply chains and stakeholder networks.

Although there may be cases where it is essential to focus carbon strategy on specific industries (e.g. the electricity generation sector), this thesis recommends that government carbon reduction policy be informed by the nature of business models not simply firms within industries. Lessons learned from the 2013 United Kingdom horsemeat scandal suggest that simplification of business models and supply chains may be instrumental in increasing management control over stakeholder interactions (Philips, 2013; see also Bowman *et al*., 2012).

9.7 Opportunities for future research

As this thesis developed, a number of further research opportunities became apparent.

Research should continue to investigate the scientific consensus on climate change and how this can inform political and economic narratives and measurements.

The literature review in Chapter 2 reveals that while the scientific consensus has permeated the political narrative, it has proved more difficult to achieve a commensurate economic consensus on the cost of climate change mitigation, and the most cost-effective approach to climate change policy. The influential Stern Review has met with resistance from distinguished quarters, including William Nordhaus and Robert Mendelsohn, both from Yale University; Martin Weitzman from Harvard and Dieter Helm of Oxford University. This thesis advocates critical disagreement and recognises that is an essential component of dialogue, through which complexity is explored and is indispensable to sustainable solutions. Having exposed the complexity, these eminent economists would do well to collaborate, work through the complexities that they have striven to expose and harness their combined intellect in resolving their epistemological disagreements; thereby helping to advance consensus on the economics of climate change.

The prospects for such collaboration are slight. Frey *et al*. (1984: p.994) observe that economists frequently disagree on the basis of the beliefs that they hold; for example on "outspokenly

normative positions on income distribution and government spending" and "propositions on … hotly debates issues such as monetarism or supply-side economics". However, there may also be another impediment to collaboration; where the self-interest of distinguished economics scholars is served by creating a distinctive reputation through critique and the formulation of alternative discourse, rather than by alignment with the output of their competitors.

Researchers could conduct studies that specifically examine the role of accountants in carbon footprint accounting.

While this thesis has placed considerable focus on the output of carbon accounting and disclosure, there is considerable scope to conduct research into the human and cultural influences on carbon footprint accounting. In this respect, it would be interesting to study financial accountants, whose responsibility it is to produce the financial statements to appraise investments and obtain and allocate investment funds; and the 'corporate social responsibility accountants' who prepare the sustainability and carbon footprint sections of the annual and corporate social responsibility (CSR) reports. The objective of this study would be to determine whether cultural differences between these two types of accountant have impacted on carbon accounting and disclosure.

Researchers should consider conducting parallel studies in other countries

This thesis obtains its data entirely from United Kingdom sources. At the same time, these sources are subject to international influences, including international protocols on physical carbon measurement, national greenhouse inventories, voluntary corporate greenhouse accounting standards and international financial accounting standards. However, it would be interesting to expand the study by incorporating findings from other countries. These may include countries whose cultures and/or economies differ from those of the United Kingdom.

Broadening the cultural reach of the study has several potential benefits. In essence, each country examination comprises a case study; a contextual laboratory in which to evaluate carbon footprint accounting and disclosure and consider the impact of variation and identify best practices. It allows researchers to consider the advantages and drawbacks of different corporate and managerial incentives, and regulatory regimes on carbon accounting. It also allows a more comprehensive study into the extent to which accounting reveals the extent to which corporate actors engage with carbon reduction, and the impact of local cultural influences on their attitudes towards reducing the corporate carbon footprint.

Researchers should investigate the potential for incentives to be used to reduce corporate carbon emissions.

During the course of this research, the use of incentives has been considered in the context of senior executive compensation schemes (Chapter 7) and at a national level, where their use may be appropriate to relieve structural resistance to carbon reduction (Chapter 8). Future research should focus on practical means of developing and applying incentives to reduce corporate carbon trajectories.

In the first instance, it would useful to conduct research over a wider sample of firms to determine the extent to which carbon objectives are incorporated into executive compensations schemes. A full survey of the FTSE100 group would provide a substantial base from which to build appropriate messages to a range of stakeholders including company managers, fund managers and policymakers. A separate stream of research should aim to identify those areas where government incentives might be instrumental in removing structural impediments to carbon reduction. One obvious example is the United Kingdom electricity generation industry, where the government has underwritten the commercial risk of developing new nuclear generation at Hinkley Point; guaranteeing the contractor a long-term, index-linked price per megawatt hour of generated electricity (United Kingdom Government, 2013). By providing a guaranteed price tied to generation (but not consumption) per megawatt hour, the government has acted in a way that reduces the contractor's development risk to an acceptable level, and that facilitates investment in low carbon electricity generation[36].

Researchers should investigate and identify specific interventions appropriate to different business models.

The disaggregation of corporate carbon emissions and reporting by top 5 or 10 carbon-material stakeholder interactions is a significant recommendation of this thesis. By making visible the emissions generated through these interactions, the intention is to use accounting to promote behavioural changes by the focal firm and its stakeholders.

Future research should undertake a range of studies to determine interventions that are appropriate within different business models. Once again, the research should aim to move beyond conceptualisation to give practical guidance to managers. Moreover, researchers should remember that different business models can be found within the same industry, as seen in the mixed-retail

[36] It has been argued that electricity generated by nuclear installations is not carbon-free, due to the carbon-intensive nature of plant construction and the mining, milling and enrichment of uranium (e.g. Kleiner, 2008).

case study, where Wm. Morrison Supermarkets differs from the other three case-study firms because it manufactures a greater proportion of its food products in-house.

Researchers should investigate the resistance among company managers to investment in energy efficiency.

In the United Kingdom, government interest in industrial energy efficiency has a long history. Harris (1994) traces this back to 1943, when the Minister for Fuel and Power invited Oliver Lyle to develop techniques used in his sugar refining business for application across a broader range of industries. In 1994, Touche Ross Management Consultants were commissioned to report to the Department of the Environment on obstacles to the uptake of energy efficiency measures.

Touche Ross identified obligatory and discretionary investments in energy efficiency and divided the latter into strategic and non-strategic categories. Strategic investments are usually associated with processes. The report noted that there were differences in the investment attitudes encountered in high, medium and low energy-intensity industries. Firms in high energy-intensive industries generally believed that they had identified and acted on most of the cost-justified opportunities. However, medium and low energy-intensive intensity firms tended to set higher hurdle rates for investment in discretionary non-strategic investments in energy efficiency (Touche Ross Management Consultants, 1994).There is an opportunity to update this research for the post-Climate Change Act era.

Research into the perception of carbon risk by analysts should consider the position of buy-side analysts.

This dissertation observes from Campbell and Slack (2011) that sell-side bank analysts describe sustainability reports as being 'unread and immaterial':

> "It is perhaps curious that whilst end user need were occasionally considered in the case of ethical/SRI funds, there was no evidence that sell-side analysts believed other information users such as mainstream fund managers and investors might require environmental risk information to be considered in their evaluation of bank risk and value" (Campbell & Slack, 2011: p.59).

Yet at the same time, this thesis has argued that the management of carbon risk is the relevant preoccupation of investors with regard to corporate emissions, and has drawn on the work of others who foresee an increasing movement of investable funds away from fossil fuel intensive sectors and into less carbon-intensive industries (Leaton *et al*., 2013; Stevenson *et al*., 2012; Gore & Blood, 2013). There is potential to investigate the perception of carbon risk on the part of buy-side analysts. Buy-side analysts produce recommendations for pension funds and other collective investment

schemes, based on research into whether individual investments are compatible with the objectives of the investing institution.

9.8 Conclusions

The findings and arguments presented in this chapter are structured and presented in such a way as to emphasise their relevance to different stakeholders. It is hoped that these findings contribute towards the efforts of other to reduce the trajectory of carbon emissions over the timescale mandated by the Climate Change Act.

The challenge is great and the scope for learning and adaptation is daunting. For these reasons, it has been necessary to defer some aspects of research to the future and to entrust these to future researchers. This chapter presents the specific findings of this thesis while revealing avenues that need to be researched but are practically beyond the scope of this thesis

Chapter Ten

Conclusion

10.1 Introduction

This thesis makes a contribution to the emerging literature on carbon footprint accounting. It begins with the presumption that carbon reduction is a collaborative enterprise; that large companies must play an important role in achieving national carbon reduction objectives and that trust is an instrumental characteristic of productive collaborations. On the basis of these presumptions, the research questions the extent to which carbon accounting is a credible indicator of organisational carbon reduction and whether any shortcomings in this regard have important implications as government and business work together to reduce national carbon emissions.

The recommendations of this thesis aim to address some of the difficulties inherent in the current design of the carbon accounting framework and to increase the visibility of carbon emissions in the corporate financial value chain. In this way, these recommendations seek to reorient carbon accounting towards broad stakeholder relations thereby stimulating dialogue, modifying behaviour and providing the impetus for targeted policy interventions.

The research objectives of the thesis were organised as follows. First, the research undertook to determine whether numbers could be used to create alternative critical narratives of carbon reduction credibility at national (macro), sectoral (meso) and firm (micro) levels. Second, it set out to create physical and financial datasets that reveal carbon trajectory and financial performance at the meso and micro levels of analysis. Third, the research questioned the extent to which large corporations present in the FTSE100 group of leading firms had reduced their carbon footprints since 2006. The fourth objective was to extract and categorise corporate report narrative statements to ascertain whether these reveal different levels of carbon reduction credibility among large corporations. Finally, the investigation explored how narratives about carbon emissions reduction might be challenged by the imaginative use of numbers, and how these might help formulate critical interventions and frame new policy initiatives.

10.2 Mapping out the research

Before reviewing the findings, it is useful to consider how the literature review has mapped out the terrain for the remainder of the study. Because carbon accounting is a subset of sustainability accounting, and of accounting itself, it has been necessary to locate the study in its broader context. In the first instance, however, it was decided to adopt a structural approach and to conduct a systematic census of the top rated academic business journals with an Association of Business School (ABS) 4-rating, and determine the population of relevant and current papers from which to conduct the literature review. Chapter 2 describes this process in detail, and explains how environmental and climate change themes were significantly under-represented in these journals. The paucity of relevant literature articles in the 4-rated accounting journals was particularly acute, as these titles contained a mere 18 and 5 environmental and climate change papers respectively. A larger number of carbon-relevant accounting papers were published by ABS 3-rated journals. In general the literature can be grouped into three broad streams. In the first, the literature considers the scale of economic development to be inexorable and that carbon emissions will rise to dangerous levels unless urgently addressed (Helm *et al*., 2007; Helm, 2008). The second criticises the notion that carbon accounting should be brought into the domain of accounting and regulated via the market mechanism (Lohmann, 2009). In the third stream, accounting is portrayed as problematic because it is difficult to frame reporting boundaries (Helm *et al*., 2007; Helm, 2008; Ascui & Lovell, 2011; Bowen & Wittneben, 2011).

Scarcity of literature can indicate a new or underdeveloped field of study. An alternative interpretation implies that developments to date may have been conducted in the field, rather than by the academe. In the case of corporate carbon footprint, the Greenhouse Gas Protocol (GHG Protocol) has emerged as the *de facto* accounting standard, and the Carbon Disclosure Project (CDP) has become established as a significant repository of self-reported carbon data. Both of these programmes represent examples of private entrepreneurial initiatives (Andrew & Cortese, 2011). In this respect, Mathews (1997) earlier lamented that business rather than academia and the accounting institutes are leading environmental accounting initiatives. Other studies suggest that carbon accounting information in its current form is neither helpful, nor being used by investors and analysts in decision-making (Kolk *et al*., 2008; Campbell & Slack, 2011).

The direction of this research has therefore focused in the first instance on the framework of carbon accounting, and is concerned with how carbon accounting informs users about the credibility of organisational carbon reduction. This focus is justified by the calls of Hopwood (2009) and Gray

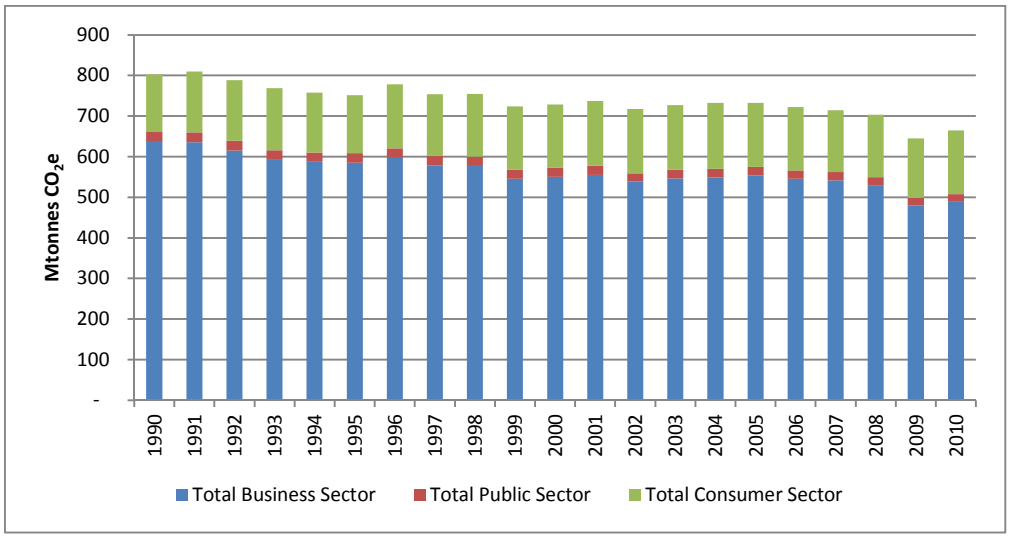
(2010) for researchers to experiment with practical representations of what sustainability (and by implication carbon) accounting might look like. Taking into consideration the limitations of accounting technology, and the difficulty of using social constructions to try and represent the relationship between an organisation and complex natural systems (Gray, 2010), carbon accounting is more meaningfully oriented towards 'telling performance stories' (Bowen & Wittneben, 2011).

For a newly-emergent accounting in need of a robust framework, it was necessary to revisit the literature of accounting theory and stakeholder theory (Freeman, 1984), and the various pronouncements regarding the purpose and users of accounting statements (Zeff, 2013). Following almost fifty years of debate and deliberation, the methodology of financial accounting has converged on a narrow stakeholder approach that prioritises relevance for investors and creditors. As a counterweight to this narrow stakeholder bias, this thesis looks forward to a business models approach in which accounting information reflects the confluence of stakeholder relations through which a focal firm delivers value (Haslam *et al*., 2012). In this respect, the direction of the research is consistent with the approach being considered by leading accounting associations who are presently reviewing the future development of the financial accounting framework (ICAEW, 2010; EFRAG, 2013; IASB, 2013; IIRC, 2013a, 2013b). Moreover, the adoption of a loose business models framework offers the opportunity to 'tell the carbon performance story' from the perspectives of structure, purpose and evaluation (Haslam *et al*., 2012).

10.3 National carbon reduction narratives

Chapter 4 derives a carbon reduction narrative constructed to reflect the key performance criteria mandated by the United Kingdom Climate Change Act, 2008, in which the Government pledged to achieve an 80% reduction in greenhouse emissions against a 1990 benchmark by the year 2050. An interim 34% reduction was mandated against the same baseline for the year 2020. Data extracted from the Environmental Accounts of the Office for National Statistics estimate that the total national carbon footprint has declined by 17% and 8% between 1990-2010, and 2006-2010 respectively (see Figure 1).

Figure 1. UK greenhouse gas emissions by broad sector: 1990-2010

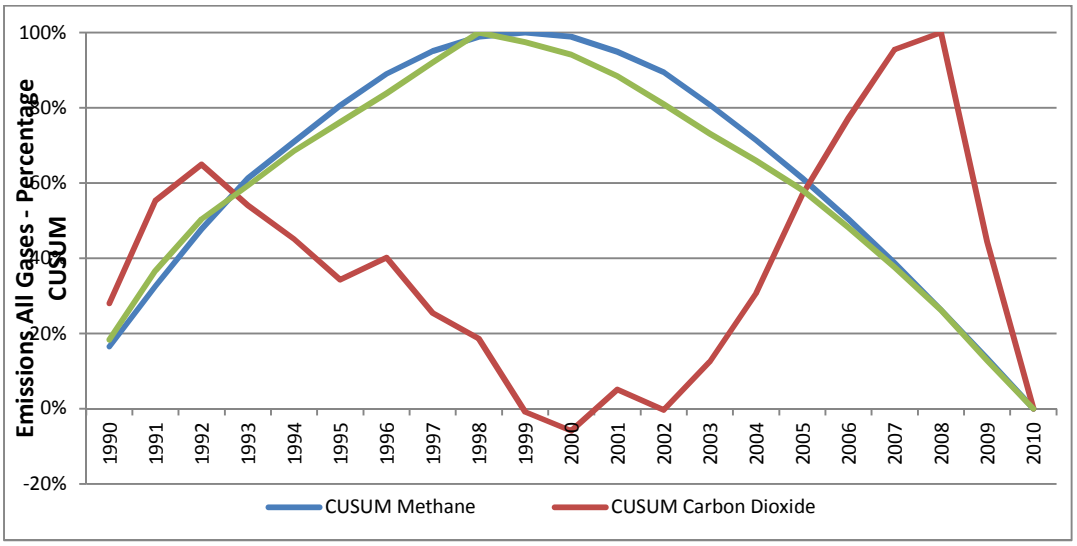


Source: Author, using data from Environmental Accounts 2012 (Office for National Statistics, 2012a).

Evidence from this research, however, supports a contrasting narrative that attributes existing carbon reductions to strategic priorities unconnected to climate change policy, and determines that these reductions were discrete, structural and non-recurring. On this basis, the research concludes that the national accounting emissions data lacks the momentum from which future carbon emissions might be inferred, and that fulfilment of the Government's mandate will require new actions whose effectiveness cannot be appraised from the existing data.

The investigation of these data employed a powerful, yet relatively unknown, statistical technique: the CUmulative SUM deviation (CUSUM), which measures bias in equal interval sequential data (Harris, 1994). Following the disaggregation of the national footprint into time series of individual greenhouse gas emissions, the CUSUM technique was used to determine change points at which significant carbon-relevant events occurred. When these data are arranged in a chart, the change points appear as kinks, which signal the change in direction of the plotted line. Figure 2 presents the CUSUM lines for the three most significant greenhouse gases by volume in the United Kingdom footprint, plotted between common axes, to reveal the presence and timing of these change points. Chapter 4 contains detailed accounts of the events that coincide with the change points identified in Figure 2.

Figure 2. CUSUM Chart – United Kingdom business sector emissions: methane, nitrous oxide and carbon dioxide (1990-2010)



Source: Author, using data from UK Environmental Accounts 2012 (Office for National Statistics 2012a).

This research has demonstrated the benefits of using the CUSUM technique to detect changes in data series as a result of events, or changes in the basis of estimating, measuring or accounting for the object described by the data. However, it has also revealed the challenges associated with this approach. While the location of change points is relatively straightforward to accomplish, using an Excel worksheet to graph the CUSUM series, the diagnosis of the change points is an onerous and time-consuming task. The determination of coincident events with inflections in the time series demands that the researcher has an extensive knowledge of national and industrial history, and specialist knowledge of industrial processes.

Examination of the national carbon footprint yielded some important implications for the remainder of the study. First, it can be concluded that the Government's carbon credibility matters where carbon reduction is targeted through collaborative enterprise with corporate stakeholders, because commitment and trust are at the heart of productive collaboration (Morgan & Hunt, 1994). Any weakness in the perceived credibility of the Government is therefore likely to discourage corporate managers from engaging fully with the national carbon strategy. With regard to the framing of the national footprint, the debate reveals the controversial nature of framing where imported carbon emissions are embedded in domestic consumption (Helm *et al.*, 2007; Helm, 2008). Furthermore, the national footprint investigation reveals how it is necessary to disaggregate top-level carbon

footprints to increase the visibility of emissions and reveal sufficient information to permit an evaluation of the credibility of reported reductions in carbon emissions in their strategic context.

10.4 Sectoral (FTSE100) carbon reduction narratives

Chapter 5 constructs a carbon reduction narrative for a meso grouping which comprises the FTSE100 group of leading companies. It was necessary, given the difficulty of articulating a shared narrative for 100 diverse companies, to construct the narrative by inference. Ultimately, the construction of the collective narrative was based on the reasonable presumption that these leading companies cannot be seen to contradict the objectives set by a democratically elected government which has mandated carbon reduction targets in law. Therefore, the narrative constructed for the FTSE100 group expresses support for the United Kingdom Government's carbon reduction targets, and the intention to contribute to their achievement in a manner that aligns with individual firm strategies. Following the outcome of the research, an alternative narrative proposed that large corporations, when taken in aggregate, have yet to demonstrate a collective reduction in their greenhouse emissions. This version of the meso narrative diminishes the credibility of industry at large, which is later confirmed in the micro (firm-level) analysis conducted in this research.

The meso investigation required the construction of an aggregated time-series dataset of large company emissions, with which to test the credibility of the carbon reduction narrative. For this purpose, the sample comprised the FTSE100 group of leading companies, and the researcher manually compiled the dataset from information contained in downloaded pdf copies of annual and corporate responsibility (CSR) reports and company websites. Of the 100 constituent firms, only 62 (the FTSE62) made consecutive carbon disclosures throughout the period 2006-2011, and this limited the size of the dataset to 62 six-year disclosure series. For each firm, the researcher extracted scope 1 and 2 emissions, aggregating these into annual FTSE62 totals. During this process, scope 3 emissions were also extracted but were later excluded from the eventual dataset because only 17 firms disclosed scope 3 emissions continuously throughout 2006-2011. By the end of this stage, the second research question had been addressed to the extent that an original physical dataset had been created, and this described the trajectory of physical emissions at meso level. Simultaneously, the same objective had been achieved at the micro level because the FTSE62 dataset contained the 2006-2011 carbon emissions time series of the four supermarket firms selected for the mixed-retail case study.

Table 1 presents the aggregated FTSE62 emissions, revealing increasing absolute carbon emissions over the period 2006-2011. The table also demonstrates how emissions from the FTSE62 accounts for around 90% of all scope 1 and 2 emissions reported by FTSE100 firms over 2006-2011.

Table 1. FTSE62 aggregated emissions (tonnes CO_2e) and as a proportion of all FTSE100 disclosures

	FTSE 62	All disclosing FTSE firms	FTSE 62 (%)
Year/Column	(1)	(2)	(3)
2006	457,103,691	473,719,229	96.5
2007	456,052,801	474,744,778	93.1
2008	442,549,761	484,514,384	91.3
2009	430,202,076	491,151,719	87.6
2010	447,377,951	511,471,483	87.5
2011	463,569,157	530,103,114	87.4
No. Firms (at 2011)	**62**	**84**	

Source: Author, using data from company annual reports, corporate responsibility reports and corporate websites.

Table 1 reveals that the FTSE62 emissions increased by an estimated 1.4% over the six year period. By contrast Figure 1 shows that the national footprint declined by 8% over 2006-2010, compared with a 2% decline in the meso footprint over the same period (see Table 1), before resuming its upward trajectory in 2011.

To the best of the researcher's knowledge, the resulting FTSE62 carbon dataset is a unique resource. Its construction presented several challenges additional to the consideration of scope 3 emissions, as discussed previously. Chapter 5 describes how the FTSE100 is a mobile population, whose composition changes as a result of fluctuations in relative market capitalisation and business combination. The amorphous character of the sample of firms affects its carbon-generating capacity from one period to the next because individual constituents acquire or divest carbon-generating business units when they buy or sell subsidiaries; and capacity is affected when an outgoing FTSE100 constituent is replaced by an incoming firm with higher market capitalisation. In addition to these considerations, it was necessary to consider each company's emissions profile individually; to adjust or note data changes so as to ensure a consistent treatment of revised comparative emissions and to adjust for differences in the series' due to acquisition and divestment of business units occurring between 2006 and 2011. While the dataset is a useful resource, its interpretation must be treated with caution, for while very effort was made to ensure consistency, the review of corporate reports

revealed that FTSE100 firms vary in their interpretation and classification of emissions by scope. This introduces ambiguity and malleability into the meso dataset.

10.5 Firm-level (large corporation) carbon reduction narratives

Four FTSE100 supermarket firms, Tesco, J. Sainsbury, Wm. Morrison Supermarkets and Marks and Spencer, representing the United Kingdom mixed-retail sector were selected for inclusion in the firm-level case study. The research concluded that while the supermarket firms claim to be supportive of the government's objective to reduce absolute carbon emissions, as mandated in the Climate Change Act, evidence from accounting reports suggests that their emissions are set on a contrary upward trajectory. Moreover, at least three out for the four case study firms have attempted to counteract negative impressions arising out of their performance by using creative accounting and disclosure strategies to manipulate the perceptions of stakeholders.

One example of creative accounting is the disclosure of emissions per square foot by the case study firms. Table 2 sets out these indicators, and reveals how this mode of presentation suggests an improvement in carbon performance over the period for two out of the four firms, and an average improvement for the sector.

Table 2. FTSE 100 mixed-retail sector – declining relative emissions: 2006 – 2011

Company	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Wm. Morrison Supermarkets	121	108	107	102	112	105
J. Sainsbury	43	38	39	43	40	45
Tesco	78	60	57	55	54	52
Marks and Spencer	27	33	27	39	34	32
Average emissions	**69**	**57**	**55**	**55**	**55**	**53**

Declining relative emissions 

Source: Author using data from annual and corporate reports. All data in kg CO_2e per square foot. Differences in average attributable to rounding.

The same information presented in absolute tonnes CO_2e creates quite a different impression because absolute emissions – the benchmark set by the Climate Change Act objectives – are increasing for each of the four case study firms, as shown in Table 3.

Table 3. FTSE 100 mixed-retail sector – increasing absolute emissions: 2006 – 2011

Company	2006	2007	2008	2009	2010	2011
Marks and Spencer Group	404,000	517,000	469,000	710,000	652,000	641,000
Wm. Morrison Supermarkets	1,283,050	1,137,532	1,162,981	1,136,899	1,332,333	1,287,259
J Sainsbury	726,398	658,186	700,147	724,000	711,000	856,000
Tesco	4,289,670	4,088,700	4,380,600	4,851,000	5,097,620	5,377,984
Total emissions	**6,703,118**	**6,401,418**	**6,712,728**	**7,421,899**	**7,792,953**	**8,162,243**
Aggregate increase in reported emissions		**-5%**	**5%**	**11%**	**5%**	**5%**

Increasing absolute emissions 

Source: Author using data from annual and corporate reports. All data in tonnes CO_2e unless otherwise stated.

Chapter 6 contains further examples of creative carbon accounting and disclosure extracted from the annual reports of the case study firms. Some of these involve the scalar manipulation of graphs and charts, while others restate baselines or make selective comparisons when computing metrics in order to gild stakeholder perceptions of the firm's carbon performance.

A review of the narrative disclosures of the case study firms in annual and CSR reports for 2006 and 2011 provides further evidence to support the alternative firm-level narrative. This part of the investigation also incorporated narrative disclosures of a large supplier to the supermarket firms, Associated British Foods plc. In the first instance, a selection of appropriate keywords was drawn up and a taxonomy of narratives constructed, based on Omanson's (1982) descriptions of central, supportive and distracting content. Used in tandem, these keywords and categories enabled the researcher to conduct a structured search of terms located in pdf copies of 18 corporate reports, and to extract and organise the corresponding narrative statements for further analysis. The search produced a list of 713 statements containing previously specified carbon reduction terms.

A thematic analysis of these disclosures categorised around one fifth as 'distracting' narrative statements disruptive to decision-usefulness. Grouping the entire list into pre-determined sub-categories revealed that around half the disclosure narratives were attributed to 'competitive advantage', in which the motivation for environmental strategies aligns with increased competitiveness and growth in market share. The remaining half divided evenly between those firms whose strategic profile corresponds with notions of 'legitimacy' or compliance with the minimum standards imposed by regulation, and others whose strategy can be described as 'enlightened

environmental management' where managers see the firm primarily as an ecologically-sustaining, rather than economic entity (Dillard *et al*., 2005).

Among the case study firms, the frequency of central, supportive and distracting narrative statements was plotted for 2006 and 2011. For each firm, the frequency of disclosure by category remained remarkably consistent in 2011 when compared with 2006. Similar results were obtained when the frequency of disclosures categorised as legitimacy, competitive advantage and enlightened management were compared over the same time periods for these firms. In each case, the consistency of disclosure by type supports the argument made earlier, that these firms have adopted a strategic approach to environmental disclosure.

Lastly, the alternative firm-level critical narrative was supported by a review of disclosures, describing the carbon elements of executive performance-related pay. The review concluded that carbon performance rewards were absent from all but two of the firms' schemes; and where it was included, the potential awards were so small as to represent immaterial elements of otherwise substantial reward schemes. The minimal scale of carbon rewards has resonance beyond the credibility of senior managers because it also signals a low agency cost of carbon to shareholders, who may fail to take proper account of organisational carbon risk. This latter observation has important implications for the development of tools to assist stakeholders in their evaluation of carbon risk, as will be seen in the next section.

The final objective is concerned with how carbon reduction narratives can be challenged by the imaginative use of numbers and how these can be used to inform policy interventions and initiatives. The relevant conclusions are discussed in the next section.

10.6 Thesis recommendations

Chapter 9 sets out the recommendations of the thesis, which are intended to inform approaches to public carbon policy and intervention, the design and application of corporate carbon accounting frameworks and the use of innovative interpretive software to aid the appraisal of organisational carbon risk. For the purpose of this section, the recommendations are collated into priorities for carbon accounting and policy intervention, presented in Table 4, and explained in greater detail below.

Table 4. Priorities for carbon accounting and policy intervention

Priority	Description
Extend mandatory carbon disclosure	Mandatory disclosure of scope 1, 2 and 3 emissions by all listed companies; extended progressively to cover all large companies
Encourage innovation in disclosure	Disclosure of top 5- 10 carbon-material stakeholder interactions alongside GHG Protocol greenhouse inventory
Transition to plural accounting	Use of plural accounting to promote challenge and encourage dialogue between the focal firm and its stakeholders engaged in carbon reduction
Disclose performance metrics	Disclosure of a range of carbon-intensity performance metrics, e.g. Carbon (tonnes CO_2e) per employee; per unit of sales revenue, and per unit of cash margin to capture multiple performance dimensions
Accelerate carbon risk appraisal	Development and use of innovative software tools that facilitate the appraisal of organisational carbon risks by the focal firm and its investors.
Introduce carbon reduction incentives and rewards	Carbon performance metrics to be incorporated into executive reward packages to modify behaviour
Strengthen policy frameworks through analysis and intervention	Clever policy framing by regulatory bodies and government, using metrics and disclosures to intervene where there are challenges and structural blockages that frustrate firm to firm interventions to reduce carbon emissions in the business model

Source: Author.

From 2013, all companies with a main listing on the London Stock Exchange are required to disclose their greenhouse emissions together with one carbon intensity ratio. This thesis recommends that the mandate should be extended to cover all listed companies, and that its reach should be expanded to include scope 3 emissions which typically account for around 85% of total footprint (Carbon Trust, 2013). While this would represent a step in the right direction, the analysis of the meso and micro datasets in Chapters 5 and 6 demonstrates that the scopes 1 and 2 retain a high level of aggregation. Scopes congeal multiple sources of information that describe separate carbon-generating actions and processes, while excluding those emissions generated via interactions with external stakeholders. This recommendation should be progressively extended to cover all large companies.

The designation of operational boundaries, comprising the various scopes, is a framing decision. While helpful in setting out responsibility and ownership, framing creates 'overflows' - potentially reportable and relevant items that defy capture (Callon, 1998). To counteract this problem, the thesis recommends a plural mode of accounting, which presents contrasting versions of the company's carbon footprint, derived from different methodologies, within the same accounting report. Using this approach, the strengths of one methodology are balanced out by the advantages of the other. Moreover, plural accounting has the additional advantage of revealing, rather than concealing the complexity and contradiction that can exist, where artificial systems attempt to capture and present physical carbon data. Plural accounting encourages challenge and dialogue among those stakeholders who collaborate in carbon reduction (see Gray, 1997, 2010; Gray *et al*., 2014). It is proposed that the top 5-10 carbon-material interactions between the firm and its stakeholders be presented alongside the GHG Protocol inventory comprising scopes 1-3. The disclosure of focal firm/ stakeholder interactions would include numbers and narratives, offering a loose business models perspective on carbon emissions.

This approach represents an enhancement of accountability. If plural accounting can help prompt the focal firm and its stakeholders to find collaborative carbon reduction, it may be possible to avoid the 'stakeholder dilemma'; where the absence of productive collaboration leads to a 'lose-lose' government-imposed solution (Freeman, 1984).

This thesis further recommends that carbon performance metrics should be incorporated into executive remuneration packages, so that managers are encouraged to create shareholder value at reduced carbon intensity. Absolute carbon reduction should be rewarded sufficiently well that the amount payable to managers represents an appropriate 'agency cost of carbon'; incurred by shareholders to ensure that managers and shareholders' interests are aligned with respect to decarbonising operations. One obstacle to this proposal is the present lack of recognition among shareholders that carbon is a risk factor. This thesis recommends that policymakers support the development of software driven benchmarking tools that make innovative use of physical carbon and financial metrics to increase investor awareness of organisational carbon risk, thereby increasing its perceived relevance in portfolio selection. Chapter 9 describes a pilot software application, designed to analyse the exposure of firms to carbon risk and to balance these risks against financial performance indicators.

Plural accounting encompasses the use of a full range of carbon intensity metrics, which can be used by management to inform judgements about carbon-materiality and the trade-offs between financial and carbon performance. Chapter 9 provides a table of suitable metrics that relate

organisational carbon emissions in tonnes CO_2e to the number of employees, value retained, shareholder equity and also incorporates other financial metrics describing company performance. These metrics can be used to compare company carbon and financial performance relative to a composite of the same criteria for the FTSE62, or for industry sub-groups of the FTSE62. In this way, a profile of the firm's physical/ financial performance and carbon risk can be constructed relative to a pool of other investable companies. The resulting information has at least two valuable applications: it can assist investors to construct portfolios that combine a desired financial return with an acceptable level of carbon risk. By the same token, company managers can use the programme to help understand and manage carbon risk in order to ensure that their firm remains attractive to investors wishing to incorporate carbon risk within their portfolio construction criteria.

Freeman's identification of the 'stakeholder dilemma' provides a useful justification for these recommendations. However, policymakers must be prepared to encounter scenarios where well-intentioned management has attempted to resolve carbon reduction through stakeholder collaboration, and reached the limits of both parties to make further progress. In these instances, it is incumbent on strong government to intervene to remove the blockages; either by providing incentives that reduce cost obstacles, or regulating to modify behaviour.

10.7 Reflections on the research

This research has followed a middle ground approach, using numbers and narratives to cross check declared intentions against performance outcomes across three levels of analysis. It has also applied the case study method to set out the micro firm-level analysis. The methodological approach is rigorous, carefully designed and appropriate to the research questions.

The numbers and narratives approach has proven itself to be particularly appropriate to this research, presenting an effective means of comparing declared intentions with eventual outcomes in an ongoing process of experimentation, trial and error. The numbers and narratives approach is still relatively unusual in social science research and this thesis has provided an opportunity to demonstrate its effectiveness.

The completion of a thesis provides an opportunity to reflect on the process of research, and how this might be improved if attempted again. In the case of this thesis, the methodology could be adapted to incorporate interviews with company managers, and this would add an interesting dimension to the research. The interview transcripts would provide a source of conversational narratives which, unlike the versions appearing in corporate reports, may be informal, unrehearsed,

spontaneous and more revealing. When compared with the carefully, and often professionally drafted narrative statements encountered in corporate reports, the interview responses may throw up contradictions or reveal an alternative unguarded version of truth.

This research observes that corporate narrative statements of intention are often at variance with the delivery of emissions reduction, with the result that credibility is impaired. An alternative research approach could consider the credibility of aspects of a reporting entity's carbon strategy, rather than evaluating the credibility of the strategy as a whole. Where a specific activity produces a successful outcome, measured in terms of carbon savings, managers may be motivated to demonstrate its credibility. Then, because supermarket firms are innovators, such 'mini cases' have the potential to add to the stock of learning and demonstrate how carbon reductions can be successfully delivered on an activity rather than entity level of analysis. This alternative approach can be justified by Mathews (1997) observation that it is corporations, rather than accountants and academics, who are leading the development of environmental management and control systems; therefore the knowledge acquired through their experience should be captured, analysed and disseminated.

At the outset of the thesis, it was originally intended to incorporate interviews with corporate finance and CSR accountants within the research, to investigate whether cultural/ professional differences impact upon the way in which large companies account for their carbon footprint. The original concept of the research project was therefore wider in scope than the final thesis. However, on completion of the literature review it became apparent that carbon footprint accounting and commitment are relatively under-researched and there was limited prior knowledge from which to expand the scope of the research. Consequently, it was decided to research the issues surrounding accounting for physical carbon emissions first, in order to contribute to a 'platform' of knowledge from which future studies can be built. It is the researcher's intention to revisit the impact of professional and cultural diversity on carbon accounting following completion of this thesis.

Cultural characteristics of carbon footprint accounting might usefully be explored by extending the research to cover other countries, and to complement the United Kingdom study. Australia, for example, has designed and implemented a distinctive approach to carbon reduction that includes the mandatory reporting of corporate emissions to a central agency and, the imposition of a carbon tax on fossil fuel consumption by large installations. This policy has become politically-charged in Australia, and the carbon tax will be withdrawn in July 2014. Australia's per capital emissions are almost twice the OECD average due to its economic reliance on fossil fuels, which also contribute significantly to the country's exports (Phillips, 2013). Against this background, it would be interesting

to consider how the differences between Australian and United Kingdom cultures affect corporate carbon reduction strategies, and how they impact the way that firms account for their emissions.

At an early stage in the research, it became apparent that the literature on 'commitment' is sparse, and the concept remains largely undeveloped since Becker's (1960) seminal contribution. This is unfortunate since commitment – like trust – is pivotal to productive collaboration, and yet its ambiguity makes it a problematic attribute to research. It would be interesting to resume the theoretical development of commitment, as progress in this area has the potential to inform the work of future social science researchers which may in turn be applied towards policy intervention and behaviour modification. To follow on from this study, it would be interesting to investigate how commitment is variously perceived by different stakeholders such as investors, managers, professional advisers and external suppliers, using methodologies that extract and compare narrative statements obtained from interviews.

Within the scope of behaviour modification, it would be useful to consider how executive compensation may be structured and implemented by large corporations to tie managers in to the achievement of stretching carbon reduction objectives. If successful, these measures would help to align management focus with proposals to decarbonise focal firm/ stakeholder interactions within the business model.

There is scope to reconsider why managers are reluctant to invest in energy efficiency. While studies of this kind have been conducted in the past (see Touche Ross, 1994) it would helpful to update the research for the post-Climate Change Act era. It would also be interesting to investigate the perception among buy-side analysts of corporate carbon risk. While Campbell and Slack (2011) have provided a useful study of sell-side attitudes, it is the buy-side analysts who produce recommendations for pension funds and other collective investments, where the need to balance risk and return may be a critical aspect of portfolio planning and selection.

Research into interventions might proceed on two levels. While these may be considered separately, it is likely that some advances made in each level may spill over to the other. At the corporate level, research should focus on focal firm/ stakeholder interventions specific to particular business models. Inevitably, because different business models undertake common activities, such as logistics or the operation of distribution networks, some aspects of this research should be transferable between business models. At the policy level, studies should identify appropriate opportunities for government intervention, and suitable means by which regulation or incentives may be deployed to alleviate obstacles to carbon reduction. Structural rigidities are likely to exist throughout the

business sector. However, the urgency of the national carbon reduction targets, combined with the pressure on public finances, dictates that researchers give priority to those pressure points whose resolution would yield the greatest carbon savings at the lowest cost.

10.8 Carbon reduction in the broader context of sustainability

As this thesis reaches its conclusion, it is appropriate to recall that carbon reduction represents a subset of 'sustainability', and that efforts to achieve ambitious reductions in greenhouse emissions should be situated within a broader context where other, equally legitimate aspirations deserve to be targeted within inclusive strategies of sustainability. Inevitably, the complexity of sustainability and the different political appeal of its constituent elements threaten to fragment progress and to force these constituents to compete with one another for space within public policy and corporate strategy.

The Brundtland Report is credited with the definition of sustainable development that establishes its parameters along both planetary and human principles. According to *Brundtland*, sustainable development is that which meets:

> "the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations World Commission on Environment, 1987: p.8).

Gray (2010: p.53) reminds us that these 'needs' include important dimensions of social justice "between and within generations". Gray's reminder is apposite because it is conceivable that the natural, economic and social aspects of sustainability will attract different political constituencies and their prospects will be enhanced or diminished according to the relative power of their sponsors.

The United Kingdom Government sought to locate climate change policy within the moral context of *Brundtland*'s sustainability, when it commissioned the Stern Review on the Economics of Climate Change. Stern costed the impact of climate change policy using a discount intended to level the interests of present and future generations. The choice of discount rate was the cause of much criticism among economic commentators, and there are difficulties in trying to achieve consensus on climate policy when this is framed within limits set by contestable interpretations of moral and social sustainability:

> "Why should this [equal consideration of future and present needs] be? Is the claim even coherent? Does it apply thousands of years into the future or are we more concerned with those in closer time proximity to those more remote? Is it limited by population? Would a faster rate of population growth mean that more resources should be sacrificed to the future? And is the underlying claim to equality robust? The claims to equality between existing people have had a mixed philosophical reception: why then should we apply them into the future when we clearly do not do so for current people?" (Helm, 2008: p.229).

Government also faces other problems of time-preference which affect climate change policy within the timescale of a single generation. For example, investment in renewable energy and nuclear power require public finance in order to reassure private providers of their financial viability. In addition, the adoption of these technologies will impose higher domestic electricity bills. Under these conditions, there is a moral dilemma facing policymakers over whether the needs of the less well-off are best served by long-term carbon reduction strategies paid for out of today's sparse disposable income.

Policymakers must also consider the potential for other externalities arising out of climate change policies. In the case of nuclear energy, while the generation of electricity is free from greenhouse emissions, the collateral impact of nuclear power on carbon emissions should not be discounted. For example, the construction of nuclear capacity is itself a carbon intensive activity, as is the mining, milling and enrichment of uranium (Kleiner, 2008). Regarding social dimensions of sustainability, the 'needs of the present' are, in part, adversely affected where the displacement of coal or gas-fired electricity plants by nuclear facilities leads to increased regional unemployment, which may be damaging to communities. The possibility of other externalities including the disposal of spent nuclear fuel, the possibility of nuclear accidents and the need to protect nuclear fuel and installations from terrorist threats are further challenges to broader sustainability, inherent in the United Kingdom's policy of developing nuclear alternatives to fossil fuel.

Likewise, the opportunity to exploit reserves of shale gas offers a lower carbon alternative to coal-powered electricity while incurring other externalities and potential trade-offs. Concerns have been expressed that 'fracking' may trigger seismic events and that the chemicals used in the process may contaminate underground water sources (Cartwright, 2013). Moreover, fracking is a potential source of fugitive methane emissions, which has led researchers at Cornell to conclude that shale gas may have a higher carbon footprint over a 20 year horizon than coal (Howath, 2012).

The researcher has chosen to investigate the credibility of carbon reduction using the firm as the unit of account. While this has permitted the researcher to extend the analysis across three levels of aggregation, it has been necessary to confine the research to the study of carbon emissions

management. Nevertheless, it is recognised that carbon reduction must be integrated within broader sustainability strategies at national and corporate levels and this challenge remains should be addressed in future by accounting researchers. Accounting must serve and help facilitate the aspirations of broad sustainability, for:

> "natural systems provide the context and sustenance for social systems, and social systems provide the context and objectives for economic systems. All three systems must be respected, nurtured, and sustained, and an ethic of accountability requires that accountability systems address all three" (Thomson, 2007: p.45).

The next section comprises final comments which close the thesis.

10.9 Final comments

This thesis explores the credibility of carbon reduction by government and large companies, inferred from statutes and disclosures in corporate reports. At each level of analysis, comparison of declared intentions with accounting numbers that describe carbon reduction results in critical alternative narratives of carbon reduction. Credibility emerges as a leading theme within this research. It is a precondition to trust which is, in turn, a fundamental characteristic of productive partnerships. This study makes an important contribution because it offers proposals designed to counteract the tendency of framing to create externalities that evade accounting (Callon, 1998). In so doing, these recommendations also offer the practical means to Gray's (1997, 2010), Gray *et al.*'s (2014) call for a plural accounting, in which alternative accounting methodologies critically oppose one another in the same accounting report. The research also highlights the strategies deployed by firms in managing the impression of carbon credibility, through creative accounting and disclosure. Finally, the thesis demonstrates how practical software tools can be used to incorporate carbon risk into portfolio selection decisions, thereby offering the potential to alter behaviour by increasing the visibility of organisational carbon risk.

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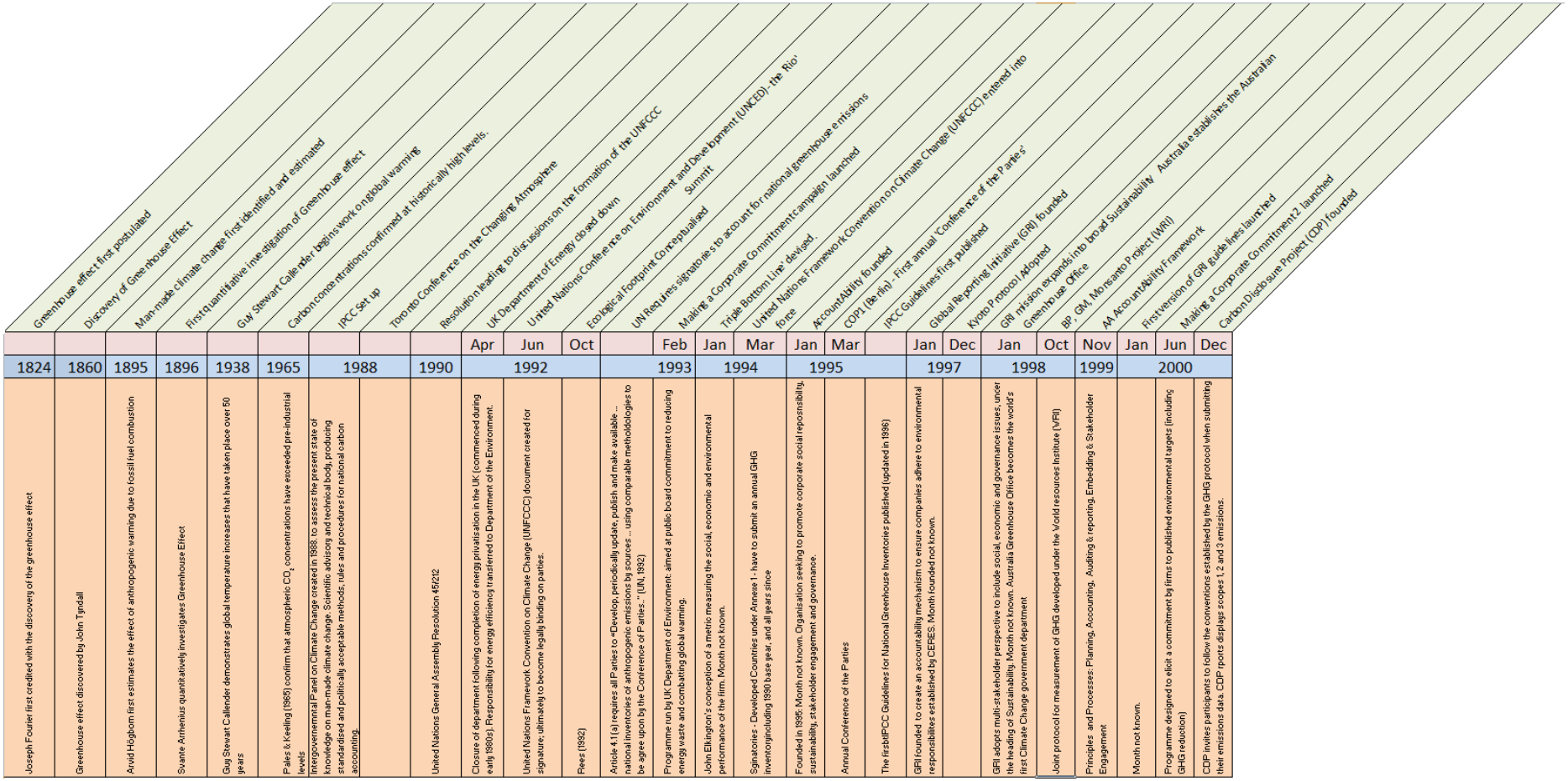
List of appendices

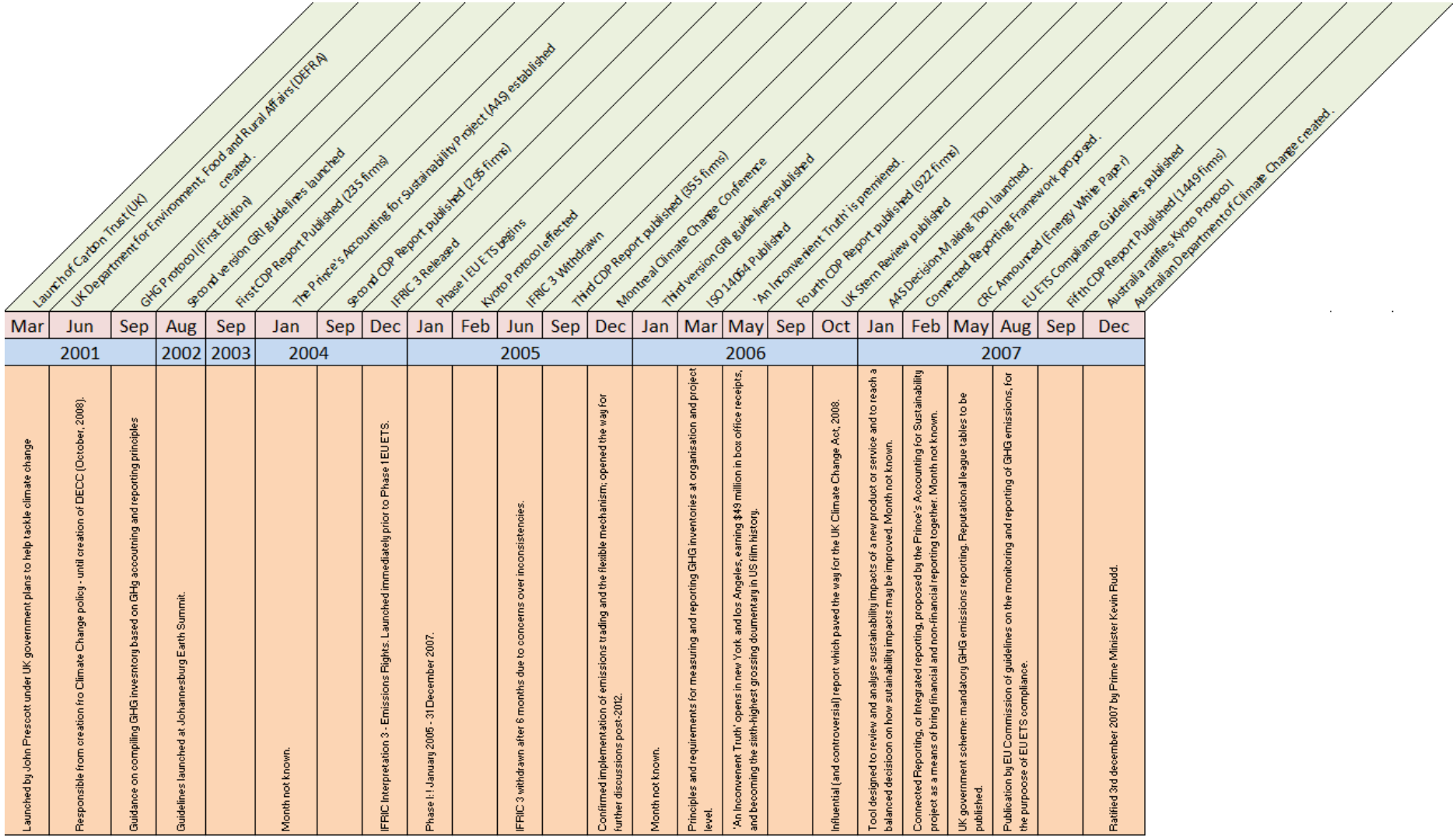
Appendix A: Climate change policy timeline

Phase 1 – Discoveries and treaties



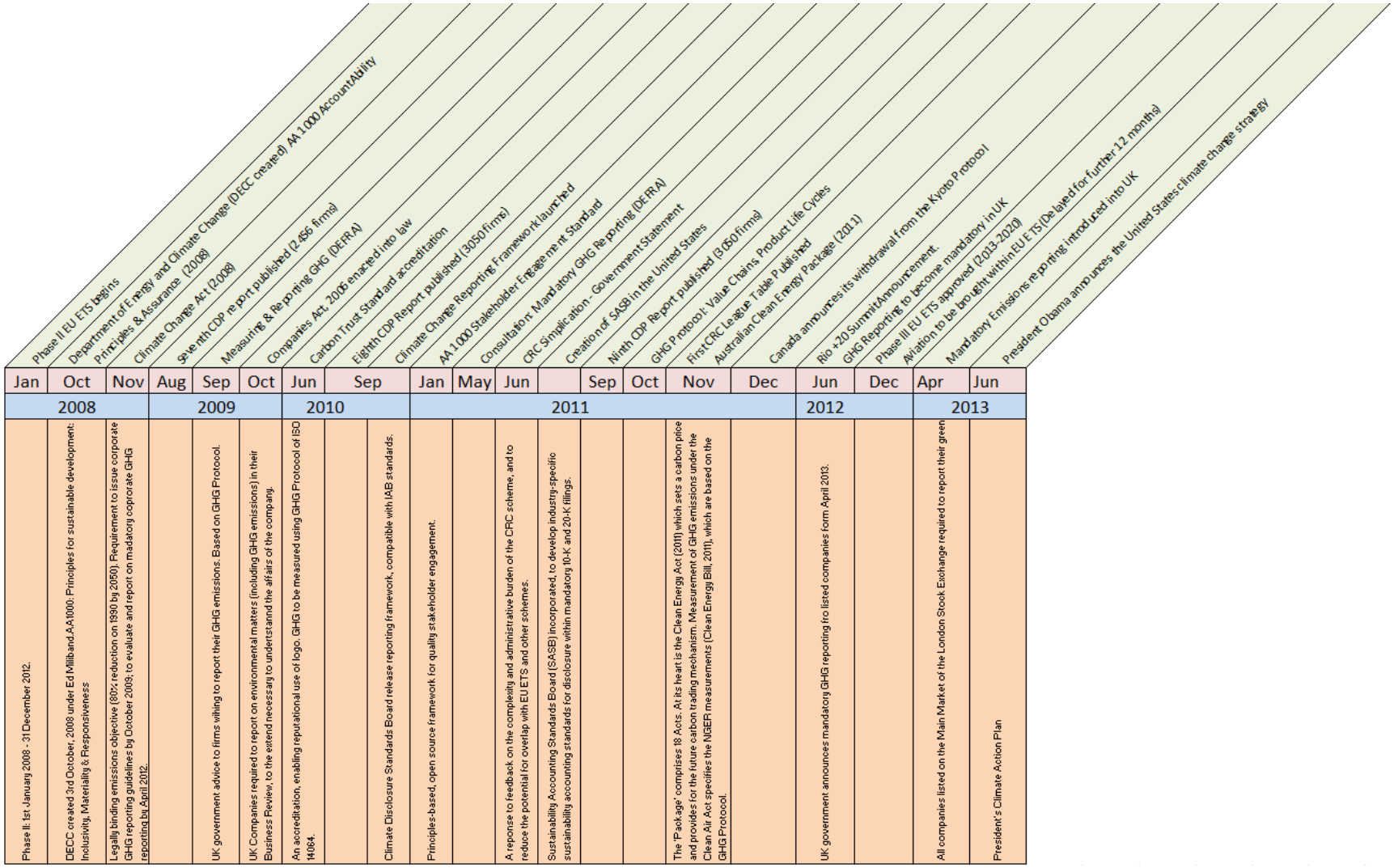
Source: Author

Phase 2 – Protocols and politics



Source: Author

Phase 3 –Consolidation and legislation



Source: Author

Appendix B: Environment and climate change articles: ABS '4-rated' journals (2005-2010)

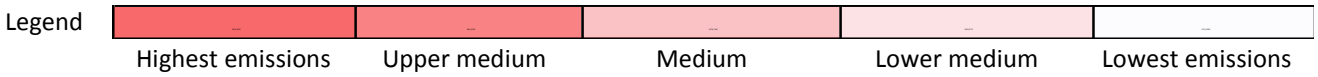
ABS Journal Category/ Title	*Issues*	*Articles*	*Environment*	*Climate Change*
Accountancy				
Journal of Accounting Research	29	210	0	0
Journal of Accounting & Economics	34	187	0	0
Accounting Review	31	366	0	0
Accounting, Organizations & Society	46	238	18	5
Review of Accounting Studies	23	141	0	0
Economics				
Econometrica	34	318	0	0
Journal of Political Economy	33	186	2	0
American Economic Review	29	1,010	21	11
Quarterly Journal of Economics	23	241	3	0
Review of Economic Studies	24	287	1	0
Journal of Economic Literature	22	103	3	3
Journal of Econometrics	71	800	1	0
Journal of Monetary Economics	49	585	0	0
Journal of Economic Theory	41	641	1	1
Review of Economics & Statistics	23	358	8	3
International Economic Review	23	290	4	1
Journal of Economic Perspectives	23	252	2	0
The Economic Journal	46	494	4	1
Journal of Environmental Economics & Management	35	278	179	49
Games and Economic Behavior	41	634	1	0
Journal of Risk and Uncertainty	25	153	11	2
Journal of the European Economic Association	35	385	2	2
Organization Studies				
Organization Science	35	331	3	0
Organization Studies	68	422	1	0
Leadership Quarterly	34	267	0	0
Human Relations	70	390	0	0
Strategic Management				
Strategic Management Journal	78	428	9	3
Finance				
Journal of Finance	35	477	0	0
Review of Financial Studies	42	463	0	0
Journal of Financial & Quantitative Analysis	25	235	0	0
Journal of Financial Economics	70	545	0	0
Journal of Money Banking & Credit	46	458	1	0
Social Science				
Journal of Economic Geography	33	188	3	1
Economic History Review	26	162	1	1
Economic Geography	23	92	5	3
American Journal of Sociology	35	222	1	0
American Sociological Review	34	252	3	0
Research Policy	59	656	7	3
Social Science and Medicine	141	2,800	2	0
Annual Review of Sociology	5	136	0	0
Environment and Planning A	70	827	74	25
Environment and Planning D: Society and Space	35	304	9	1
Sociology of Health and Illness	41	331	0	0
Risk Analysis: An International Journal	47	687	101	12
General Management				
Academy of Management Review	24	292	0	0
Academy of Management Journal	35	376	3	0
Administrative Science Quarterly	23	122	1	0
Journal of Management	36	272	1	1
Journal of Management Studies	48	388	3	0
Harvard Business Review	71	1,397	34	23
British Journal of Management	30	257	3	1
TOTALS	**2,059**	**21,934**	**526**	**152**

Source: Author, using journals identified by The Association of Business Schools (2010)

Note: The Environment Article count includes the 152 Climate Change articles.

Appendix C: FTSE100 meso carbon footprint dataset (indicative) aggregated total emissions

Company	2011	2010	2009	2008	2007	2006
ANGLO AMERICAN PLC						
BHP BILLITON PLC						
RIO TINTO PLC						
ROYAL DUTCH SHELL PLC						
TUI TRAVEL PLC						
BP PLC						
UNITED UTILITIES GROUP PLC						
SCOTTISH AND SOUTHERN ENERGY PLC						
GLAXOSMITHKLINE PLC						
LONMIN PLC						
SMITHS GROUP PLC						
ASTRAZENECA PLC						
BRITISH AMERICAN TOBACCO P.L.C.						
DIAGEO PLC						
RSA INSURANCE GROUP PLC						
INVENSYS PLC						
RECKITT BENCKISER GROUP PLC						
STANDARD LIFE PLC						
CAPITAL SHOPPING CENTRES GROUP PLC						
MAN GROUP PLC						
3I GROUP PLC						
ALLIANCE TRUST PLC						
WM MORRISON SUPERMARKETS PLC						
EXPERIAN PLC						
AMEC P.L.C.						
LEGAL & GENERAL GROUP PLC						
SMITH & NEPHEW PLC						
BRITISH LAND COMPANY PLC (THE)						
HAMMERSON PLC						
REED ELSEVIER PLC						
PEARSON PLC						
NEXT PLC						
WPP PLC						
AVIVA PLC						
LAND SECURITIES GROUP PLC						
KINGFISHER PLC						
CAPITA GROUP PLC (THE)						
BRITISH SKY BROADCASTING GROUP PLC						
JOHNSON MATTHEY PUBLIC LIMITED COMPANY						
BT GROUP PLC						
CENTRICA PLC						
J SAINSBURY PLC						
ROLLS-ROYCE GROUP PLC						
SEVERN TRENT PLC						
STANDARD CHARTERED PLC						
LLOYDS BANKING GROUP PLC						
HSBC HOLDINGS PLC						
MARKS AND SPENCER GROUP PLC						
ROYAL BANK OF SCOTLAND GROUP PLC (THE)						
SABMILLER PLC						
BARCLAYS PLC						
BAE SYSTEMS PLC						
CAIRN ENERGY PLC						
VODAFONE GROUP PUBLIC LIMITED COMPANY						
TESCO PLC						
ASSOCIATED BRITISH FOODS PLC						
TULLOW OIL PLC						
BG GROUP PLC						
NATIONAL GRID PLC						
XSTRATA PLC						
KAZAKHMYS PLC						
INTERNATIONAL POWER PLC						
TOTALS (Tonnes CO2e - Scopes 1 & 2)	**463,569,426**	**447,376,755**	**430,201,195**	**442,553,960**	**456,051,148**	**457,100,954**



Source: Author, using data extracted from company annual reports, sustainability reports websites. Note: Each line uses shading to describe the relative emissions for a single firm within the period 2006-2011. Viewed as a whole, darker regions indicate clusters of firms whose emissions have increased over the period. Emissions profiles of different companies may vary significantly in scale.

Appendix D: United Kingdom national carbon footprint (1990-1999)

Sector	(thousands of tonnes CO_2e)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
A	Agriculture, forestry and fishing	64,184	63,968	63,832	63,151	63,367	62,927	63,460	63,101	62,258	61,576
B	Mining and quarrying	39,742	40,341	41,181	40,595	37,345	38,824	40,033	39,549	37,857	34,983
C	Manufacturing	173,851	174,123	165,818	160,122	162,087	158,216	161,354	161,164	153,582	135,645
D,E	Electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management activities and remediation services	264,244	260,947	247,777	228,731	223,823	221,373	220,498	202,208	207,058	195,890
F	Construction	8,888	8,855	8,875	9,020	9,391	9,655	9,963	10,212	10,475	10,818
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	12,516	12,890	12,716	12,996	13,451	13,671	14,061	13,966	14,422	14,955
H,J	Transport and storage; information and communication	64,557	65,078	66,098	68,160	68,697	70,849	77,334	78,738	81,746	81,152
I	Accommodation and food services	2,865	3,321	3,106	3,300	3,294	3,420	3,648	3,295	3,546	3,771
K	Financial and insurance activities	215	209	203	206	203	201	200	188	185	191
L,M,N	Real estate activities; professional, scientific and technical activities; administrative and support service activities	5,035	5,433	5,305	5,531	5,683	5,907	6,056	5,834	6,074	6,388
	Total Business Sector	**636,097**	**635,164**	**614,911**	**591,811**	**587,340**	**585,043**	**596,607**	**578,255**	**577,204**	**545,367**
O	Public administration and defence; compulsory social security	11,082	10,342	10,431	10,641	9,990	10,164	9,882	9,138	8,453	9,182
P	Education	5,878	6,154	6,243	5,325	4,691	4,706	5,055	5,866	5,942	5,343
Q	Human health and social work activities	4,356	4,710	5,136	4,891	5,121	5,241	5,557	5,356	5,095	4,927
R,S	Arts, entertainment and recreation; other service activities	3,318	3,483	3,119	3,357	3,330	3,468	3,392	3,415	3,269	3,128
	Total Public Sector	**24,634**	**24,689**	**24,929**	**24,214**	**23,132**	**23,579**	**23,887**	**23,775**	**22,758**	**22,580**
T	Activities of households as employers; undifferentiated goods and services-producing activities of households for own use	190	192	194	196	198	200	202	203	205	207
Z	Consumer expenditure	141,577	150,013	148,281	152,664	147,359	142,462	157,492	151,908	154,542	155,494
	Total Consumer Sector	**141,766**	**150,204**	**148,475**	**152,860**	**147,557**	**142,662**	**157,694**	**152,112**	**154,747**	**155,701**
	Total Greenhouse Gas emissions	**802,498**	**810,058**	**788,315**	**768,885**	**758,029**	**751,284**	**778,188**	**754,142**	**754,709**	**723,648**

Source: Adapted from Office for National Statistics (2012a)

Appendix D: United Kingdom national carbon footprint (2000-2010)

Sector	(thousands of tonnes CO_2e)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
A	Agriculture, forestry and fishing	59,214	56,516	56,446	56,120	56,056	56,388	54,492	52,833	52,427	51,719	52,145
B	Mining and quarrying	33,590	34,108	33,671	30,990	30,155	28,742	25,229	25,427	24,769	24,289	23,939
C	Manufacturing	130,996	126,201	117,465	119,048	118,085	116,435	113,406	113,528	109,726	92,829	92,983
D,E	Electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management activities and remediation services	206,654	215,169	208,201	213,447	212,294	213,979	221,742	216,805	211,074	188,675	194,838
F	Construction	10,973	11,122	11,025	11,027	11,087	11,476	11,271	11,851	11,489	10,317	10,525
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	15,294	15,323	15,013	15,567	15,636	15,878	16,029	16,645	16,442	16,703	17,581
H,J	Transport and storage; information and communication	83,325	86,354	86,943	90,596	96,049	100,698	94,046	95,354	93,948	86,599	87,745
I	Accommodation and food services	3,856	3,888	3,387	3,595	3,499	3,488	3,256	3,192	3,221	3,167	3,325
K	Financial and insurance activities	196	214	218	222	229	243	244	272	269	234	242
L,M,N	Real estate activities; professional, scientific and technical activities; administrative and support service activities	6,526	6,424	5,958	6,133	6,019	6,140	6,036	6,067	6,088	5,505	5,623
	Total Business Sector	**550,624**	**555,319**	**538,326**	**546,746**	**549,109**	**553,468**	**545,750**	**541,974**	**529,454**	**480,038**	**488,946**
O	Public administration and defence; compulsory social security	9,118	9,343	8,916	9,476	9,358	7,777	7,812	8,141	8,070	7,039	7,006
P	Education	4,879	4,363	3,925	3,539	3,685	4,185	4,086	4,014	3,923	3,547	3,710
Q	Human health and social work activities	4,816	5,542	4,822	4,776	5,211	5,952	5,353	5,223	5,339	4,996	5,142
R,S	Arts, entertainment and recreation; other service activities	3,144	3,201	2,829	2,961	2,910	3,037	2,822	2,703	2,802	2,713	2,585
	Total Public Sector	**21,957**	**22,450**	**20,492**	**20,752**	**21,162**	**20,950**	**20,073**	**20,080**	**20,133**	**18,296**	**18,444**
T	Activities of households as employers; undifferentiated goods and services-producing activities of households for own use	209	210	212	215	217	219	220	222	224	220	222
Z	Consumer expenditure	155,865	159,590	158,410	159,012	162,238	158,255	155,915	152,092	153,303	146,673	156,845
	Total Consumer Expenditure	**156,074**	**159,801**	**158,622**	**159,226**	**162,454**	**158,473**	**156,135**	**152,314**	**153,526**	**146,893**	**157,067**
	Total Greenhouse Gas emissions	**728,654**	**737,570**	**717,440**	**726,724**	**732,725**	**732,892**	**721,958**	**714,368**	**703,113**	**645,227**	**664,457**

Source: Adapted from Office for National Statistics (2012a)

Appendix E: CUSUM calculations

(Emissions stated in thousands of tonnes CO_2e)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total Business Sector GHG Emissions	636,097	635,164	614,911	591,811	587,340	585,043	596,607	578,255	577,204	545,367
Residual	72,880	71,947	51,694	28,594	24,123	21,826	33,391	15,038	13,987	-17,850
CUSUM	72,880	144,828	196,522	225,117	249,239	271,066	304,456	319,494	333,481	315,632
Total Consumer Sector GHG Emissions	141,766	150,204	148,475	152,860	147,557	142,662	157,694	152,112	154,747	155,701
Residual	- 12	- 3	- 5	- 1	- 6	- 11	4	- 1	1	2
CUSUM	- 12	- 15	- 20	- 21	- 27	- 38	- 34	- 35	- 34	- 32
Business Sector Methane Emissions	95,220	94,335	92,698	89,681	82,808	82,524	80,425	75,969	71,856	67,031
Residual	30,277	29,392	27,756	24,738	17,865	17,581	15,482	11,027	6,914	2,089
CUSUM	30,277	59,669	87,425	112,163	130,028	147,609	163,092	174,119	181,032	183,121
Business Sector Nitrous Oxide Emissions	66,107	66,261	61,481	56,696	56,980	55,361	55,451	55,886	55,776	45,102
Residual	18,435	18,588	13,809	9,024	9,308	7,689	7,779	8,214	8,103	- 2,571
CUSUM	18,435	37,023	50,832	59,856	69,164	76,853	84,632	92,846	100,949	98,379
Business Sector Carbon Dioxide Emissions	460,965	460,471	446,707	430,899	432,329	430,959	443,833	427,892	434,022	424,218
Residual	21,666	21,173	7,408	- 8,399	- 6,970	- 8,339	4,535	- 11,407	- 5,277	- 15,080
CUSUM	21,666	42,839	50,247	41,848	34,878	26,539	31,073	19,667	14,390	- 690
Carbon Dioxide: Air Transport Services	20,246	19,181	20,912	22,713	22,678	24,581	26,369	27,954	31,301	33,739
Residual	- 12,589	- 13,654	- 11,923	- 10,123	- 10,158	- 8,254	- 6,467	- 4,881	- 1,535	903
CUSUM	- 12,589	- 26,243	- 38,166	- 48,289	- 58,446	- 66,701	- 73,167	- 78,048	- 79,583	- 78,679

Source: Author, using data from Office for National Statistics (2012a)

Appendix E: CUSUM calculations

Appendix 2 – CUSUM Calculations	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**		
(Emissions stated in thousands of tonnes CO_2e)													
Total Business Sector GHG Emissions	550,624	555,319	538,326	546,746	549,109	553,468	545,750	541,974	529,454	480,038	488,946	Average	563,217
Residual	-12,593	-7,898	-24,891	-16,471	-14,108	-9,749	-17,467	-21,243	-33,763	-83,179	-74,271		
CUSUM	303,039	295,141	270,251	253,780	239,672	229,923	212,456	191,213	157,450	74,271	-0		
Total Consumer Sector GHG Emissions	156,074	159,801	158,622	159,226	162,454	158,473	156,135	152,314	153,526	146,893	157,067	Average	153,541
Residual	3	6	5	6	9	5	3	- 1	- 0	- 7	4		
CUSUM	- 29	- 23	- 18	- 12	- 3	2	4	3	3	- 4	0		
Business Sector Methane Emissions	62,855	57,682	54,893	49,184	47,752	46,366	45,058	43,471	42,217	41,239	40,528	Average	64,942
Residual	- 2,087	- 7,261	- 10,049	- 15,758	- 17,191	- 18,576	- 19,885	- 21,471	- 22,725	- 23,703	- 24,414		
CUSUM	181,034	173,773	163,724	147,966	130,775	112,199	92,314	70,843	48,118	24,414	- 0		
Business Sector Nitrous Oxide Emissions	44,323	41,868	40,152	39,735	40,520	39,726	37,663	36,969	36,163	34,204	34,693	Average	47,672
Residual	- 3,349	- 5,805	- 7,520	- 7,938	- 7,152	- 7,946	- 10,010	- 10,703	- 11,509	- 13,468	- 12,979		
CUSUM	95,030	89,225	81,705	73,767	66,615	58,669	48,660	37,956	26,447	12,979	0		
Business Sector Carbon Dioxide Emissions	435,442	447,794	435,067	449,221	453,355	459,636	455,042	453,440	442,775	396,283	404,916	Average	439,298
Residual	- 3,856	8,495	- 4,231	9,922	14,057	20,338	15,744	14,142	3,477	- 43,016	- 34,383		
CUSUM	- 4,546	3,950	- 281	9,641	23,697	44,035	59,779	73,921	77,398	34,383	- 0		
Carbon Dioxide: Air Transport Services	37,228	36,683	35,772	37,007	39,206	42,626	43,244	43,790	43,157	41,366	39,789	Average	32,835
Residual	4,392	3,848	2,937	4,171	6,371	9,790	10,409	10,955	10,322	8,531	6,953		
CUSUM	-74,287	-70,439	-67,502	-63,331	-56,960	-47,169	-36,761	-25,806	-15,484	-6,953	0		

Source: Author, using data from Office for National Statistics (2012a)

Appendix F: CUSUM calculation United Kingdom coal production (thousands of tonnes)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
UK Coal Production	92,762	94,202	94,493	68,199	48,785	53,037	50,197	48,495	41,177	37,077
Residual	50,606	52,046	52,337	26,043	6,629	10,881	8,041	6,339	- 979	- 5,079
CUSUM	50,606	102,651	154,988	181,031	187,660	198,540	206,581	212,920	211,940	206,861

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
UK Coal Production	31,198	31,930	29,989	28,279	25,096	20,498	18,517	17,007	18,053	17,874	18,417	Average	42,156
Residual	- 10,958	- 10,226	- 12,167	- 13,877	- 17,060	- 21,658	- 23,639	- 25,149	-24,103	- 24,282	- 23,739		
CUSUM	195,903	185,677	173,509	159,632	142,572	120,913	97,274	72,125	48,022	23,739	0		

Source: Author, using data from DECC (2012a: p.202)

Appendix G: The dash for gas

Year Commissioned	Power Station (gas)	Installed Capacity (MW)	Annual Installed Capacity (MW)
1991	Rossecote	229	**229**
1992	Teeside	1,875	**1,875**
1993	Glanford Brigg	260	
	Killingholme B	900	
	Peterborough	405	
	Rye House	715	
	Corby	401	**2,681**
1994	Killingholme A	665	
	Kneadby	749	
	Barking	1,000	
	Derwent	214	
	Deeside	500	
	Knapton	40	**3,168**
1995	Charterhouse St	31	
	Fellside	180	
	Little Barford	665	
	Medway	688	**1,564**
1996	Connah's Quay	1,380	
	South Humber Bank	1,285	
	Kings Lyn	340	**3,005**
1998	Barry	230	
	Didcot B	1,430	
	Rocksavage	810	
	Thornhill	50	
	Seabank 1	812	**3,332**
1999	Cottam Development Centre	400	
	Sutton Bridge	800	
	Enfield	392	
	Sandbach	56	**1,648**
2000	Damhead Creek	800	
	Salt End	1,200	
	Seabank 2	410	
	Shoreham	400	
	Fife	123	**2,933**
Dash for Gas: Total Installed Capacity		**20,435**	**20,435**

Source: Author, using data from DECC (2010)

Appendix H: Carbon intensity ranking - FTSE 62 meso subset

Total Revenue 2006 - 2011	Total tonnes CO_2e	Revenue £/tonnes CO_2e	Firm	Carbon Intensity Rank	Quartile	Δ tonnes CO2 2006 -2011	Δ % tonnes 2006 - 2011
23,843,739,970	390,794,000	61.01	INTERNATIONAL POWER PLC	1	1	14,957,000.00	24.4%
14,366,453,130	87,800,000	163.63	KAZAKHMYS PLC	2	1	14,500,000.00	149.5%
79,682,981,060	137,600,000	579.09	ANGLO AMERICAN PLC	3	1	- 17,200,000.00	-47.8%
168,687,243,400	275,500,000	612.29	RIO TINTO PLC	4	1	- 6,500,000.00	-13.2%
6,291,489,950	9,878,823	636.87	LONMIN PLC	5	1	- 132,004.00	-7.4%
192,805,387,050	293,108,696	657.79	BHP BILLITON PLC	6	1	- 10,600,000.00	-20.6%
96,512,852,900	137,193,875	703.48	XSTRATA PLC	7	1	9,300,000.00	58.5%
112,577,400,000	140,820,000	799.44	SCOTTISH AND SOUTHERN ENERGY PLC	8	1	- 840,000.00	-3.3%
62,655,218,450	48,306,396	1,297.04	BG GROUP PLC	9	1	1,525,000.00	25.4%
13,159,000,000	9,549,963	1,377.91	UNITED UTILITIES GROUP PLC	10	1	- 1,579,037.00	-73.4%
73,285,000,000	43,000,000	1,704.30	NATIONAL GRID PLC	11	1	4,900,000.00	102.1%
78,411,444,400	42,089,625	1,862.96	TUI TRAVEL PLC	12	1	- 2,844,636.00	-30.7%
4,665,719,780	2,357,673	1,978.95	TULLOW OIL PLC	13	1	1,161,183.00	539.1%
121,347,000,000	58,533,711	2,073.11	CENTRICA PLC	14	1	124,892.00	1.6%
1,089,400,140,761	473,000,000	2,303.17	ROYAL DUTCH SHELL PLC	15	1	- 4,000,000.00	-4.5%
51,518,000,000	19,570,000	2,632.50	ASSOCIATED BRITISH FOODS PLC	16	1	1,160,000.00	47.3%
			1st QUARTILE TOTAL			3,932,398.00	

Source: Author, using data from annual reports, corporate responsibility reports and company websites

Appendix H: Carbon intensity ranking - FTSE62 meso subset

Total Revenue 2006 - 2011	Total tonnes CO_2e	Revenue £/tonnes CO_2e	Firm	Carbon Intensity Rank	Quartile	Δ tonnes CO2 2006 -2011	Δ % tonnes 2006 - 2011
10,385,000,000	3,645,967	2,848.35	SEVERN TRENT PLC	17	2	153,800.00	36.5%
1,114,754,663,300	381,000,000	2,925.87	BP PLC	18	2	- 2,600,000.00	-4.0%
66,502,768,000	13,918,000	4,778.18	SABMILLER PLC	19	2	400,000.00	20.0%
1,961,500,000	328,213	5,976.30	HAMMERSON PLC	20	2	30,864.00	83.8%
21,394,057,297	2,390,669	8,948.98	CAIRN ENERGY PLC	21	2	640,527.00	284.9%
301,561,000,000	28,085,574	10,737.22	TESCO PLC	22	2	1,088,314.00	25.4%
3,270,900,000	294,540	11,105.11	CAPITAL SHOPPING CENTRES GROUP PLC	23	2	- 2,140.00	-4.0%
83,962,300,000	7,340,055	11,438.92	WM MORRISON SUPERMARKETS PLC	24	2	4,208.55	0.3%
154,440,000,000	13,221,700	11,680.80	GLAXOSMITHKLINE PLC	25	2	- 624,500.00	-25.0%
7,628,600,000	593,619	12,851.00	LAND SECURITIES GROUP PLC	26	2	57,595.00	75.1%
45,222,085,000	3,460,500	13,068.08	ROLLS-ROYCE GROUP PLC	27	2	133,500.00	29.5%
110,578,145,400	7,250,000	15,252.16	ASTRAZENECA PLC	28	2	- 100,000.00	-7.6%
68,737,000,000	4,355,000	15,783.47	DIAGEO PLC	29	2	- 10,000.00	-1.4%
53,746,800,000	3,393,000	15,840.50	MARKS AND SPENCER GROUP PLC	30	2	237,000.00	58.7%
19,694,800,000	1,191,066	16,535.44	NEXT PLC	31	2	33,013.00	20.3%
			2^{nd} QUARTILE TOTAL			- 557,818.45	

Source: Author, using data from annual reports, corporate responsibility reports and company websites

Appendix H: Carbon intensity ranking - FTSE62 meso subset

Total Revenue 2006 - 2011	Total tonnes CO_2e	Revenue £/tonnes CO_2e	Firm	Carbon Intensity Rank	Quartile	Δ tonnes CO2 2006 -2011	Δ % tonnes 2006 - 2011
3,230,000,000	191,412	16,874.60	BRITISH LAND COMPANY PLC (THE)	32	3	25,558.00	97.3%
76,302,000,000	4,447,092	17,157.73	BRITISH AMERICAN TOBACCO P.L.C.	33	3	- 13,172.00	-1.8%
111,979,000,000	5,942,000	18,845.34	BAE SYSTEMS PLC	34	3	447,000.00	78.4%
16,281,200,000	843,000	19,313.40	SMITHS GROUP PLC	35	3	- 119,000.00	-49.6%
57,029,000,000	2,917,000	19,550.57	KINGFISHER PLC	36	3	67,000.00	16.5%
44,078,300,000	2,209,787	19,946.85	JOHNSON MATTHEY PUBLIC LIMITED COMPANY	37	3	89,000.00	27.3%
14,140,000,000	608,371	23,242.40	INVENSYS PLC	38	3	- 7,128.00	-6.6%
42,445,000,000	1,674,900	25,341.81	RECKITT BENCKISER GROUP PLC	39	3	- 5,100.00	-1.8%
111,026,000,000	4,375,731	25,373.13	J SAINSBURY PLC	40	3	129,602.00	17.8%
227,305,000,000	8,470,000	26,836.48	VODAFONE GROUP PUBLIC LIMITED COMPANY	41	3	650,000.00	49.6%
122,818,000,000	4,049,547	30,328.82	BT GROUP PLC	42	3	119,000.00	18.6%
136,834,000,000	4,490,379	30,472.71	BARCLAYS PLC	43	3	400,831.00	84.7%
30,259,000,000	936,226	32,320.18	PEARSON PLC	44	3	32,548.00	27.6%
13,178,748,300	382,178	34,483.30	SMITH & NEPHEW PLC	45	3	25,282.71	50.2%
14,614,200,000	404,368	36,140.84	CAPITA GROUP PLC (THE)	46	3	67,726.00	254.7%
13,579,371,700	355,000	38,251.75	EXPERIAN PLC	47	3	5,000.00	9.4%
			3rd QUARTILE TOTAL			1,914,147.71	

Source: Author, using data from annual reports, corporate responsibility reports and company websites

Appendix H: Carbon intensity ranking - FTSE62 meso subset

Total Revenue 2006 - 2011	Total tonnes CO_2e	Revenue £/tonnes CO_2e	Firm	Carbon Intensity Rank	Quartile	Δ tonnes CO2 2006 -2011	Δ % tonnes 2006 - 2011
33,444,000,000	849,953	39,348.06	REED ELSEVIER PLC	48	4	32,115.00	26.8%
52,584,782,200	1,226,905	42,859.70	STANDARD CHARTERED PLC	49	4	163,921.00	189.4%
2,334,000,000	46,342	50,364.68	3I GROUP PLC	50	4	- 2,268.00	-23.9%
184,652,000,000	3,483,320	53,010.35	ROYAL BANK OF SCOTLAND GROUP PLC (THE)	51	4	398,700.00	155.3%
286,920,088,850	4,714,000	60,865.53	HSBC HOLDINGS PLC	52	4	199,000.00	31.4%
31,519,000,000	508,630	61,968.42	BRITISH SKY BROADCASTING GROUP PLC	53	4	88,863.00	366.8%
132,653,000,000	1,736,529	76,389.74	LLOYDS BANKING GROUP PLC	54	4	197,791.00	109.2%
16,942,500,000	207,646	81,593.19	AMEC P.L.C.	55	4	9,950.00	31.9%
21,408,000,000	128,734	166,296.39	STANDARD LIFE PLC	56	4	- 3,292.00	-13.5%
45,456,000,000	272,706	166,685.10	RSA INSURANCE GROUP PLC	57	4	- 8,643.00	-17.3%
8,175,066,500	42,902	190,552.11	MAN GROUP PLC	58	4	588.00	6.9%
557,587,000	2,911	191,544.83	ALLIANCE TRUST PLC	59	4	791.00	401.5%
224,127,000,000	892,214	251,203.19	WPP PLC	60	4	34,222.00	23.7%
199,014,000,000	771,944	257,808.86	AVIVA PLC	61	4	40,115.00	32.1%
31,316,000,000	103,047	303,900.16	LEGAL & GENERAL GROUP PLC	62	4	24,886.00	240.2%
			4^{th} QUARTILE TOTAL			1,176,739.00	

Source: Author, using data from annual reports, corporate responsibility reports and company websites

Appendix J: Ratio analysis and other activity characteristics of the FTSE 100 mixed retail companies

Tesco plc (All data in £m unless otherwise stated)	2006	2007	2008	2009	2010	2011	2012
Group Revenue	39,454	42,641	47,298	54,327	56,910	60,931	64,539
Gross Revenue (Inc. Value Added Tax)	43,137	46,611	51,773	59,426	62,537	67,573	72,035
Total UK Household Expenditure on Goods	383,244	400,208	409,988	407,693	425,609	431,435	
Proportion UK Household Expenditure of Goods spent at Tesco	0.11	0.12	0.13	0.15	0.15	0.16	
£1 in every '£X' spent at Tesco: X =	**9**	**9**	**8**	**7**	**7**	**6**	
Gross Profit	3,028	3,463	3,630	4,218	4,607	5,060	5,261
Gross Margin (%)	**7.7%**	**8.1%**	**7.7%**	**7.8%**	**8.1%**	**8.3%**	**8.2%**
Taxation	649	772	673	788	840	864	879
Profit for the Year	2,235	1,881	2,130	2,166	2,336	2,671	2,814
Profit for the Year (%)	**5.7%**	**4.4%**	**4.5%**	**4.0%**	**4.1%**	**4.4%**	**4.4%**
Employment Costs	4,269	4,595	5,293	5,798	6,195	6,768	6,857
Depreciation	829	897	982	1,167	1,358	1,445	1,499
EBIT	2,352	2,797	2,866	3,316	3,490	3,868	3,934
Value Added	**7,450**	**8,289**	**9,141**	**10,281**	**11,043**	**12,081**	**12,290**
Value Added % Group Revenue	**19%**	**19%**	**19%**	**19%**	**19%**	**20%**	**19%**
Cash Generated from Operations	2,619	2,611	3,343	3,960	4,745	3,992	4,408
Net Cash Generated from Operations (% Group Revenue)	**6.6%**	**6.1%**	**7.1%**	**7.3%**	**8.3%**	**6.6%**	**6.8%**
Opening Inventories	1,309	1,457	1,931	2,430	2,669	2,729	3,162
Closing Inventories	1,457	1,931	2,430	2,669	2,729	3,162	3,598
Cost of Sales	29,640	31,104	35,279	40,779	42,504	45,942	48,910
Inventory Turnover	**21.4**	**18.4**	**16.2**	**16.0**	**15.7**	**15.6**	**14.5**
Trade Payables	2,832	3,317	3,936	4,748	5,084	5,782	5,971
Cost of Sales	29,640	31,104	35,279	40,779	42,504	45,942	48,910
Add Closing Inventories	1,457	1,931	2,430	2,669	2,729	3,162	3,598
Less Opening Inventories	1,309	1,457	1,931	2,430	2,669	2,729	3,162
Credit Purchases	29,788	31,578	35,778	41,018	42,564	46,375	49,346
Trade Payables Days	**35**	**38**	**40**	**42**	**44**	**46**	**44**
Market Capitalisation	32,079.6	37,547.6	28,335.0	33,687.2	33,796.5	32,082.9	
Market Capitalisation FTSE	1,514,810	1,503,950	1,082,980	1,395,210	1,532,220	1,446,100	
Market Capitalisation (% FTSE100)	**2.1%**	**2.5%**	**2.6%**	**2.4%**	**2.2%**	**2.2%**	
Borrowings	**5,388**	**5,700**	**8,056**	**16,450**	**13,273**	**11,075**	**11,749**
Opening Share Price (pence)	331.5	404.5	477.25	360	428	425	403.45
Closing Share Price (pence)	404.5	477.25	360	428	425	403.45	336
Dividend (pence per share)	8.63	9.64	10.9	11.96	12.95	14.46	14.76
Total Shareholder Return (TSR)	**24.6%**	**20.4%**	**-22.3%**	**22.2%**	**2.3%**	**-1.7%**	**-13.1%**
Number of Tesco Employees (Worldwide)	368,213	413,061	444,127	470,000	471,732	492,714	519,671
Number of Tesco Employees (UK)	**261,578**	**270,417**	**282,868**	**286,392**	**287,669**	**290,000**	**300,373**
Number of Tesco Employees (UK Full-Time Equivalent)	175,459	184,461	193,197	194,220	199,604	200,966	205,852
Total Number People in Work (millions - UK)	29.088	29.362	28.905	29.098	28.975	29.146	29.569
Tesco Employees % Total UK People in Work	**0.9%**	**0.9%**	**1.0%**	**1.0%**	**1.0%**	**1.0%**	**1.0%**
Total Number of Retail Outlets	**2,672**	**3,263**	**3,751**	**4,332**	**4,811**	**5,380**	**6,234**
Total Retail Space (thousand sq. ft)	**55,215**	**68,189**	**76,338**	**88,451**	**93,985**	**103,600**	**112,433**
Group Revenue per Square Foot per annum (£)	**715**	**625**	**620**	**614**	**606**	**588**	**574**

Source: Author, using data from company annual reports. Share prices obtained from Google Finance.

Appendix J: Ratio analysis and other activity characteristics of the FTSE 100 mixed retail companies

J Sainsbury plc (All data in £m unless otherwise stated)	2006	2007	2008	2009	2010	2011	2012
Group Revenue	16,061	17,151	17,837	18,911	19,964	21,102	22,294
Gross Revenue (Inc. Value Added Tax)	17,317	18,518	19,287	20,383	21,421	22,943	24,511
Total UK Household Expenditure on Goods	383,244	400,208	409,988	407,693	425,609	431,435	
Proportion UK Household Expenditure of Goods spent at Sainsburys	0.05	0.05	0.05	0.05	0.05	0.05	
£1 in every '£X' spent at Sainsburys: X =	**22**	**22**	**21**	**20**	**20**	**19**	
Gross Profit	1,067	1,172	1,002	1,036	1,082	1,160	1,211
Gross Margin (%)	**6.6%**	**6.8%**	**5.6%**	**5.5%**	**5.4%**	**5.5%**	**5.4%**
Taxation	46	153	150	177	148	187	201
Profit for the Year	58	324	329	289	585	640	598
Profit for the Year (%)	**0.4%**	**1.9%**	**1.8%**	**1.5%**	**2.9%**	**3.0%**	**2.7%**
Employment Costs	1,793	1,785	1,957	2,003	2,073	2,119	2,173
Depreciation	576	589	480	469	479	482	499
EBIT	229	520	479	466	848	911	902
Value Added	**2,598**	**2,894**	**2,916**	**2,938**	**3,400**	**3,512**	**3,574**
Value Added % Group Revenue	**16%**	**17%**	**16%**	**16%**	**17%**	**17%**	**16%**
Cash Generated from Operations	624	744	811	918	1,006	854	1,067
Net Cash Generated from Operations (% Group Revenue)	**3.9%**	**4.3%**	**4.5%**	**4.9%**	**5.0%**	**4.0%**	**4.8%**
Opening Inventories	559	576	590	681	689	702	702
Closing Inventories	576	590	681	689	702	812	938
Cost of Sales	11,875	12,801	13,557	14,490	15,192	16,053	17,000
Inventory Turnover	**21**	**22**	**25**	**25**	**22**	**21**	**21**
Trade Payables	1,419	1,706	1,703	1,728	1,782	1,836	1,903
Cost of Sales	11,875	12,801	13,557	14,490	15,192	16,053	17,000
Add Closing Inventories	576	590	480	689	702	812	938
Less Opening Inventories	559	576	590	681	689	702	702
Credit Purchases	11,892	12,815	13,447	14,498	15,205	16,163	17,236
Trade Payables Days	**44**	**49**	**46**	**44**	**43**	**41**	**40**
Market Capitalisation	7,642	7,386	5,706	5,976	6,951	5,651	
Market Capitalisation FTSE	1,514,810	1,503,950	1,082,980	1,395,210	1,532,220	1,446,100	
Market Capitalisation (% FTSE100)	**0.5%**	**0.5%**	**0.5%**	**0.4%**	**0.5%**	**0.4%**	
Borrowings	**2,431**	**2,463**	**2,202**	**2,202**	**2,331**	**2,413**	**2,767**
Opening Share Price (pence)	315.25	409.25	425.25	328.5	323.3	376.3	302.9
Closing Share Price (pence)	409.25	425.25	328.5	323	376.3	302.9	345.1
Dividend (pence per share)	8	9.75	12	13.2	14.2	15.1	16.1
Total Shareholder Return (TSR)	**32.4%**	**6.3%**	**-19.9%**	**2.3%**	**20.8%**	**-15.5%**	**19.2%**
Number of Employees (Worldwide)	153,300	146,900	151,000	148,500	146,900	148,400	152,000
Number of Sainsburys Employees (UK)	**153,300**	**146,900**	**151,000**	**148,500**	**146,900**	**148,400**	**152,000**
Number of Sainsburys Employees (UK Full-Time Equivalent)	96,200	95,500	98,600	97,300	97,300	99,300	101,900
Total Number People in Work (millions - UK)	29.088	29.362	28.905	29.098	28.975	29.146	29.569
Sainsburys Employees % Total UK People in Work	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**	**0.5%**
Total Number of Retail Outlets	**752**	**788**	**823**	**792**	**872**	**934**	**1,012**
Total Retail Space (thousand sq. ft)	**16,737**	**17,364**	**17,901**	**16,703**	**17,750**	**19,108**	**19,320**
Group Revenue per square foot	**960**	**988**	**996**	**1,132**	**1,125**	**1,104**	**1,154**

Source: Author, using data from company annual reports. Share prices obtained from Google Finance.

Appendix J: Ratio analysis and other activity characteristics of the FTSE 100 mixed retail companies

Marks and Spencer plc (All data in £m unless otherwise stated)	2006	2007	2008	2009	2010	2011	2012
Group Revenue	7,798	8,588	9,022	9,062	9,537	9,740	9,934
Gross Profit	2,986	3,341	3,487	3,372	3,619	6,016	3,755
Gross Margin (%)	**38.3%**	**38.9%**	**38.6%**	**37.2%**	**37.9%**	**61.8%**	**37.8%**
Taxation	225	278	308	199	180	182	164
Profit for the Year	523	660	821	507	523	599	490
Profit for the Year (%)	**6.7%**	**7.7%**	**9.1%**	**5.6%**	**5.5%**	**6.1%**	**4.9%**
Employment Costs	1,073	1,174	920	1,154	1,259	1,264	1,254
Depreciation	274	283	318	409	428	468	480
EBIT	850	1,046	1,211	870	852	837	747
Value Added	**2,197**	**2,503**	**2,449**	**2,433**	**2,539**	**2,569**	**2,481**
Value Added % Group Revenue	**28%**	**29%**	**27%**	**27%**	**27%**	**26%**	**25%**
Cash Generated from Operations	1,096	1,293	1,070	1,291	1,229	1,200	1,203
Net Cash Generated from Operations (% Group Revenue)	14.1%	15.1%	11.9%	14.2%	12.9%	12.3%	12.1%
Opening Inventories	339	373	416	489	536	613	685
Closing Inventories	373	416	489	536	613	685	682
Cost of Sales	4,812	5,247	5,535	5,690	5,918	6,016	6,179
Inventory Turnover	**14**	**13**	**12**	**11**	**10**	**9**	**9**
Trade Payables	243	260	227	357	792	919	989
Cost of Sales	4,812	5,247	5,535	5,690	5,918	6,016	6,179
Add Closing Inventories	373	416	489	536	613	685	682
Less Opening Inventories	339	373	416	489	536	613	685
Credit Purchases	4,846	5,290	5,608	5,737	5,995	6,088	6,176
Trade Payables Days	**18**	**18**	**15**	**23**	**48**	**55**	**58**
Market Capitalisation	12,075.0	9,514.3	3,407.0	6,377.6	5,854.1	4,933.9	
Market Capitalisation FTSE	1,514,810	1,503,950	1,082,980	1,395,210	1,532,220	1,446,100	
Market Capitalisation (% FTSE100)	**0.8%**	**0.6%**	**0.3%**	**0.5%**	**0.4%**	**0.3%**	
Borrowings	**2,187**	**1,656**	**3,538**	**3,201**	**2,833**	**2,526**	**2,276**
Opening Share Price (pence)	505	717	560	214.75	402	369	311
Closing Share Price (pence)	717	560	214.75	402	369	311	382.3
Dividend (pence per share)	14	18.3	22.5	17.8	15	17	17
Total Shareholder Return (TSR)	**44.8%**	**-19.3%**	**-57.6%**	**95.5%**	**-4.5%**	**-11.1%**	**28.4%**
Number of Employees (Worldwide)	70,310	75,871	75,389	77,864	76,267	78,169	81,208
Number of Marks & Spencer Employees (UK)	67,351	72,555	71,613	73,110	70,643	71,835	74,758
Number of Marks & Spencer Employees (UK Full-Time Equivalent)	**nd**	**nd**	**nd**	**nd**	**nd**	**nd**	**nd**
Total Number People in Work (millions - UK)	29.088	29.362	28.905	29.098	28.975	29.146	29.569
Marks & Spencer Employees % Total UK People in Work	**0.2%**	**0.2%**	**0.2%**	**0.3%**	**0.2%**	**0.2%**	**0.3%**
Total Number of Retail Outlets	**625**	**730**	**900**	**964**	**1,010**	**1,064**	**1,119**
Total Retail Space (thousand sq. ft)	**15,119**	**15,594**	**17,200**	**18,000**	**19,000**	**19,800**	**20,700**
Group Revenue per square foot	**515.77**	**550.72**	**524.53**	**503.44**	**501.95**	**491.92**	**479.90**

Source: Author, using data from company annual reports. Share prices obtained from Google Finance.

Appendix J: Ratio analysis and other activity characteristics of the FTSE 100 mixed retail companies

Wm Morrison (All data in £m unless otherwise stated)	2006	2007	2008	2009	2010	2011	2012
Group Revenue	12,115	12,462	12,969	14,528	15,410	16,479	17,663
Gross Revenue (Inc. Value Added Tax)	13,100	13,547	14,109	15,791	16,751	17,913	19,200
Total UK Household Expenditure on Goods	383,244	400,208	409,988	407,693	425,609	431,435	
Proportion UK Household Expenditure of Goods spent at Morrisons	0.03	0.03	0.03	0.04	0.04	0.04	
£1 in every '£X' spent at Morrisons: X =	**29**	**30**	**29**	**26**	**25**	**24**	
Gross Profit	2,978	636	818	913	1,062	1,148	1,217
Gross Margin (%)	**24.6%**	**5.1%**	**6.3%**	**6.3%**	**6.9%**	**7.0%**	**6.9%**
Taxation	63	121	58	195	260	242	257
Profit for the Year	-250	248	554	460	598	632	690
Profit for the Year (%)	**-2.1%**	**2.0%**	**4.3%**	**3.2%**	**3.9%**	**3.8%**	**3.9%**
Employment Costs	1,717	1,506	1,505	1,617	1,707	1,838	1,916
Depreciation	381	282	289	290	304	309	319
EBIT	- 261	423	612	671	907	904	973
Value Added	**1,837**	**2,211**	**2,406**	**2,578**	**2,918**	**3,051**	**3,208**
Value Added % Group Revenue	**15%**	**18%**	**19%**	**18%**	**19%**	**19%**	**18%**
Cash Generated							
Cash Generated from Operations	269	583	579	790	735	898	928
Net Cash Generated from Operations (% Group Revenue)	**2.2%**	**4.7%**	**4.5%**	**5.4%**	**4.8%**	**5.4%**	**5.3%**
Opening Inventories	425	399	368	442	494	511	638
Closing Inventories	399	368	442	494	577	638	759
Cost of Sales	9,156	9,364	9,739	11,016	11,548	12,380	13,346
Inventory Turnover	**22**	**24**	**24**	**24**	**22**	**22**	**19**
Trade Payables	1,202	906	1,091	1,395	1,350	1,400	1,282
Cost of Sales	9,156	9,364	9,739	11,016	11,548	12,380	13,346
Add Closing Inventories	399	368	442	494	577	638	759
Less Opening Inventories	425	399	368	442	494	511	638
Credit Purchases	9,130	9,333	9,813	11,068	11,631	12,507	13,467
Trade Payables Days	**48**	**35**	**41**	**46**	**42**	**41**	**35**
Market Capitalisation	6,751.8	8,641.8	7,521.4	7,294.9	7,109.0	8,403.0	
Market Capitalisation FTSE	1,514,810	1,503,950	1,082,980	1,395,210	1,532,220	1,446,100	
Market Capitalisation (% FTSE100)	**0.4%**	**0.6%**	**0.7%**	**0.5%**	**0.5%**	**0.6%**	
Borrowings	**1,319**	**1,022**	**851**	**1,050**	**1,240**	**1,052**	**1,715**
Opening Share Price (pence)	193.5	254.5	322	280.25	277.4	267.6	326.2
Closing Share Price (pence)	254.5	322	280.25	277.4	267.6	326.2	263
Dividend (pence per share)	3.7	4	4.8	5.8	8.2	9.6	10.7
Total Shareholder Return (TSR)	**33.4%**	**28.1%**	**-11.5%**	**1.1%**	**-0.6%**	**25.5%**	**-16.1%**
Number of Morrisons Employees (Worldwide)	134,337	117,804	124,530	117,454	133,743	132,074	131,207
Number of Morrisons Employees (UK)	**134,337**	**117,804**	**124,530**	**117,454**	**133,743**	**132,074**	**131,207**
Number of Morrisons Employees (UK Full-Time Equivalent)	93,041	84,653	89,855	83,736	94,724	95,181	94,114
Total Number People in Work (millions - UK)	29.088	29.362	28.905	29.098	28.975	29.146	29.569
Morrisons Employees % Total UK People in Work	**0.5%**	**0.4%**	**0.4%**	**0.4%**	**0.5%**	**0.5%**	**0.4%**
Total Number of Retail Outlets	**378**	**368**	**382**	**375**	**425**	**439**	**475**
Total Retail Space (thousand sq. ft)	**10,633**	**10,505**	**10,837**	**11,131**	**11,867**	**12,261**	**12,904**
Group Revenue per square foot	**1,139**	**1,186**	**1,197**	**1,305**	**1,299**	**1,344**	**1,369**

Note: Gross sales (2010 - 2012) not disclosed in statements. Values extrapolated by grossing up at the rate of 8.7%.

Source: Author, using data from company annual reports. Share prices obtained from Google Finance.

Appendix K: Analysis of carbon-related narratives by category and sub-category

This page is the first page of a 173-page report, and is included as an appendix in order to illustrate the method by which the narrative database used in Chapter 7 has been compiled.

Analysis of Carbon-Related Narratives by Category				Company					Year			Narrative Category			Narrative Sub-Category						Issues																						
Narrative (Red = Central; Blue = Supportive)	Narrative No.	AR = 1	CSR = 1	Tesco	Sainsbury	Morrisons	M&S	ABF	2006	2010	2011	Central	Supportive	Distracting	Present	Future	Past	Legitimacy	Competitive	Enlightened	Stak'r Engag't	Opp Cost	Take Resp'ty	Public Target	L-Term Planning	S-Term Planning	Refrigeration	Renewable Energy	Energy Eff'y	Transport Eff'y	Bal priorities	Accounting	Accountability	Policy	Governance	Pledge	Investment	Performance	Ind. Collab	Product	Research	Process	Distractor
"We are committed to playing our part in tackling climate change by reducing our energy use and emissions from our distribution fleet. **In 2005/06, we reduced our energy use per square foot by 15%** which has saved 59,000 tonnes of carbon dioxide emissions".	1	1		1					1			1			1														1	1													
"To be a successful, sustainable business we have to ensure that our drive to bring cheaper prices is achieved without compromising our standards, reducing quality, damaging the environment or harming the suppliers and workers who produce the goods we sell. So we take a partnership approach to working with suppliers – **sharing our knowledge and listening to suppliers' feedback**. This includes **providing technical expertise, advice and insight** into customer trends and **making regular payment, on time**".	2	1		1					1			1			1						1										1												
"As a responsible Company, Tesco works hard to bring real benefits to the communities we serve, the environment and the economy. This is recognised through our inclusion in the FTSE4Good and Dow Jones Sustainability indices".	3	1		1					1					1																													Badge collecting
"We **monitor a wide range of KPIs**, both financial and non-financial. Across the Group, **KPIs are set locally**, with oversight from the Executive Directors, to ensure they are tailored to drive the priorities of each business. **Each business operates a Steering Wheel**, our balanced scorecard. This year we have rolled-out our Corporate Responsibility management system to our International operations. **Each business reports quarterly** on social, ethical and environmental matters alongside their Customer, Operations, Finance and People KPIs".	4	1		1					1			1			1																1	1											

Source: Author, using narratives extracted from corporate annual reports and corporate responsibility reports (2006-2011)

Appendix L: Mixed-retail case study – Analysis of directors' compensation & environmental/ carbon reduction incentives

J. Sainsbury plc. Estimates based on actual performance (2011)

		Actual Bonus		Actual Compensation	Deferred Share Award Includes			
Board Directors	Base Salary	Annual Bonus Bonus Plan	Deferred Share Award	Total[1]	Strategic Goals[3]	Strategic Goal Includes 'Respect for our environment'[4]	'Respect for our environment' includes: Carbon Reduction Objective	Climate Change % Total Compensation[1]
Justin King	900	520	934	2,354	234	58	15	0.6%
Mike Coupe	544	213	372	1,129	93	23	6	0.5%
John Rogers	286	170	282[2]	456	71	18	4	1.0%
Darren Shapland	560	202	372	1,134	93	23	6	0.5%
David Tyler	450	0	0	450	0	-	-	0.0%
Totals	**2,740**	**1,105**	**1,678**	**5,523**	**490**	**123**	**31**	**0.6%**

J. Sainsbury plc. Estimates based on Maximum Performance (2011)

		Maximum Bonus			Maximum Compensation	Maximum Deferred Share Award Includes			
Board Directors	Base Salary	Annual Bonus Bonus Plan	Deferred Share Award	Value Builder Share Plan	Total	Strategic Goals[3]	Strategic Goal Includes 'Respect for our environment'[4]	'Respect for our environment' includes: Carbon Reduction Objective	Carbon Reduction % Total Maximum Compensation
Justin King	900	1,125	1,125	1,980	5,130	281	70	18	0.3%
Mike Coupe	544	435	435	1,088	2,502	109	27	7	0.3%
John Rogers	286	229	229	572	1,316	57	14	4	0.3%
Darren Shapland	560	448	448	1,120	2,576	112	28	7	0.3%
David Tyler	450	360	360	900	2,070	90	23	6	0.3%
Totals	**2,740**	**2,597**	**2,597**	**5,660**	**13,594**	**649**	**162**	**41**	**0.3%**

Source: Author, using data from company annual reports

Notes applicable to both tables - All amounts exclude pension contributions and benefits in kind

[1] Excludes awards under Value Builder Share Plan, as vesting is delayed for three years and is conditional on sustained target achievement

[2] Financial statements do not explain why the actual award exceeds 80% base salary, per Board Directors' compensation agreement

[3] Conditional on the achievement of a 'profit gateway' threshold. There are four strategic goals, of which one is 'respect for our environment'.

[4] Conditional on the achievement of a 'profit gateway' threshold. There are four elements of 'respect for our environment': one element quantifies a carbon reduction 'objective'

Appendix L: Mixed-retail case study – Analysis of directors' compensation & environmental/ carbon reduction incentives

Tesco plc. (2011)

		Actual Bonus		Actual Compensation	Actual Compensation Includes		
Board Directors	**Base Salary**	**Short-Term Cash**	**Short-Term Deferred Shares**	**Total [1] (All Short-Term)**	**Corporate Objectives [2]**	**Environmental Impact [3,4]**	**Environmental Impact % Total Actual Compensation**
Richard Brasher	825	765	632	2,222	381	63	2.9%
Philip Clarke	825	765	632	2,222	381	63	2.9%
Andrew Higginson	825	765	632	2,222	381	63	2.9%
Sir Terry Leahy	1,432	1,328	1,386	4,146	748	125	3.0%
Tim Mason	1,025	888	805	2,718	464	77	2.8%
Laurie Mcllwee	752	765	632	2,149	381	63	3.0%
Lucy Neville-Rolfe	625	574	474	1,673	286	48	2.8%
David Potts	825	765	632	2,222	381	63	2.9%
Totals	**7,134**	**6,615**	**5,825**	**19,574**	**3,401**	**567**	**2.9%**

Source: Author, using data from company annual reports

[1] Excludes awards under long-term incentives which vest after the year end, and are conditional on sustained performance against financial objectives

[2] Corporate objectives are rewarded at maximum 25% of cash element and 30% of share element

[3] 'Reducing our environmental impact' is one of six specified corporate objectives. One sixth of award for corporate objectives is assumed for this category.