DEVELOPING A CARBON AUDIT FRAMEWORK TO SUPPORT CORPORATE LEVEL CARBON REDUCTION STRATEGIES

by

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As a reaction to the increasing evidence of human influence on the climate system through carbon emissions, international political fora and national governments are increasingly fixing targets for their reduction (UNEP, 2000). However, practical and strategic barriers currently exist in translating national policy targets to a sub-national level carbon reduction effort (SDC, 2002). As a result, a huge potential for decarbonisation remains largely untapped within the corporate sector, which is currently inhibiting progress towards the UK Government’s long-term carbon reduction goal.

It is argued that this reduction goal can only be satisfied by embracing a paradigm shift in the approach to carbon reduction. This shift should transfer the emphasis away from a ‘top-down’ strategy through national policy levers to a ‘bottom-up’ approach focused at the sub-national level. To facilitate this paradigm shift and overcome the barriers to emissions reduction at the corporate level, the overall drive behind this research project is to develop environmental auditing techniques to formulate a pragmatic and comprehensive carbon audit framework.

To promote the feasibility of this audit framework, current carbon management practices were initially identified by reviewing corporate environmental reports and interviewing environmental managers from case study organisations. The findings from these investigations in addition to a review of environmental auditing literature were then employed to develop the carbon audit framework. In evaluating the applicability of this framework to case study organisations, it was found that current data availability was a principal factor preventing the comprehensive management of corporate level carbon emissions.
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Abbreviations and Acronyms

ACCA  Association of Chartered Certified Accountants
AHGCC  Ad Hoc Group on Climate Change
CERES  Coalition for Environmentally Responsible Economies
DEFRA  Department for Environment, Food and Rural Affairs
DETR  Department of the Environment, Transport and Regions
DoE  Department of Energy
ECCM  Edinburgh Centre for Carbon Management
EEA  European Environment Agency
EMAS  Eco-management and Audit Scheme
EMS  Environmental Management System
FTSE  Financial Times Stock Exchange
GEMI  Global Environmental Management Initiative
GRI  Global Reporting Initiative
ICC  International Chamber of Commerce
ISO  International Organisation of Standardisation
IPCC  Intergovernmental Panel on Climate Change
LCA  Life-cycle assessment
NRDC  National Resource Defence Council
PERI  Public Environmental Reporting Initiative
PIRC  Pensions and Investment Research Consultants
RCEP  Royal Commission on Environmental Pollution
SDC  Sustainable Development Commission
UK  United Kingdom
UNEP  United Nations Environment Programme
UNEP IE  United Nations Environment Programme: Industry and Environment
WBCSD/WRI  World Business Council for Sustainable Development/World Resource Institute
Global climate change is one of the most significant issues facing the international arena as it seeks to embrace sustainable development (Ad Hoc Group on Climate Change (AHGCC), 2002). The Intergovernmental Panel on Climate Change (IPCC, 2001) has intensified warnings associated with the rate, extent and consequences of global warming, highlighting the potential for unpredictable and high-impact changes to destabilise the climate system. It is projected that such scenarios will precipitate in wider ecological, economic and social repercussions around the world (Jo and McPherson, 2001; United States National Academy of Sciences, 2002). However, the Royal Commission on Environmental Pollution (RCEP, 2000) argues that in order to stabilise this climate system, and hence curtail such impacts, a 60 percent reduction in carbon emissions is required by 2050.

As a reaction to mounting evidence of human influence on the climate system through carbon emissions, international political fora and national governments are increasingly addressing such carbon reduction targets (United Nations Environment Programme (UNEP), 2000). These are largely underpinned by the 1997 Kyoto protocol which subjects the UK to a legally-bound reduction target of 12.5 percent in greenhouse gases by 2008-2012 from a 1990 baseline level (European Environment Agency (EEA), 1999). In addition, the UK Government has telescoped the long-term reduction goal of carbon emissions outlined by the RCEP (2000) to a demanding domestic target of 20 percent from 1990 levels by 2010 (Eyre, 2001).

As the largest source of these carbon emissions, the corporate sector has a pivotal role to play in any carbon reduction goal (Department for Environment, Food and Rural Affairs (DEFRA), 2001c). However, this potential has, to date, remained largely untapped owing to a multitude of practical and strategic barriers which inhibit the formulation of corporate level strategies to address national carbon reduction targets and policies (Sustainable Development Commission (SDC), 2002). As such, the Edinburgh Centre for Carbon Management (ECCM, 2003) argues that the radical shift to a low carbon economy, necessary to satisfy the domestic reduction goal, will not be realised.

In order to overcome these barriers, the overall drive behind this research project is to develop environmental auditing techniques to formulate a comprehensive carbon audit framework. The approach is specifically focused at the sub-national level by developing an innovative,
robust and pragmatic environmental management tool to support the implementation and evaluation of carbon reduction strategies.

1.1 An outline of subsequent chapters

The initial part of the dissertation establishes the context of the project. Following from this first chapter, which provided an introduction depicting the drive behind the study, chapter two frames the case for developing a carbon audit framework. The third chapter then outlines the methodology that will be employed to generate criteria to underpin the audit framework, which are then presented and discussed in chapter four. The fifth chapter discusses and evaluates the framework in the context of three case study organisations. Conclusions then follow in chapter six, outlining how well the overall objective and aims were addressed. A set of appendices provides specific details of the methodology not considered appropriate to the main text.
Carbon dioxide plays a major role absorbing outgoing terrestrial radiation and constitutes the most salient contribution to climate change (Kinzig and Kammen, 1998; Jo and McPherson, 2001). Critically, long-term levels of most other greenhouse gases are predicted to decrease, yet, as illustrated in figure 2.1, carbon dioxide emissions are forecast to rise after 2010 (Department of the Environment, Transport and Regions (DETR), 2000).

DEFRA (2001b) argues that this trend is owing to, *inter alia*, continued economic growth. As the largest source of current direct and indirect emissions, in addition to their pivotal role in projected emissions (UNEP, 2000), the corporate sector has a significant role to play in reducing the carbon intensity of this growth (DEFRA, 2001c; Eyre, 2001). However, SDC (2002) argues that the ‘bottom-up’ led decarbonisation potential of business has, to date, remained largely untapped owing to strategic and practical barriers. It is the objective of this chapter to frame the case for an innovative approach to tackle these barriers; a sub-national level carbon audit framework.

![Figure 2.1](image.png)

*Figure 2.1* Projections of UK carbon dioxide emissions with measures from the climate change programme. Adapted from the DETR (2000) p.53 and the DEFRA (2001b) p.44.
2.1 Reacting to climate change: is there a need for a paradigm shift?

To address climate change, international political fora have called for a global treaty to commit countries to focus on the issue, adapt to its effects and report on actions being taken to reduce greenhouse gas emissions (IPCC, 1990). Part of this treaty is underpinned by the 1997 Kyoto protocol which, as outlined in chapter 1, subjects the UK to a legally-bound carbon reduction target. In addition, however, the UK has set out a voluntary long-term carbon reduction goal of 20 percent from 1990 levels by 2010 (Eyre, 2010). This latter target constitutes one of the four principal goals underpinning the UK’s long-term strategic vision for its energy policy outlined in the energy white paper (Department of Trade and Industry (DTI), 2003).

To satisfy these obligations, strategic thinking has focused on a ‘top-down’ approach through national policy levers (SDC, 2003), collectively reported under the UK climate change programme (DETR, 2000). This aims to secure carbon reduction through a combination of fiscal measures, regulation, voluntary agreements and advisory policies (DEFRA, 2000). Despite such mechanisms, however, the Edinburgh Centre for Carbon Management (ECCM, 2003) argues that the radical shift to a low carbon path, necessary to satisfy the domestic goal, will not be realised. This has been attributed to, inter alia, the nature of the ‘top-down’ approach which, according to the SDC (2002), stifles diversity and innovation, ultimately preventing the internalisation of emission externalities. Alternatively, Bennett and Newborough (2001) and the SDC (2002, 2003) have demonstrated that a huge potential exists for carbon reduction at the sub-national level which has received little attention from national-scale policy makers.

In light of the modest anticipated progress made towards carbon reduction targets, the pivotal role of organisations in reducing emissions and the largely untapped decarbonisation potential of business, it seems pertinent to explore a paradigm shift in the approach to carbon reduction; to one focused at the sub-national level. Embracing this shift will transfer the bias away from setting a regulatory context within which sub-national level decisions are made to influencing the corporate decision-making context within which policies are implemented (SDC, 2002). However, the question that emerges is that if such an approach can yield significant carbon reduction, why has it not already been implemented? What then, are the barriers that limit the translation of national carbon reduction targets to sub-national level reduction strategies?
2.2 Practical barriers inhibiting the paradigm shift

The ‘top-down’ approach to decarbonising the economy assumes that policy-making decisions made within central government are subsequently implemented at sub-national and local levels (Angel et al., 1998). However, the ECCM (2003) demonstrate that a lack of integration in the multiplicity of carbon reduction programmes, policies and agencies engenders transaction and opportunity costs to the realisation of those efforts at the corporate level. Soloman (1999) argues that such costs will ultimately prevent an economy from operating effectively. For example, in investigating the transaction costs associated with a carbon tradable permit system in California, Dwyer (1992) estimated that the administrative burdens of searching, bargaining and monitoring accounted for between 10 and 30 percent of the total price of the credits. Thus, the SDC (2002) argue that such costs, exacerbated by the corporate commitment to the lowest price, the political will of entrepreneurs and an intrinsic lack of resources, present significant barriers to the implementation of ‘top-down’ carbon reduction policy levers.

In addition, this centralised approach recognises that the development of any sub-national level decarbonisation strategy depends on the initial measurement and consequent formulation of a carbon reduction implementation plan (DETR, 2000). However, a fundamental barrier surfaces from this assumption; there are currently no internationally accepted standards for measuring, reporting and verifying greenhouse gases at the sub-national level (World Business Council for Sustainable Development and the World Resources Institute (WBCSD/WRI), 2001; Marshall and Brown, 2003). As a result, organisations have developed their own management methodologies, engendering an idiosyncratic and fragmented approach, which is of limited use for external benchmarking purposes (ENDS, 1998a, 2001a; UNEP, 2000).

2.3 Trends underpinning the barriers

These barriers will become exacerbated with time owing to the accelerated trend among organisations towards managing carbon emissions (Loreti et al., 2000). This is attributed to a multitude of factors which, as demonstrated in figure 2.2, are primarily driven by profit motives (FORGE, 2002). The motivating factors underlying this trend will now be discussed.

The Coalition for Environmentally Responsible Economies (CERES, 2002) argues that climate change is occurring at a rate that creates a real risk of disastrous financial consequences for business. These risks stem from two principal sources; those associated with physical damages resulting from climate change, and, to the costs of policies aimed at mitigation (the Global
Environmental Management Initiative (GEMI), 2000). Thus, the WBCSD/WRI (2001) assert that a principal motivating fact or for managing carbon and reporting on emissions is through the business case; it facilitates the control of risks from greenhouse gases, ensures long-term success and demonstrates compliance with policies aimed at emissions reduction.

In light of such policies, Loreti et al. (2001) argue that carbon management strategies may also form a prerequisite for company participation in domestic or international programmes, such as the UK’s carbon emissions trading scheme. Molitor et al. (2003) anticipate that, contrary to assertions made by the DETR (2000), emerging carbon instruments will not be fungible, that is, they will not be interchangeable. Instead, it is argued that carbon products will evolve like other commodity markets, with different grades reflecting different qualities inherent in the product (figure 2.3) (Molitor et al., 2003). Such categorisation will lead to the highest level of carbon management and disclosure to satisfy the requirements for the highest value credits. However, in the absence of an internationally accepted protocol for managing and reporting sub-national level greenhouse gases, to what extent can the carbon market evolve legitimately?

---

**Figure 2.2.** Key drivers for environmental reporting divided into four components: strategy, management, operational performance and reporting. Adapted from the FORGE Group (2002) p.4.

<table>
<thead>
<tr>
<th>Management</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve risk management</td>
<td>Company participation in carbon reduction programmes</td>
</tr>
<tr>
<td>Ensure long-term success in a competitive environment</td>
<td>Improve market share through enhanced products or services</td>
</tr>
<tr>
<td>Respond to a risk to, and opportunity for, business commitment</td>
<td>Enhance value to shareholders</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operational performance</th>
<th>Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve operational efficiency</td>
<td>Provide transparency in performance to stakeholders</td>
</tr>
<tr>
<td>Reduce operational costs</td>
<td>Establish dialogue with stakeholders</td>
</tr>
<tr>
<td>Respond to increasing level of external monitoring and benchmarking of performance by external organisations</td>
<td>Demonstrate compliance with government reduction targets.</td>
</tr>
</tbody>
</table>

---
It is further argued that such participation in carbon reduction schemes in conjunction with the management of greenhouse gas performance can identify opportunities to reduce operating costs (Brophy and Starkey, 1998). For example, Halifax reported a saving of £700,000 in energy costs in 2000 following the introduction of energy targets (Halifax Group plc, 2001).

Loreti et al. (2000) advocate that a further factor advancing environmental management and its consequent disclosure arises from social grounds. Stakeholders can evaluate performance and verify the legitimacy of emissions’ reduction claims (National Resource Defence Council (NRDC), et al., 2002). Through such corporate social responsibility, public relations can be improved, engendering a competitive edge for that company (Martin et al., 1992). However, CERES (2002) weigh this argument more critically, arguing that failure to assess the risks of climate change could represent a breach of fiduciary responsibility, carrying potential legal liabilities. This is particularly eminent among investors who demand information regarding the implications and uncertainties of climate change on their investments (NRDC et al., 2002).

### 2.4 Current practice

In light of these driving factors towards increased carbon management, specifically the latter in disclosing information to shareholders, the UK Government challenged the FTSE top 350 companies in 1998 to report on their greenhouse gas emissions by 2001 (ENDS, 1998b; 1999).
Although no internationally accepted standards for reporting environmental performance exist (UNEP, 2000; ENDS, 2001a), there is a consensus between best practice reporting guidelines that the vehicle to disclose carbon emissions management data should be the corporate environmental report. For example, DEFRA (2001b) argues that carbon production is a ubiquitous aspect of economic activity and so basic environmental performance indicators, against which all organisations should aim to report, should encompass carbon emissions.

The 1990s witnessed the start of a dramatic increase in this practice of environmental reporting, tracked by a number of publications (Wheeler and Elkington, 2001). SustainAbility et al. (1993) produced the first landmark report identifying developments in this area. This research was to evolve into a five-stage reporting model and the instigation of fifty ‘reporting ingredients’ against which reports could be scored (SustainAbility and UNEP, 1996; 1997). In parallel with these benchmark papers, KPMG (1996; 1999) identified trends in international reporting by the top 250 global corporations and the top 100 companies in 11 countries. It was found, for example, that 84 percent of corporations belonging to the FTSE top 100 reported environmental information in 1999 (KPMG, 1999). More recently, CSR Network (2001; 2003) has identified further trends in global environmental reporting practices according to content, medium and sector categories (Line et al., 2001). For example, it was noted that in 2000, 23 percent of global 100 companies reported on greenhouse gas emissions (CSR Network, 2001).

In evaluating progress made towards the Government’s challenge, such global surveys are of limited use. In addition to presenting little information on greenhouse gas disclosure practices, CSR Network (2003) identified marked geographical differences to environmental reporting, ultimately inhibiting the applicability of global studies to the UK. This problem has, in part, been alleviated by a study investigating environmental reporting in the FTSE 350 conducted by Pensions and Investment Research Consultants (PIRC, 1998). They ascertained that 65 percent of those corporations reported on environmental issues, of which most were integrated within their annual reports (PIRC, 1998). Although this study provides information regarding generic environmental disclosure practices, there still remains a need to discover how many corporations within the FTSE 350 register are meeting the Government’s challenge, but also to identify the level and extent to which greenhouse gas reporting is currently being conducted.

2.5 Approaching the barriers

To address the aforementioned barriers associated with sub-national level carbon reduction strategies and hence to support the process of corporate emissions management, there has been
a plethora of environmental and greenhouse gas reporting guidance documentation (AHGCC, 2002). Some of the more widely used tools are outlined in table 2.1. However, all currently present strategic barriers between defining corporate carbon reduction targets, developing a strategy to achieve those targets and evaluating the resultant performance. These barriers can be considered through three principal limitations.

Initially, the guidance documents do not provide a practical environmental management tool that extends the reporting process beyond the emissions measurement stage. For example,

Table 2.1 Some of the most frequently used tools and guidelines for calculating greenhouse gas emissions. Following the AHGCC (2002) p. A.28-29.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Resource</th>
<th>Published</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMI</td>
<td>Business and Climate Change Web Site</td>
<td>2000</td>
<td>Guidance for assessing, and developing a strategy to address, climate change risks at facility and corporate levels.</td>
</tr>
<tr>
<td>UNEP</td>
<td>Guidelines for Calculating Emissions for Business and Non-Commercial Organisations</td>
<td>2000</td>
<td>Guidance for calculating sub-national level greenhouse gas emissions, aggregating sources to provide a single-figure greenhouse gas indicator.</td>
</tr>
</tbody>
</table>
UNEP (2000) guidelines only outline methodologies to calculate sub-national level greenhouse gas emissions. However, there is no systematic process of formulating a practical strategy to reduce emissions through set objectives and targets. This is, in part, overcome by the DEFRA (2001c) guidelines which encourage organisations to set targets against current performance. However, with no instruction to assess progress against these targets or to develop a strategy to meet them, which, as ISO (1996) and EMAS (2001) assert, is a critical step in the management of environmental impacts, a major barrier to formulating a reduction strategy is encountered.

In addition, the scope of the guidelines is limited to emissions directly emanating from on-site operations. However, Loreti et al. (2000; 2001) argue that in some corporate sectors, carbon emissions, and hence opportunities for their reduction, come from the use of the product rather than its manufacture. For example, Whirlpool has estimated that their washing machines use 50 times more energy over their working lives than that consumed to produce them (WBCSD/WRI, 2001). Thus, by widening the focus of emissions management to indirect sources from both up- and down-stream operations, efforts and resources can be focused more effectively to reduce emissions (UNEP, 2002). This advocates the evaluation of carbon throughout the full product or service life, a process called life-cycle assessment (LCA) illustrated in figure 2.4 (Welford, 1998a; Loreti et al., 2000). This approach is largely undeveloped in the guidelines, but is expected to become increasingly relevant as emphasis moves away from traditional end-of-pipe solutions to a holistic evaluation of greenhouse gas emissions (UNEP, 2000).

A final barrier to employing the guidelines for comprehensively manage carbon emissions is that they provide a single generic measurement approach across all organisational sectors. For example, the WBCSD/WRI (2001) suggests that all organisations should account for direct emissions emanating from any production of electricity, industrial processing, transportation and fugitive emissions. However, the SDC (2002) argues that organisations work at different scales and cover a range of individual issues, implying the limitations to such an approach. For example, Loreti et al. (2001) argue that emissions from business travel may be significant for a

![Figure 2.4](image-url)  
*Figure 2.4. Outlining the scope of life-cycle assessment (LCA). Adapted from Welford (1998) and Loreti et al. (2000), p.32.*
service sector company but not for an electrical utility. In addition, the purpose of managing carbon emissions will vary between companies (Brophy and Starkey, 1998), as emphasised in figure 2.2. Thus, it is questioned whether such an approach is appropriate or whether carbon emissions can be more effectively managed through a sector-specific approach.

2.6 Overcoming the barriers

Reacting to these barriers identifies a second need; to develop a comprehensive and pragmatic environmental management tool to support the implementation and evaluation of sub-national level carbon reduction strategies. This ‘bottom-up’ approach will, in turn, help to bridge the gap between reduction targets and policies defined at the national level and the development of corporate strategies to address these programmes. The SDC (2002) argues that such a holistic approach to carbon reduction, encompassing both ‘top-down’ and ‘bottom-up’ strategies will stimulate diversity and innovation in addition to the transferral of best practice and knowledge.

Humphrey and Hadley (2000) suggest that any activity monitoring environmental performance against previously agreed policy targets or statutory standards demands an environmental audit approach. Thus, it is demonstrated in figure 2.5 that a tool, supporting the implementation of sub-national level carbon reduction strategies, could be advanced by developing environmental auditing techniques such as those outlined by Ledgerwood et al. (1992), Welford (1998b) and Humphrey and Hadley (2000) into a carbon audit framework. The International Chamber of Commerce (ICC, 1989) defines environmental auditing as:

‘A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organisation, management and equipment are performing with the aim of safeguarding the environment.’

Accordingly, a carbon audit framework would provide a systematic procedure for measuring, evaluating, reporting and verifying emissions in addition to implementing a carbon reduction action plan. In the context of the cycle of continuous improvement, this framework would also facilitate the identification of carbon reduction opportunities related to potential cost savings and the benchmarking of performance, ultimately leading to opportunities to gain an edge over competitors and the transition towards a more sustainable future (Welford, 1998b).
2.7 Summary

In light of the contribution of carbon to climate change, the pivotal, yet largely untapped, role of business in emissions reduction and the modest anticipated progress made towards national carbon reduction targets, the case for a paradigm shift, to one focused at the sub-national level, has been presented. However, there is a clear research need to discover the current state and extent of carbon emissions management at this organisational level. In addition, there is a need to formulate a comprehensive and pragmatic environmental management tool to support the implementation and evaluation of carbon reduction strategies.
In order to satisfy these needs, the overall project objective outlined in the introduction will be addressed through three specific aims:

1. To review current practices of carbon emissions reporting at the corporate level and the extent to which they address national level carbon reduction targets.
2. To critically appraise environmental auditing literature and guidelines to develop the academic foundation supporting the carbon audit framework.
3. To apply the framework to three distinct corporate sectors to evaluate the applicability of a single generic approach or if their inherent variations demand a sector-specific tool.
In framing the case for this dissertation, it was demonstrated that a clear research need exists to discover the current state of carbon emissions management at the sub-national level and that a pragmatic environmental management tool needs developing to support the implementation of carbon reduction strategies at this level. To address these needs, a two-stage methodology has been followed. Initially, corporate environmental reports were reviewed with the objective of documenting the current disclosure of carbon emissions management practices. The second stage focused on the formulation of a carbon audit framework, employing the results from the review, interviews from case studies and environmental auditing literature. The integration of these stages and how they address the research aims is illustrated in figure 3.1, adapted from figure 2.5 in order to demonstrate how they relate to the overall project objective.

3.1 Stage 1: Identifying current practice

The methodology for reviewing current carbon emissions management was developed through a consideration of the following subsidiary aims:

1. To examine best practice carbon accounting and reporting conventions against which to evaluate current carbon management strategies.
2. To explore current disclosure practices of carbon emissions at the sub-national level.
3. To determine the extent to which corporate carbon reduction strategies address national level greenhouse gas reduction targets, policies and protocols.
4. To identify inconsistencies in, and potential barriers to, sub-national carbon accounting practices, which need addressing in the development of a carbon audit framework.

3.1.1 Reviewing corporate environmental reports

In order to address the subsidiary aims, corporate environmental reports were reviewed. It has already been implied that these reports should, *inter alia*, act as a vehicle for disclosing an organisation’s carbon performance and management strategies (DEFRA, 2001b). However, to qualify this assumption, best-practice environmental reporting guidelines were evaluated to
determine the level and scope of carbon-related information that should be integrated within an environmental report. There was a consensus between this documentation that any such report should incorporate greenhouse gas emissions. For example, the FORGE Group (2002) asserts that financial services organisations should disclose energy and transport information because they represent significant risks to bottom line costs, deliver reputational benefits and influence the management of carbon, which is increasingly controlled by legislation. Considerations from the guidelines were amalgamated to present a best-practice environmental reporting framework (figure 3.2). The resulting three phase-nine step model illustrates that carbon issues have linkages with each phase of the environmental reporting process, specifically the second.

Figure 3.1  Development of a two-stage methodology to address the overall project objective and research aims. Developed from figure 2.5. Darker blue boxes relate the methodology to the project aims.
Step 1. Investigate the rationale for a public environmental report
- Identify the costs and benefits of developing a reporting strategy.
- Present the case to management; attain board level commitment.
- Communicate the programme to all tiers of the organisation.
- Identify a network of employees to implement the strategy.

Step 2. Identify key stakeholders
- Identify target audiences and characterise potential issues of concern.
- Consult and subsequently address the needs that have been expressed.
- Continue dialogue throughout the reporting process.

Step 3. Identify environmental aspects and impacts
- Inventory and prioritise impacts according to significance.
- Basic reporting principles require that greenhouse gases, emissions to air and energy consumption be scoped into any report.

Step 4. Develop performance indicators linked to the significant impacts
- There is a consensus that direct carbon emissions and energy consumption should form core indicators of the reporting strategy.
- However, disagreement surrounds the integration of indirect carbon emissions into core or additional performance indicators.

Step 5. Set objectives and targets against performance indicators
- Establish historic performance datum against which targets are set. This step may be carried out after step 6 for first time reporters.
- Targets for carbon emissions should be specific, quantified and set to a timescale. For example, $x$ percent reduction over $x$ years.

Step 6. Measure current performance
- Collection of data → Collation
- Communication → Analyse

Step 7. Evaluate current performance and develop an action plan
- Assess current performance against the objectives and targets.
- Develop an action plan in response to current performance.

Step 8. Draft report
- Prepare reports with varying levels of detail to meet audience demands.
- Greenhouse gas impacts may merit a separate section in the report.

Step 9. Verify, publish and distribute report
- Verification adds credibility, but level used depends on the organisation.

**Figure 3.2** A best practice framework for environmental reporting. Adapted from FORGE (2002), DEFRA (2001b), EMAS (2001b), Environment Australia (2000), GRI (2002a), PERI (1992) and UNEP IE (1994).
It must be appreciated, however, that this reporting process is part of a wider continuous cycle of improvement, depicted by an environmental management system (EMS) (EMAS, 2001b). In evaluating this system, it is evident that public communications occur within the latter stages of the cycle. However, many requirements for an EMS, such as establishing objectives and targets and identifying significant environmental impacts, are mirrored in the reporting process (figure 3.2). Thus, the two management tools can be described as complementary; the completion of one aids the implementation of the other. The linkages between reporting and an EMS are, however, diverse and have been investigated by authors including Welford (2001b), EMAS (2001b) and Netherwood (2001). Such considerations are not within the remit of this study but provide an interesting area for future research in comparing the extent to which the two models integrate, and ultimately drive, carbon emissions management.

Thus, figure 3.2 supports the justification for reviewing corporate environmental reports to elucidate the current practices of carbon emissions management. It is recognised however, that other approaches are similarly applicable. For example, information could have been gathered from organisations using interview or questionnaire techniques or environmental audits could have been reviewed to ascertain how they weight carbon considerations. However, evaluating reports was considered the most appropriate method in light of their importance as a source of information underlining the state of an organisation’s environmental performance (Gonella et al., 1998), and the relatively little research that has examined methods for conveying data within these reports (Marshall and Brown, 2003). In addition to their availability, this survey method also provides a structured and systematic approach to collecting data (Kolk, 1999).

3.1.2 Developing review topics against which to assess the reports

Using the best-practice framework for environmental reporting (figure 3.2), it was ascertained that an organisation’s carbon performance data and management strategies should essentially be integrated within the scoping and measurement phase. Thus, this phase was focused on to develop review topics against which to assess the environmental reports. In order to formulate these topics, however, carbon or greenhouse gas accounting and reporting guidelines (table 2.1) were initially evaluated to identify best-practice approaches to reporting on carbon. Again, considerations from these documents were amalgamated to present a best-practice framework for carbon reporting (figure 3.3), which thus provided a summary of the review topics.

As illustrated in figure 3.3, these documents provided guidance for the completion of steps 3 to 8 from figure 3.2, verifying the applicability of the environmental reporting framework. Con-
Step 1. Outline the environmental context
1.1 Identify climate change as an issue of business concern.
1.2 Integrate national carbon reduction targets into corporate planning processes.
1.3 Assess the potential use of market-based carbon reduction mechanisms.

Step 2. Define the organisational context
2.1 Delineate the organisational boundaries of the carbon reporting process.
2.2 Delineate the operational boundaries of the carbon reporting process.

Step 3. Identify environmental aspects and impacts
3.1 Conduct a broadly focused strategic assessment of the organisation to ensure that all carbon risks and opportunities are identified.
3.2 Scope in the significant carbon risks and opportunities from this inventory. At a minimum, this should encompass energy consumption, process-related emissions and transport-related emissions.

Step 4. Develop performance indicators linked to the significant impacts
Performance indicators are divided into core and additional indicators, where the former represent a minimum reporting requirement.

- Core indicators
  4.1.1 Tonnes of carbon emitted
  4.1.2 Direct energy consumption
  4.1.3 Indirect energy consumption
  4.1.4 Financial expenditure on carbon reduction schemes

- Additional indicators
  4.2.1 Transportation of materials, products or employees
  4.2.2 Energy efficiency initiatives
  4.2.3 Ambient carbon concentration
  4.2.4 Energy consumption footprint

4.3 However, GRI (2001b) state that core indicators can be omitted if justified.

Step 5. Set objectives and targets against performance indicators
5.1 Determine historic performance datum against which targets are set.
5.2 Establish carbon-reduction objectives and targets.

Step 6. Measure current performance
6.1 Identify sources of carbon scoped into the report from step 3.
6.2 Collect data and apply a calculation approach to each source.
6.3 Collate by aggregating each source to a corporate-wide
6.4 Analyse and communicate by normalising the data.
6.5 Note assumptions and sources of uncertainty.

Step 7. Evaluate current performance and develop an action plan
7.1 Relate the organisation’s carbon performance to the objectives and targets.
7.2 Develop an action plan to reduce carbon emissions.

Step 8. Draft, verify, publish and distribute the report
8.1 If appropriate verify the carbon emissions measurements.
8.2 Integrate considerations from the carbon report into the environmental policy.

currently however, the carbon specific guidance transcended this generic reporting framework, accounting for the additional inclusion of stages 1 and 2 within figure 3.3. These specific guidelines were also able to resolve areas of conflict in the environmental reporting framework (figure 3.2). For example, from figure 3.2, GRI (2002a) suggests that direct and indirect carbon emissions should form core environmental performance indicators, whereas DEFRA (2001b) implies that such indicators should only be described from direct emissions. By reviewing the carbon specific guidelines, a general consensus was found; both direct and indirect emissions should comprise core indicators, except for those emanating from transport (figure 3.3).

The list of review topics in figure 3.3 was then translated into a review package, summarised in appendix 1. The organisation of this package largely follows that outlined by Lee et al. (1999) who promoted a methodology for reviewing environmental statements and appraisals. The package presents a series of review topics, arranged hierarchically in three levels with a fourth providing guidance for the reviewer:

- **Review areas.** There are eight principal areas against which an organisation should aim to disclose its carbon performance. They are depicted by one digit preceding the topic, for example, 3. Identify environmental aspects and impacts.

- **Review criteria.** To satisfy each review area, information should be disclosed on individual criteria. These criteria are preceded by two digits in the list of review topics, for example, 3.1 Inventory all carbon risks and opportunities.

- **Review sub-criteria.** These describe detailed categories that should be employed to evaluate individual criteria. Three digits precede a sub-criterion, for example, 3.1.1 Direct emissions from sources owned or controlled by the reporting organisation.

- **Examples.** Examples are not reviewed, but provide factors that should be considered in evaluating a sub-criterion. They are depicted by four digits preceding the topic, for example, 3.1.1.1 The production of electricity, heat or steam.

A schematic of this hierarchical structure is presented in figure 3.4. The base level is depicted by examples, which provide an aid to the assessment of the sub-criteria. Evaluations of these sub-criteria are then used to assess the succeeding level, criteria. Assessment of the criteria, in conjunction with any supplementary information gained from the report and personal judgements regarding the relative importance of the criteria, are employed to evaluate the review areas, providing an overall indication of carbon disclosure in that principal topic.
3.1.3 The coding system

Morhardt (2001) indicates that three principal approaches exist to assess environmental reports against checklists of review topics. Initially, qualitative coding systems can be employed. This approach has been demonstrated by Krut and Munis (1998) who used typographical symbols to evaluate review criteria. Secondly, textual analyses can aid the characterisation of general approaches made to disclosing information (Morhardt, 2001). Finally, numerical scoring or coding systems can be used to assign quantitative measures to evaluate review topics. Systems devised by UNEP and SustainAbility (1996, 1997), Davis-Walling and Batterman (1997) and Deloitte, Touche and Tohmatsu (1999, 2002) have all used this latter approach.

Of these approaches, the numerical coding system was employed to evaluate carbon disclosure practices in the environmental reports. This was largely due to its ability to highlight strengths and weaknesses in the reports (UNEP and SustainAbility, 1996), a subsidiary aim of this project. In order to explore current practices, it was considered that using a qualitative approach may reduce comparability because, as Jones and Alabaster (1999) argue, assigning a yes or no code may not provide a fair picture of how well a criterion is met.

However, many criticisms hinder the applicability of these quantitative coding systems. Krut and Munis (1998) argue that assigning numerical values to criteria encourages the creation of averages and rankings. This is deemed unfair on the premise that corporations have different operations and hence different environmental impacts (Morhardt, 2001). However, this project aims to identify trends in the topics that an organisation is reporting on. Thus, codes will be compared between categories rather than corporations, avoiding organisational rankings. This
is why the review topics have not been weighted; it is not the aim of this project to rank corporations on the basis of their carbon performance or management strategy disclosures.

Further, Jones and Alabaster (1999) have described existing quantitative coding systems as flawed because they ignore the axioms relating to their level of measurement. For example, the variables in these systems are categorical, making them inappropriate for the arithmetic additions and statistical analyses performed on them (Morhardt, 2001). However, in exploring current disclosure practices, as in this study, it is argued that the relative frequencies of topics need to be examined. This advocates the use of the modal average, which is meaningful to the categorical variables that will be generated from this review (Jones and Alabaster, 1999).

Initially, a five-stage coding system, applicable to all review topics in the review package, was devised which assessed the degree of coverage of that topic in the environmental report. However, in applying this system, it was found that not every topic could be assessed against this five-stage scale. For example, many of the environmental performance indicators were either present or absent, demanding a dichotomous approach. Thus, a second system was developed.

This revised approach focused on the formulation of separate coding systems for categories of review areas. The WBCSD/WRI (2001) argues that each step in the carbon reporting process, and hence in the review package, corresponds to the satisfaction of a reporting principle. For example, the identification of environmental aspects and impacts (review area 3) corresponds to the relevance of the information presented. This is consistent with GRI (2002a) who have similarly developed reporting principles, but for environmental reports. Thus, the two sets of principles were compared to identify which best represented each topic in the package. The principles employed, the reasons for their choice and the review areas which they assessed are illustrated in figure 3.5. This overcame many of the limitations in the initial coding system by providing specific criterion against which to assess categories of comparable review areas.

Figure 3.5 demonstrates that assessments of the latter principles are largely dependent on those of former principles. For example, codes assigned to the comparability and accuracy principles are, in part, determined by the completeness of the report. This trend corresponds to the nature of the review topics which are presented in a sequential order. This is also consistent with GRI (2002a) who argue that some of the principles, such as transparency, ‘overarch’ the full reporting cycle and as such are inherently determined by all stages in the report. The complete coding system for assessing the environmental reports is outlined in appendix 2.
3.1.4 Sampling the corporate environmental reports

Environmental reports were sampled from the FTSE 350 index in order to examine the extent to which the Government’s challenge, summarised in chapter 2, has been met and to identify disclosure practices from different organisational sectors. A probability sampling technique was employed to select the reports in order to representatively estimate the modal codes of the review topics (Saunders et al., 2003). This technique was completed through three stages:

3.1.4.1 Identifying a suitable sampling frame

The sampling frame was initially defined using current listings of organisations belonging to the FTSE 350\textsuperscript{1} register. However, this list had to be refined by identifying those that indicated

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.5.png}
\caption{The principles employed to assess the review areas (RAs). The white boxes depict the reasons for choosing the principles, the principles themselves are highlighted in the lighter blue boxes and the RAs which they will assess are shown in the darker blue boxes.}
\end{figure}

environmental awareness. This was completed using the following criteria:

- Being a member of the GEMI, the WBCSD or the CERES;
- Being an identified user of the GRI, DEFRA, FORGE or PERI reporting guidelines;
- Having one or more environmental report listed on the reporting website page of the University of Sunderland’s Centre for Environmental Informatics\(^2\) or the Corporate Register website\(^3\);
- By reviewing an organisation’s corporate Annual Report.

Using these criteria, the environmental awareness of an organisation was categorised against a six-point scale (table 3.1). This categorisation is intended to reflect the state of environmental reporting in the FTSE 350, and so does not infer the quality of the disclosures. Where criteria are not met, it was presumed that the corporation does not disclose environmental information. This was deemed reasonable in light of one of the principal attributes of an environmental report; to be easily accessible to all stakeholders (Gonella \textit{et al}., 1998). Thus, the results will represent the \textit{minimum} number of organisations belonging to each reporting category.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No environmental awareness disclosed.</td>
</tr>
<tr>
<td>1</td>
<td>The organisation expresses an intention to report or to develop an environmental reporting strategy.</td>
</tr>
<tr>
<td>2</td>
<td>The organisation produces a short environmental, social or sustainability statement in their Annual Report.</td>
</tr>
<tr>
<td>3</td>
<td>Environmental performance data and management strategies are disclosed electronically on the organisation’s own webpage.</td>
</tr>
<tr>
<td>4</td>
<td>The organisation produces an environmental report. Owing to the lack of standardisation in this discipline (Marshall and Brown, 2003), this code was sub-divided to reflect the diversity in the approaches taken.</td>
</tr>
<tr>
<td>4a</td>
<td>Addresses environmental issues.</td>
</tr>
<tr>
<td>4b</td>
<td>Addresses environmental and social issues.</td>
</tr>
<tr>
<td>4c</td>
<td>Provides a ‘corporate social responsibility’ report, addressing environmental, health and safety, social and community issues.</td>
</tr>
<tr>
<td>5</td>
<td>The organisation produces a sustainability report. It discloses information against the three dimensions of environmental, social and economic factors.</td>
</tr>
</tbody>
</table>


3.1.4.2 Identifying a suitable sample size

This process established that 111 of the organisations produced a corporate environmental or sustainability report (codes 4 and 5 in the categorisations), which equates to 31.7 percent of the total. Of these, only 109 can form the population because three of the organisations publish environmental performance data within the same report. This outcome alone is worthy of note and will be discussed further in the analysis section. According to Sekaran (1992), in order for an adequate sample to represent this population with a 95 percent level of certainty, 86 organisations should be selected. However, owing to time constraints, it was only feasible to review 56 of these, which still represents over 50 percent of the population.

3.1.4.3 Selecting a sampling technique

Following guidance from Saunders et al. (2003), a stratified random sampling technique was considered the most appropriate for selecting environmental reports. In light of the different positions of organisations along the continuum of environmental disclosure (UNEP IE, 1994), a representative sample from ‘good practice’ reporters was considered important to act as a term of reference. Thus, the stratified sampling method ensured that the resulting sample was distributed in the same way as the population in terms of these stratifying criteria (Bryman, 2001). A random approach was selected because the FTSE 350 register was already ordered, alphabetically, and so allowed the sample to be selected without bias (Saunders et al., 2003).

To identify those environmental reports that should constitute the ‘good practice’ stratum, only those recommended by DEFRA (2001c) or that won an award from the Association of Chartered Certified Accountants (ACCA) were incorporated. Thus, the ACCA Environmental Reporting Awards (2000-2003) were examined to ensure that those reports reviewed under the banner of ‘good practice’ corresponded to those that received an award.

Following the methodology outlined by Saunders et al. (2003), each case within both strata was labelled with a unique number. Numbers corresponding to these cases were then selected from random number tables to determine the sample for each stratum. Consistent with Bryman (2001), the first number was chosen at random to prevent any opportunity for human bias. In this way, 56 organisations were selected, 8 of which belonged to the ‘good practice’ stratum. These organisations are listed in appendix 3, disaggregated according to strata.
3.2 Stage 2: Developing and evaluating a carbon audit framework

The methodology for formulating and assessing the carbon audit framework evolved through a consideration of the latter two project aims (section 2.8) and the following subsidiary aims:

1. To examine the specific needs that a sub-national level carbon audit framework should meet, the understanding of which will ultimately underpin the proposed framework.
2. To identify the motivations for and perceived barriers to disclosing and managing carbon emissions, recognition of which will feed into the audit framework.
3. To determine, evaluate and address the potential barriers and benefits to using a carbon emissions management tool at the sub-national level.
4. To develop and evaluate a pragmatic environmental management tool to facilitate the measurement of corporate-level carbon emissions.

As illustrated in figure 3.1, the key to addressing these subsidiary aims is to link an awareness of current carbon management practices with environmental auditing procedures to develop and evaluate a carbon audit framework. Following the landmark work of Glaser and Strauss (1967), this approach demands a research strategy ingrained in grounded theory. This theory involves a combination of inductive and deductive methodologies; theory is initially generated from data, which is subsequently tested in further observations (Bryman, 2001). Thus, the grounded theory strategy is employed to unite the research element of the project with the formulation and evaluation of its theory, the carbon audit framework. This was achieved using three principle sources of data; results from the current practice review, environmental auditing literature and case study analyses (figure 3.6).

3.2.1 Results from the current practice review

The initial review explored current disclosure practices of carbon emissions in environmental reports. Through the inductive approach, comprehensively managed carbon reporting aspects in addition to those framed with inconsistency were identified in order to advance informative and pragmatic findings to develop criteria constituting the audit framework.
3.2.2 Environmental auditing literature

As illustrated in figure 3.6, environmental auditing literature will be reviewed as part of the inductive approach to developing the framework. It will provide a robust organisation of the criteria within the framework and develop its overall structure.

3.2.3 Case study analyses

To complete the grounded theory research strategy, a case study approach was considered most appropriate. As figure 3.6 illustrates, this not only supports the inductive stage of the strategy, in contributing to the formulation of the audit framework, but also supports its deductive stage, in assessing the validity of the proposed model. In addition, the case studies were able to
recognise the complexity and context of the anticipated setting of the model, the organisation (Punch, 1998), and present a platform for using multiple sources of evidence to evaluate the framework (Yin, 2003). Thus, the purpose of analysing carbon management strategies within a case study context can be summarised as two-fold:

1. To provide additional information on the current practices of and motivations for carbon management strategies to feed into the audit framework.
2. To collect multiple sources of empirical data to evaluate the validity of the carbon audit framework within its real-life context.

Three case studies were selected from different organisational sectors in order to allow a range of perspectives to influence the formulation of the carbon audit framework. Variations inherent in the case studies also facilitated the comparative assessment of the audit framework, directly addressing the third project aim (section 2.8). Each case was chosen from the list of FTSE 350 reporting organisations identified from stage 1 of the research, ensuring a consistent scale with the review. The case studies, with justification for their choice, are outlined below.

**AMEC plc (Construction sector):** Owing to the slower decline in the carbon intensity of the construction sector compared to other industries, Murtishaw et al. (2001) argue that their share of emissions is rising. This presents a clear basis for investigating opportunities for emissions reductions in this sector. The construction industry was also chosen because of its potential application to LCA. The importance of LCA to this sector is highlighted in the Government’s ‘Building a Better Quality of Life’ strategy, designed to minimise energy consumption in the construction and use of buildings (DETR, 2000).

**Aviva plc (Services sector):** Although typified by a poor environmental reporting record (KPMG, 1999), Salway (1997) argues that this sector is becoming increasingly prominent in the UK’s greenhouse gas inventory. Further, DEFRA (2001b) suggests that this sector is expected to be a key driver in the rise in carbon emissions forecast after 2010 (figure 2.1). However, the decarbonisation potential of this sector has remained largely untapped (DETR, 2000), providing many opportunities for investigating emissions reductions.

**British Airways Authority (BAA) plc (Transport sector):** Eyre (2001) asserts that the transport sector has a pivotal role to play in any national-level carbon reduction strategy. It currently constitutes the third largest source of greenhouse gases but, more importantly, is the fastest growth sector of these emissions (DEFRA, 2001b). ECCM (2003) suggests that even in
the context of increased carbon taxes imposed on transportation, its carbon intensity is set to rise, illustrating the need to identify carbon reduction opportunities in this sector.

Thus, following the case study classifications outlined by Stake (1994), these case studies form a collective or comparative research strategy. Corresponding to the two-fold purpose of this strategy outlined above and in figure 3.6, its organisation will be presented through two stages:

3.2.3.1 The inductive stage

In order to elicit information, attitudes and values regarding the management and disclosure of carbon emissions within the case study context, interview techniques were selected. The style and design of these interviews were largely driven by their dual purpose, namely:

1. Through a descriptive research aim, to depict current profiles of carbon management practices, from which to integrate findings into the audit framework.
2. Through an exploratory research aim, to seek insights into the potential applicability of a carbon audit framework in addition to its anticipated benefits and barriers.

To address these aims, a hybrid interview strategy was developed employing both structured and semi-structured interview techniques. Following guidance from Saunders et al. (2003), the descriptive aim demanded a structured approach with pre-coded questions. In applying this strategy, each respondent received the same interview stimulus, ensuring a consistent and comparable analysis of carbon management practices between case studies (Bryman, 2001). Saunders et al. (2003) add that using such pre-coded questions to compare interview responses has the advantage of reducing interviewer variability and potential misinterpretation.

However, in addressing the exploratory aim of the interview, Saunders et al. (2003) argue that a semi-structured approach with open-ended questions is more applicable. The inherent flexibility of this strategy allowed respondents to expand on relevant issues which added depth, significance and a personal perspective to an evaluation of the substance and structure of the carbon audit framework (Bryman, 2001). In addition, Saunders et al. (2003) assert that this flexibility allows the interviewer to vary the logic of the questions presented according to the specific circumstances of the respondent. This attribute was particularly pertinent to the initial question in the interview guide which, in delineating the boundaries of the discussion, affected the applicability of many of the subsequent exploratory questions.
Healey and Rawlinson (1994) argue that using this hybrid approach combines advantages from both the structured and semi-structured interview techniques. Logically, however, it also has the potential to compound data quality problems. For example, interviewer and interviewee biases may become more pronounced (Healey and Rawlinson, 1994). In an attempt to redress data quality issues, practical guidance for preparing and delivering interviews was followed from Bryman (2001) and Saunders et al. (2003). For example, a list of interview topics was presented to the respondent prior to the interview, allowing the interviewee time to consider the information being requested, which ultimately promoted the validity and reliability of the data (Saunders et al., 2003). In addition, theoretical concepts were avoided, interviews took place in an environment where the respondent felt comfortable, usually their own office, and responses were transcribed immediately following the interview (Bryman, 2001).

A further problem relating to this issue of data quality, emanating specifically from the semi-structured component of the hybrid approach, is its lack of standardisation which questions the generalisability of the findings (Saunders et al., 2003). Yin (1994) argues that this problem is exacerbated when using the case study approach owing to its small number of unrepresentative samples. However, the purpose of the interviews is, through the inductive approach, to present theoretical propositions to underpin a framework that can be tested in different contexts. Thus, although the results can not be used to infer the current situation in the FTSE 350 register, they can still generate valuable theories that can be tested in subsequent contexts (Saunders et al., 2003). Owing to this limited generalisability in addition to the small sample size, piloting was not considered necessary.

The interview guide, detailed in appendix 4, was thus prepared to directly address the purposes of the interview and to limit potential data quality problems. The initial section of this guide focuses on the descriptive purpose and, as such has a structured design. The latter section, however, addresses the exploratory aim and is thus presented in a semi-structured style. Table 3.2 depicts the justification for each question and how they address the subsidiary objectives.

3.2.3.2 The deductive stage

In order to complete the grounded theory approach, guidance from the proposed carbon audit framework was empirically tested by performing as complete a carbon audit as possible on each case study. Yin (2003) argues that such a deductive strategy requires theoretical concepts to guide data collection. Thus, by using the theoretical concepts embedded in the framework to conduct the carbon audit will evaluate its feasibility within a real-life context.
Table 3.2 An outline, objective and justification of each question within the interview guide. The subsidiary aims which each question addresses is also described.

<table>
<thead>
<tr>
<th>Question</th>
<th>Subsidiary aim</th>
<th>Question objective</th>
<th>Classification of question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Setting the context</td>
<td>To define the boundaries of the case study, providing a framework for discussion and a feasible and practically scaled analysis.</td>
<td>Open-ended</td>
</tr>
<tr>
<td>1.2</td>
<td>3</td>
<td>To determine the sources of carbon emissions from the organisation to evaluate the scope necessary for their comprehensive management.</td>
<td>Pre-coded</td>
</tr>
<tr>
<td>1.3</td>
<td>3</td>
<td>To identify the extent to which different sources of carbon are currently being monitored.</td>
<td>Pre-coded</td>
</tr>
<tr>
<td>1.4</td>
<td>3</td>
<td>To examine the techniques currently being used to monitor carbon emissions to evaluate the practicalities of the carbon measurement process.</td>
<td>Pre-coded</td>
</tr>
<tr>
<td>1.5</td>
<td>2</td>
<td>To identify and prioritise the motivating factors for monitoring carbon emissions, which need to underpin the carbon audit framework.</td>
<td>Pre-coded</td>
</tr>
<tr>
<td>1.6</td>
<td>3</td>
<td>To explore the scale of and reasons for disparities between the level of monitoring carried out internally and that which is disclosed externally.</td>
<td>Pre-coded</td>
</tr>
<tr>
<td>2.1</td>
<td>1</td>
<td>To evaluate the specific need for a tool to manage the organisation’s carbon emissions and support national level carbon reduction targets.</td>
<td>Open-ended</td>
</tr>
<tr>
<td>2.2</td>
<td>4</td>
<td>To examine the strategic and practical obstacles of employing a carbon management tool, which will need to be addressed in the development of the audit framework.</td>
<td>Open-ended</td>
</tr>
<tr>
<td>2.3</td>
<td>4</td>
<td>To examine the potential benefits of the management tool, which need to be embraced in the development of the audit framework.</td>
<td>Open-ended</td>
</tr>
<tr>
<td>2.4</td>
<td>4</td>
<td>To identify whether the obstacles and barriers are specific to the organisation or its sector.</td>
<td>Open-ended</td>
</tr>
<tr>
<td>2.5</td>
<td>5</td>
<td>To evaluate the need to propose a single or sector-specific approach to the development of the carbon audit framework.</td>
<td>Open-ended</td>
</tr>
</tbody>
</table>

3.3 Limitations of the methodology

An inherent limitation of the initial stage of the project includes the potential subjectivity with which review topics were assigned codes. It is for this reason that many scoring systems used to evaluate corporate environmental reports recommend the use of two independent reviewers.
For example, Deloitte, Touche and Tohmatsu (2002) argue that they balance subjective views and create a sound basis for discussing areas of contention. Although the use of two reviewers was not feasible in this project, subjectivity was kept to a minimum by explicitly following the definitions of the codes outlined in the coding system. In addition, by reviewing a number of reports, it was possible to calibrate codes, developing a consistent and repeatable approach.

The sample size of case studies used to evaluate the carbon audit framework presents a further limitation. Owing to time constraints, only three case studies could be investigated. As these do not represent all sectors, the generalisability of this evaluation to the FTSE 350 becomes limited. Although they still provide a valid test of the framework within the context of their specific sectors, further investigation is needed to validate its applicability to the FTSE 350.
The results chapter is divided into two parts mirroring the two stages of the methodology; the
initial part presents current disclosure practices of carbon emissions and the second focuses on
the responses from the interviews. Conclusions from these two sections are then integrated in
the summary, disaggregated according to informative and pragmatic findings, which will then
be used to feed into the carbon audit framework.

4.1 Part 1: Current disclosure practices of carbon emissions

The principal findings from reviewing corporate environmental reports are summarised below.
Initially, their context is set by exploring the trends relating to generic environmental reporting
practices. The analysis then focuses on the carbon component of this process by depicting the
trends in, and influences on, their current disclosure.

4.1.1 Trends in corporate environmental reporting

Whilst exploring current disclosure practices of carbon emissions at the corporate level, trends
underpinning generic environmental reporting practices were identified. Although an examin-
ation of these trends does not fall directly within the remit of this study, they will be briefly
outlined to provide the setting within which carbon emissions are disclosed.

As illustrated in the previous chapter, 31.7 percent of organisations belonging to the FTSE 350
register produce a corporate environmental or sustainability report. The relative significance
of this result is presented in figure 4.1, which outlines the current level of, and media used to
disclose, environmental awareness in the FTSE 350. For example, 66.9 percent of the organi-
sations show at least some level of environmental awareness, of which almost half is manifest
within a separate non-financial report. This level of awareness is consistent with the survey
conduct by the PIRC (1998) who estimated the figure to be slightly lower, at 65 percent
(figure 4.1 insert). However, the age of this survey suggests that the dramatic increase in
environmental reporting tracked by Wheeler and Elkington (2001) is beginning to stabilise. It
is important to note, however, that this trend may have become influenced by the results in figure 4.1 representing the minimum number of organisations belonging to each reporting category, as outlined in section 3.1.4.1.

Although this collective environmental awareness has changed little over the past five years, figure 4.1 illustrates that the medium used to convey this awareness has altered significantly since the PIRC survey, which found the majority of environmental disclosures to be made within the company’s Annual Report (PIRC, 1998). To examine this trend, the study will be narrowed to a consideration of the FTSE 100 in order to compare the results to surveys carried out by KPMG (1996, 1999) who investigated these media in more detail.

If the threefold KPMG reporting classifications (figure 4.2 insert) are employed, there appears to be an overall reduction in environmental awareness in the FTSE 100 since 1999. However, as illustrated in figure 4.2, this taxonomy no longer presents the full picture. Environmental reporting practices have evolved; disclosing performance data in the company’s Annual Report or within separate environmental reports has decreased, to be replaced, in part, by disclosure

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**Figure 4.1** The current level of and media used to disclose environmental awareness in the FTSE 350. For comparison, the insert presents awareness in 1998 from the FTSE 350, identified by the PIRC (1998).
within social, sustainability or community reports. Moreover, additional reporting categories have developed, including the integration of environmental awareness within Corporate Social Responsibility reports and on the company’s webpage (figure 4.2). These additional categories indicate that overall environmental awareness has increased in the FTSE 100 from 84 percent in 1999 to a current level of 92 percent. This supports global reporting trends depicted by the CSR Network (2003) but also reveals that the marginal increase in reporting practices identified in the FTSE 350 has principally been driven by the largest 100 corporations.

This brief analysis on generic environmental reporting illustrates that the media within which carbon emissions are currently being disclosed are diverse. Figure 4.3 demonstrates that each medium represents a discrete stage along an environmental reporting continuum related to the extent to which the report meets stakeholder needs. Thus, as carbon performance data are increasingly integrated within triple bottom line accountability reports, it can be expected that their evaluation will become more comprehensive in order to meet these needs (figure 4.3). However, subsequent analyses question this assumption.
4.1.2 Trends in carbon disclosure practices

The review package, detailed in appendix 1, identified eight principal themes for assessing the level at which organisations are currently disclosing their carbon emissions performance data and management strategies. The modal code for each theme, or review area, across the 56 organisations surveyed from the FTSE 350 is presented in figure 4.4. It was found particularly informative to summarise these codes on a radar plot.

Figure 4.4 highlights that not all review areas are disclosed at a consistent level, as depicted by its erratic profile. Hemming et al. (2003) took an analogous approach to present the current level at which organisations are addressing attributes of sustainable development. They imply that such an inconsistent profile can indicate a low level of activity in addressing those aspects being assessed (Hemming et al., 2003), which, in turn, describes a poorly developed carbon reporting process. This could reflect the idiosyncratic and fragmented approach to managing carbon identified by ENDS (2001a) and UNEP (2000). It would be interesting to compare this situation over time to see if it evolves into a more rounded, and hence, developed profile.
Positively, however, modal codes in figure 4.4 indicate that a higher frequency of companies are currently disclosing carbon emissions within an external reporting context compared to those choosing to circumvent this issue. In fact, 96.4 percent of all corporations reported carbon as an issue of business concern. However, this does not take into account the relative level of these disclosures. For example, figure 4.4 illustrates that only one review area, identifying aspects and impacts, received a modal code above 2, depicting a carbon reporting process currently framed with significant omissions and an inadequate treatment of relevant aspects. This is consistent with generic reporting trends outlined by the CSR Network (2001) who estimated that only a third of global top 100 companies reported full performance data on carbon emissions in 2001.

Thus, the principal strength of this carbon reporting process focuses on the completeness with which carbon related aspects and impacts are identified (figure 4.4). However, the relevance of its environmental context, the accuracy with which carbon performance is measured and the transparency with which this performance is evaluated all depict weaknesses in the disclosure process. For example, companies readily presented statistics related to their carbon emissions, but failed to disclose how these figures were derived, thus reducing their potential accuracy and transparency. Each of these review areas contributes to the overall picture of current

![Figure 4.4 Modal code for each review area in the review package (appendix 1).](image-url)
carbon disclosure practices and therefore, to address the subsidiary aims outlined in the methodology, these will now be discussed according to three themes; their scope, expression and the extent to which they address national level greenhouse gas reduction targets.

4.1.2.1 The scope of current carbon reporting practices

In order to evaluate the scope of carbon management practices currently being framed within corporate environmental reports, the third review area, identifying aspects and impacts, will initially be examined. Figure 4.5 depicts the results of this review area, categorised according to those review criteria used to assess the completeness of the organisation’s carbon emissions inventory and those used to evaluate the disclosure of significant sources from this inventory.

Clearly, the weight of identifying environmental aspects and impacts within an environmental report is placed on the significant carbon risks and opportunities as opposed to identifying all potential risks from which this selection can be made. This questions the comprehensiveness of the carbon reporting process because, as DEFRA (2001a) assert, the scope of the report will largely be defined by the initial scoping process.

![Figure 4.5 Modal codes related to the identification of aspects and impacts, assessed against the principle of completeness. Sub-criteria used to assess the inventory are depicted below the bold diagonal line, those evaluating significant sources above it.](image-url)
Within those sources that are identified, however, figure 4.5 demonstrates that indirect carbon emissions from imports of electricity, heat or steam are the most comprehensively discussed. It is perhaps surprising that direct emissions, which the WBCSD/WRI (2001) classify as a minimum reporting requirement, are identified to the same level of totality as other indirect emissions which organisations are only encouraged to account for (WBCSD/WRI, 2001). This could reflect emerging shifts in the composition of the UK’s industry base (DETR, 2000). For example, as the service sector becomes more prominent (Eyre, 2001), so the focus is expected to move away from reporting on direct emissions, characteristic of the manufacturing sector (Murtishaw et al., 2001), to indirect sources which are more pertinent to the service sector.

Consistently, figure 4.5 illustrates that actual disclosures of carbon performance data related to their significant sources typically encompass energy consumption and transport emissions. Although both categories are reported to the same level of completeness, their frequency of disclosure is not analogous; energy consumption is the most commonly reported carbon emissions source. In fact, all organisations that reported carbon-related issues within their environmental report (96.4 percent) made reference to their energy performance. This is consistent with a survey carried out by UNEP (2000) who found that the most frequently reported global warming issue within 75 international environmental reports in 2000 was energy consumption. However, the UNEP survey also highlighted the poor level of disclosure on transport emissions, a finding since supported by the CSR Network (2003). Again, this could reflect the shift in the UK’s industry base, as three-quarters of the surveyed FTSE 350 organisations were found to report on these mobile sources of carbon.

A further review area that elucidates the scope of carbon reporting practices in the FTSE 350 is that germane to the setting of objectives and targets. Figure 4.4 indicates that the comparability of this review area is largely hindered by significant omissions in its context, as manifest in its assigned code, 2. Modal codes of the sub-criteria constituting this review area are presented in figure 4.6. These codes demonstrate that although the specific objectives and targets present a best practice approach to this aspect of the carbon reporting process, the consistent lack of a base year against which they are set reduces their comparability.

In the context of generic environmental reporting practices, KPMG (1999) identified emissions to air as one of the most frequent areas within which targets are defined. In the global top 250 companies, for example, half published plans on their emissions to air in 1999 (KPMG, 1999). Since this survey, however, progress has been made in defining carbon related targets, at least within the UK’s division of these organisations; over three-quarters of the companies surveyed
made some reference to such targets. This is particularly pertinent as it demonstrates a commitment to continually improving environmental performance (DEFRA, 2001a).

The review areas previously discussed demonstrate valuable trends in those aspects of the carbon reporting process that are currently disclosed. However, to comprehensively identify the scope of these disclosures, it is equally important to evaluate those aspects depicting weaknesses in the reporting process. For example, figure 4.4 illustrates that the accuracy with which carbon performance is measured (review area 6) and the transparency with which this performance is evaluated (review area 7) are only present in ambiguous or evasive statements.

Although quantitative data on carbon emissions performance are often disclosed, demonstrated by review area 3, the means with which they are derived are rarely presented. This is manifest by each criterion and sub-criterion within review area 6 being coded an accuracy level of zero. In then evaluating this performance, table 4.1 illustrates that only two sub-criteria, reporting performance against objectives and identifying potential solutions to reducing emissions, have a modal code above zero. This portrays a fragmented approach to the carbon reporting process; current performance is often stated, targets are often set, yet the two are rarely integrated by

![Diagram](image-url)

**Figure 4.6** Modal codes related to the setting of objective and targets, assessed against the principle of comparability. Sub-criteria assessing the historic performance datum are to the right of the bold diagonal lines, those evaluating objectives and targets to its left.
Table 4.1 The modal codes for the sub-criteria in review area 7, evaluating performance, assessed against the principle of transparency

<table>
<thead>
<tr>
<th>Sub-criteria</th>
<th>Description</th>
<th>Modal code</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1.1</td>
<td>Report the current position of the organisation with respect to its objectives and targets</td>
<td>1</td>
</tr>
<tr>
<td>7.1.2</td>
<td>Highlight areas of success and weakness</td>
<td>0</td>
</tr>
<tr>
<td>7.2.1</td>
<td>Identify solutions to reduce carbon emissions</td>
<td>2</td>
</tr>
<tr>
<td>7.2.2</td>
<td>Describe the commitment and resources necessary for plan implementation</td>
<td>0</td>
</tr>
<tr>
<td>7.2.3</td>
<td>Outline potential obstacles to the action plan</td>
<td>0</td>
</tr>
<tr>
<td>7.2.4</td>
<td>Monitor and commit to continuous improvement</td>
<td>0</td>
</tr>
</tbody>
</table>

Evaluating the former against the latter. This reduces the potential ability of the targets in demonstrating the organisation’s commitment to continual improvement.

Similarly, figure 4.4 illustrates that the second review area, defining the organisational context, depicts a weakness in the carbon reporting process, being predominantly served by an evasive or ambiguous statement. However, the WBCSD/WRI (2001) argues that clear and appropriate organisational and operational boundaries contribute to the relevance and transparency of the report. As figure 3.5 demonstrates, a poor approach to the relevance principle undermines the potential functionality of the entire report.

4.1.2.2 The expression of current carbon emissions performance data

In order to explore the metrics currently being applied to convey this scope of carbon reporting practices within an environmental report, the fourth review area, developing carbon-related performance indicators, will now be examined. By expressing the content of a report, Marshall and Brown (2003) argue that these indicators should form a critical component of any report evaluation because they raise questions about its ability to meet stakeholder expectations. The modal codes reflecting the comparability of carbon-related performance indicators are depicted in figure 4.7, disaggregated according to core and additional indicators.

Figure 4.7 illustrates that carbon emissions performance data are typically expressed through four performance indicators, which, with the exception of emissions from transportation, share the same articulate level of comparability. These metrics are equally distributed between core
and additional indicators. However, as figure 3.3 demonstrates, this binary categorisation of indicators reflects their relevance to report users so that the former, core indicators, should be weighted to a minimum reporting requirement (GRI, 2002a). Figure 4.7 reveals that this recommendation has not been adhered to in the FTSE top 350; half of the core indicators have a modal code of zero. A potential explanation surrounds the caveat introduced by GRI (2002b) who state that any core indicator can be omitted if justified. However, examining the codes assigned to the organisations for the review criterion 4.3 (covering this caveat), reveals that only Waste Recycling Group plc indicated any justification for omitted indicators.

In order to evaluate the ability of these indicators to meet stakeholder expectations, the ISO standard 14031 (1999) has classified indicators according to a three-level typology. This typology identifies management performance, operational performance and environmental condition indicators. Marshall and Brown (2003) used this taxonomy to infer values relating to indicators, as illustrated in figure 4.8. For example, they assert that managerial indicators describe the ability of an organisation to meet environmental goals. As these are expected to influence future results, they are depicted as leading indicators (GEMI, 1997). In contrast, operational performance and environmental condition metrics fail to make this connection...
between current and future performance (Marshall and Brown, 2003). As such, they are described as lagging indicators (GEMI, 1997).

This hierarchy of indicators can be applied to evaluate the metrics currently being employed to convey carbon emissions performance data. Whenever a carbon-related performance indicator was discussed in an environmental report, it was coded. Thus, by identifying the frequency of each indicator used and assigning it to a category in the metrics hierarchy (figure 4.8), their collective value to stakeholders can be ascertained. The proportion of indicators belonging to each category is depicted in figure 4.9. It must be noted however, that these figures reflect the frequency of metrics used, not their quality.

Figure 4.9 shows that almost three-quarters of indicators used to express carbon performance data belong to the operational category, which consist of lagging indicators (GEMI, 1997). This is consistent with disclosing absolute amounts of energy inputs to or carbon outputs from the organisation, as reflected in figure 4.7. However, Marshall and Brown (2003) argue that the inability to connect these inputs and outputs with their future performance reduces the usefulness of the information. A greater use of managerial performance metrics would overcome this problem (Marshall and Brown, 2003).

However, a major limitation with this approach taken by Marshall and Brown (2003) is that performance indicators are considered in isolation, not as a component of the reporting cycle.
In evaluating figure 4.6, for example, establishing carbon reduction targets, which focus on the future performance of the organisation, is coded to a high level of comparability. This suggests that operational performance indicators may be used as a platform from which targets are set. These targets may then become the intended tools to influence future results.

To place these results in a wider reporting context, they can be compared to the proportion of generic environmental performance indicators assigned to this three-level typology from environmental reports surveyed by Marshall and Brown (2003). This study reviewed all metrics portrayed in 79 reports from corporations belonging to the Dow Jones Stock Exchange and calculated the percentage of metrics belonging to each indicator category according to sector. In comparing these results however, it must be recognised that, as identified by CSR Network (2003), marked geographical differences may occur in environmental reporting practices. The results are compared in table 4.3.

Table 4.3 shows the prevalence of measures, both among organisational sectors and between generic and carbon performance indicators, related to operational performance. Within this category, similar trends are evident between the generic and carbon performance indicators; in both data sets, the service sector has the lowest proportion of operational performance metrics whereas the manufacturing sector maintains the highest level. Owing to the minor magnitude of these sectoral differences however, Marshall and Brown (2003) suggest that the level at which companies were grouped could have determined the observed trends. However, the fact
Table 4.3 A comparison of the metrics used in generic environmental reports and those used to express the carbon component of those reports. Figures for the generic metrics are taken from Marshall and Brown (2003), where 778 measures were evaluated from 79 firms. The carbon evaluations are taken from 165 measures from 56 firms.

<table>
<thead>
<tr>
<th>Metric typology</th>
<th>Industry</th>
<th>Overall percentages for each typology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Natural Resource</td>
<td>Manufacturing</td>
</tr>
<tr>
<td></td>
<td>Generic metrics</td>
<td>Carbon metrics</td>
</tr>
<tr>
<td>Managerial performance</td>
<td>7.9</td>
<td>26.7</td>
</tr>
<tr>
<td>Operational performance</td>
<td>83.3</td>
<td>73.3</td>
</tr>
<tr>
<td>Environmental condition</td>
<td>8.8</td>
<td>0.0</td>
</tr>
</tbody>
</table>

that the carbon-related metrics mirror, albeit at a consistently lower level, these trends supports the potential for true variation represented in these figures.

Similarly, the carbon-related performance indicators show consistently higher managerial performance measures across all organisational sectors, implying a stronger commitment to future performance evaluation in comparison to generic performance measures. Sectoral biases in carbon reporting practices are discussed in more detail in section 4.1.2.3.

Although the metrics used to convey carbon emissions in an environmental report have been described, they give no indication on how they are physically presented. In evaluating the results from the final review area, verifying, publishing and distributing the report, it is found that most organisations disclose their carbon emissions within a separate section of the report. This does indicate a level of weight that is being assigned to carbon emissions.

4.1.2.3 Addressing national level greenhouse gas reduction targets

In order to meet the UK’s legally-bound carbon reduction target of 12.5 percent by 2008-2012 from a 1990 baseline level (EEA, 1999), DETR (2000) argues that significant change will be needed within the business sector. To provide the baseline for this change, the Government challenged all FTSE 350 companies to report on their greenhouse gas emissions by 2001 (ENDS, 1998b; 1999). Clearly, however, this challenge has not been addressed. As the results on generic environmental reporting have demonstrated, over a quarter of these companies still do not disclose information on their environmental performance.
Of those organisations that do disclose this information, review area one provides an insight into the extent to which they address Government targets. All sub-criteria assessing the level at which organisations are setting their reduction goals within the context of Government targets or using national carbon reduction mechanisms to achieve these goals received a modal code of zero. Clearly, the motivations for disclosing this information are not based on pressure from the Government. These motives will be evaluated in more detail when investigating the responses from the interviews.

4.1.3 Factors influencing carbon disclosure practices

Having identified current trends in the disclosure of carbon emissions performance data and management strategies, it is pertinent to explore any potential influences underpinning these observed patterns. By detailing characteristics of the reviewed reporting organisations, three such influences will be investigated; sectoral biases, the type of report within which carbon disclosures were evaluated and the use of reporting guidance documentation.

4.1.3.1 Sectoral biases

In order to investigate the potential influence of industry sector on carbon disclosure practices, three sectoral profiles are compared to the modal average profile in figure 4.10. These sectors correspond to those of the case studies outlined in chapter two, providing an additional insight into the context of their carbon management and reporting practices. Each profile in figure 4.10 depicts an inconsistent level of disclosure between the eight review areas, substantiating the generic low level of activity in addressing these areas previously identified from the summary profile. However, this level of inconsistency varies markedly according to sector, which can be used to assess their relative strengths and weaknesses. For example, the financial services sector shows relative strengths in the areas of measuring and evaluating current performance, whereas the transport sector is relatively strong in outlining the environmental context and setting carbon-related objectives and targets.

Profiles in figure 4.10 indicate that the construction industry consistently exhibits the lowest disclosure level for each of the eight review areas, compared to the financial services sector, which generally portrays the strongest profile in disclosing carbon-related information. These findings contravene international environmental reporting trends outlined by KPMG (1999) and Line et al. (2002) who identified a higher level of environmental reporting within resource
based and manufacturing industries than service sector organisations. It is argued that a higher level of scrutiny given to ‘dirty industries’ by environmental pressure groups stimulates this disparity between sector reporting practices (Henriques and Sadorsky, 1999). Thus, the discrepancies could reflect differences in the pressures placed on industries in the UK, supporting the marked geographical variations to environmental reporting identified by the CSR Network (2003), or could indicate a degree of superficiality in generic reporting trends that do not take into account the specific report content. However, reports from other countries and additional reporting components need to be investigated to evaluate the merits of these hypotheses.

These sectoral profiles can be used for benchmarking purposes, by comparing an organisation’s individual profile with its sector average. Following Hemming et al. (2003), this process will identify gaps between what an organisation currently discloses and what is deemed generally feasible and acceptable by its sector. For example, figure 4.11 illustrates how the case study

Figure 4.10 The influence of sector on carbon disclosure practices. The number in brackets refers to the number of organisations which make up that profile. The modal average summary profile is presented to aid comparison.
organisations compare with their sector average. It is demonstrated that BAA plc is the only organisation to be performing ahead of its sector as its individual profile encompasses that of its sector profile (figure 4.11). However, those of AMEC plc and Aviva plc are contained within their sector profiles, indicating relative inadequacies in their reporting practices. Thus, relative strengths and weaknesses can be ascertained from these comparisons which can direct efforts to improve the organisation’s carbon reporting strategy.

4.1.3.2 Type of environment report published

A second potential influencing factor that was investigated focused on the type of report within which carbon disclosures were evaluated. Figure 4.12 presents the modal code of each review
area against the categories of reporting media outlined in figure 4.3. Following the reporting continuum (figure 4.3), it would be anticipated that, in order to meet their specific stakeholder needs, the modal codes from Corporate Social Responsibility reports would be consistently higher than those from environmental reports. However, the media profiles in figure 4.12 do not support this expectation; the modal codes from both Corporate Social Responsibility and environmental reports depict a similar rounded profile, indicating a comparable level of development pivoting around a modal code of 2.

This suggests that although the concept of a hierarchical ladder may be an appropriate analogy to depict the range of issues being discussed within different reporting media, it is not apposite for indicating the level at which these issues are being disclosed. Thus, the trends previously identified in generic environmental reporting within the FTSE 350, specifically the increasing integration of environmental performance data within triple bottom line accountability reports, may not necessarily represent the dramatic increase in report development initially thought. It could be argued that these results reflect the pressure for organisations to advance along the reporting ‘development ladder’ towards Corporate Social Responsibility reports (Wheeler and Elkington, 2001), so that terminologies may be used for report titles which do not necessarily coincide with their scope or content.

Figure 4.12 The influence of the type of environmental report within which carbon emissions and management strategies are disclosed.
4.1.3.2 Use of guidance documentation

A further potential influencing factor that was explored addressed the extent to which reporting guidance documentation was consulted. Figure 4.13 indicates the modal code of each review area according to the number of guidance documents that were consulted to produce the report.

Clearly, as their number increases, so there is a general rise in the modal code of each review area (figure 4.13). In addition, the profiles of the modal codes generally become less erratic as guidelines are increasingly used, indicating a rise in the level of activity in those review areas. These findings support the assertion made in ‘Framing the Case’, that individual guidelines present strategic and practical barriers to the comprehensive management of carbon emissions. A combination of guidelines is needed to approach best practice in any of the review areas, reinforcing the need for an innovative environmental management tool to support corporate level carbon reduction strategies.

![Figure 4.13](image_url)  
*Figure 4.13* The influence of guidance documentation on the modal codes of the review areas (this only takes into consideration those guidelines that were declared in the environmental report).
4.2 Part 2: Responses from the interviews

The responses from interviewing representatives from the case study organisations are divided into two components to mirror their dual purpose in contributing to the inductive stage of the research strategy. Initially, the profiles of current management practices will be outlined and then insights will be explored into the potential applicability of a carbon audit framework.

4.2.1 Current management practices

The results from the structured part of the interview guide are depicted in table 4.3 to present a comparable analysis of current carbon emissions management practices between the case study organisations. There is a clear discrepancy within all companies between the potential sources of carbon identified and those which are currently being monitored or measured.

Consistent with the findings from the corporate environmental reports, indirect emissions from electricity, heat or steam largely seem to be driving the carbon management strategies of the case study organisations. BAA is the only company to incorporate direct emissions within its

| Table 4.3 Current carbon emissions management practices in the three case study organisations. |
|-------------------------------------------------|----------------|----------------|
| Number of sources of carbon emissions           | AMEC plc | Aviva plc | BAA plc |
| Direct emissions                                | 1        | 1          | 3       |
| Indirect emissions from electricity, heat or steam | 2        | 2          | 2       |
| Other indirect carbon emissions sources         | 3        | 4          | 3       |
| Total                                           | 6        | 7          | 8       |
| Number of sources currently being monitored     |           |            |         |
| Direct emissions                                | 0        | 0          | 2       |
| Indirect emissions from electricity, heat or steam | 2        | 2          | 2       |
| Other indirect carbon emissions sources         | 0        | 0          | 0       |
| Total                                           | 2        | 2          | 4       |
| How the sources are currently being measured    |           |            |         |
| Direct monitoring systems                       | 0        | 0          | 0       |
| Using activity data and conversion factors      | 2        | 2          | 4       |
| Other measurement technique                     | 0        | 0          | 0       |
management policy, by considering the carbon emitted from chemical processing and from the
generation of electricity and heat from its combined heat and power (CHP) plant. Table 4.3
indicates that all carbon sources are currently being measured using activity data, largely in the
form of meter readings or quantities of energy supplied, which are then converted into carbon
dioxide equivalents using conversion factors.

These findings, in conjunction with those from the environmental reports, demonstrate that the
scope of carbon emissions management is predominantly limited to those sources associated
with the production of electricity and gas. However, Loreti et al. (2000) argue that restricting
this focus minimises opportunities for carbon reductions and hence inhibits the effective use of
resources and efforts to meet reduction targets. Widening this focus will demand a systematic
approach to identifying all potential sources of carbon material to the organisation, an issue
which needs integrating into any carbon emissions management tool. A potential solution to
this identification process centres on the checklist approach used in the interviews, which
promoted a time-efficient and comprehensive consideration of all carbon sources.

4.2.2 The applicability of a carbon audit framework

The responses from the semi-structured part of the interview will now be examined to explore
personal perspectives on the potential applicability of a carbon audit framework. Interviewees
from AMEC and BAA immediately recognised the need for a carbon management tool within
their organisations, although Percy (2003, pers comm) from the latter company, argued that its
applicability may be lost at the sectoral level owing to the diversity of emissions sources which
then become apparent. However, MacRonald (2003, pers comm) from Aviva, felt that their
individual company programmes were sufficiently advanced to manage carbon emissions and
address Government targets. Indicators reflecting the generic applicability of this framework
can be evaluated by considering the perceived barriers and advantages to its employment

4.2.2.1 Barriers

Two principal barriers to using a carbon audit framework were identified by the interviewees.
Initially, Percy (2003, pers comm) argued that a management tool focused at the corporate
level would not devolve ownership to those employees who have control over the emissions at
the ‘floor’ level of the organisation. In addition, the diversity of company portfolios, especially
at the level of the FTSE 350, can hinder the consistency of carbon measurements within an
organisation. For example, Aviva are partial tenants in many of the buildings in which they operate, which reduces their influence over carbon emissions (MacRonald (2003), pers comm). Each of these barriers needs to be addressed in the formulation of the carbon audit framework, in order to increase its feasibility.

4.2.2.2 Benefits

Many of the perceived benefits to employing a carbon management tool mirrored those factors previously identified as motivations for managing carbon emissions. For example, financial, environmental and reputation benefits were alluded to by all interviewees. In addition, Carter (2003, pers comm) from AMEC, argued that such a management tool may promote innovative solutions to maintain the continuous improvement commitment made by many organisations. These advantages all need to be embraced in the formulation of a carbon audit framework to maintain its applicability and practicality.

4.3 Summary

The principal findings of current carbon reporting and management practices identified from environmental reports and case study organisations are integrated below, divided according to informative and pragmatic findings. Each of these findings will then be used in the subsequent chapter to advance criteria underpinning the development of a carbon audit framework.

4.3.1 Informative findings

1. There is currently a low level of activity in addressing those eight principal areas of carbon reporting that have been assessed.
2. The comparability of carbon-related objectives and targets is often hindered by the lack of a baseline carbon performance datum.
3. The relevance of the carbon component of environmental reports is often undermined by poorly defined organisational boundaries.
4. The metrics used to convey carbon reporting practices are dominated by lagging indicators which have a limited ability to meet stakeholder expectations.
5. National-level carbon reduction targets, policies and protocols are currently not integrated within organisational level carbon reporting and management strategies.
7. Using a combination of guidance documentation improves carbon reporting strategies.

4.3.2 Pragmatic findings

8. The comprehensiveness of carbon reports is currently hindered by limited inventoring of the potential sources of carbon emissions. A checklist approach may provide a systematic and time-efficient method to consider all sources.
9. Emissions from electricity, gas and transportation are the most frequently measured sources of carbon. These need to be embraced in the first stage of any carbon audit.
10. Direct emissions from process-related sources are less feasible to incorporate into a carbon audit framework. This suggests the use of a staged approach to gradually incorporate these sources into the corporate level management strategy.
11. The majority of carbon sources are currently being monitored using activity data.
12. To promote buy-in from employees, a corporate educational programme should aim to raise awareness and identify individual roles and responsibilities in working towards the carbon-reduction strategy.
13. A flexible approach to managing carbon emissions is necessary in the context of a diverse company portfolio.
14. The motivations and objectives for managing carbon emissions need to underpin the scope and direction of the carbon audit framework.
Employing the findings from the current practice review, interviews from the case studies and environmental auditing literature, the carbon audit framework will now be outlined. In order to complete the grounded theory approach taken in this dissertation, this audit framework will then be evaluated using the real-life context of the case study organisations.

5.1 Development of a carbon audit framework

The carbon audit framework is presented in figure 5.1. Individual criteria constituting each audit stage were developed using the informative and pragmatic findings from the current practice analysis, which promoted the feasibility of the management tool. The organisation of these criteria and the overall structure of the audit framework were derived from a synthesis of environmental auditing procedures (figure 5.1).

The carbon audit framework aims to overcome the limitations in greenhouse gas reporting and accounting guidelines that were identified whilst framing the case for this dissertation. These limitations can, in part, account for the idiosyncratic approach that has been identified to managing sub-national level carbon emissions. Initially, the audit framework promotes a pragmatic and comprehensive approach that extends the management of carbon emissions beyond the measurement stage. In addition, it allows comparisons to be made between organisations by promoting a generic approach across sectors yet, concurrently, recognises the specificity of an organisation’s emissions sources by explicitly defining individual operational boundaries.

Comprehensively managing these sub-national level emissions will then provide the platform, which is currently lacking, to enable companies to embrace the national level carbon reduction programmes, policies and protocols outlined in the UK’s climate change programme. Using such policies will ultimately support the Government’s long-term reduction goal.

It is important to recognise however, that this environmental audit will not work in isolation; it forms just one important component of an organisation’s environmental management system.
1. **Set the context**
   - Identify the objectives and motivations of the carbon audit in order to maintain its applicability and practicality.
   - Define the organisational boundaries of the audit scope.
   - Establish a corporate education programme to promote buy-in from all levels of the organisation.

2. **Plan the audit**
   a) **Organisational considerations**
      - Systematically define operational boundaries using a checklist.
      - Organisational differences in carbon emissions sources demand a sector specific approach to this process.
      - However, at a minimum, the audit for all organisations should embrace emissions from electricity, gas and transportation.
   b) **Methodological considerations**
      - The low level of activity in carbon reporting suggests an incremental approach to managing all potential sources.
      - Gradually, direct emissions from process-related emissions should be incorporated into the management strategy to increase opportunities for carbon reductions.
      - Select the most appropriate method for data collection; for electricity, gas and transportation, use activity data.

3. **Undertake the audit**
   - Determine a procedure for setting a baseline carbon performance datum to improve the comparability for objectives and targets.
   - Use guidance documentation to measure carbon emissions.
   - Embrace a flexible approach to collecting data on carbon

4. **Evaluate the findings**
   - Present the data and evaluate the significance of emissions.
   - Relate reduction efforts to national level targets, policies and protocols.

5. **Report and verify**
   - Convey the results using leading indicators to improve their use for stakeholders.
   - One potential approach would be to use a carbon footprint of the organisation compared to a footprint of its target, to provide a managerial performance indicator.

6. **Implement the action plan based on the audit**

---

**Figure 5.1** The carbon audit framework. Adapted from Humphrey and Hadley (2000), ICC (1989), Ledgerwood *et al.* (1992) and Welford (1998b). The numbers in boxes refer to the numbers of the informative and pragmatic findings outlined in section 4.3.
For example, Welford (1998b) argues that without top management commitment, an internal environmental audit programme is unlikely to succeed.

5.2 Evaluation of the carbon audit framework

In order to complete the grounded theory strategy taken in this dissertation, guidance from the proposed carbon audit framework (figure 5.1) was empirically tested by performing a carbon audit on each case study. However, it was not feasible to evaluate each criterion or to complete every stage of the framework as the audit was not initiated by the organisation. However, the principal findings from this exercise are outlined below, discussed according to the different stages that were evaluated.

5.2.1 Setting the context

Humphrey and Hadley (2000) suggest that a fundamental stage in setting the context of any environmental audit focuses on the initial identification of the audit scope by establishing, for example, its physical location and spatial limits. Following the carbon audit framework, this was completed after identifying commercial objectives and expectations of the audit. Guidance from the WBCSD/WRI (2001) was employed to define these organisational boundaries, which recommend that the structure of an organisation be divided according to the level of control that it has over individual facilities. Thus, those facilities not controlled are omitted from the scope of the audit. The preliminary meeting with the auditee aimed to discuss these organisational boundaries, but barriers were immediately identified in applying the guidelines.

In the case of BAA, for example, these boundaries were set analogous to the perimeter fence at Heathrow Airport, the only site for which traffic data had been collected (Percy, 2003, pers comm). Dividing this site into its constituent facilities resulted in the identification of many facilities, such as retail outlets, not falling within the control of BAA. However, electricity is supplied through five intakes, which is not further disaggregated according to individual users. Thus, it was impossible to assign emissions according to facilities, which reduced the potential applicability of the audit framework in addressing those emissions controlled by BAA.

In addition, it was found that organisational boundaries used to estimate carbon emissions were not always representative of the whole organisation. For example, the Norwich Island Site was used to carry out the carbon audit on Aviva. All facilities within this site are served by green
tariff electricity, which resulted in its overall carbon emissions in 2002 representing 3 percent of the total emissions from all Aviva buildings in the UK. However, the Norwich Island Site corresponds to 7.32 percent of Aviva’s total floor area, demonstrating that boundaries could be chosen to reflect the individual intentions of the auditee.

These insights reflect a clear recommendation for a phase two audit framework. Organisational boundaries, in addition to the extent to which they represent the company, should be explicitly outlined when evaluating the audit findings. For example, 55 percent of Heathrow Airport’s energy is consumed from other companies within its perimeter fence (BAA, 2002). Thus, two carbon emissions figures could be declared; one for the whole airport and a second estimating emissions from facilities directly under its control.

5.2.2 Planning the audit

Ledgerwood et al. (1992) divide the planning phase of an environmental audit into two stages reflecting its organisational and methodological considerations. Both of these considerations were addressed in the preliminary meeting where the depth, and hence, operational boundaries of the audit were established.

In framing the case for this dissertation, it was found that greenhouse gas reporting guidelines consider a narrow focus of emissions sources, which reduces opportunities for their reduction (Loreti et al., 2001). This project attempted to overcome such limitations by extending these operational boundaries. However, it was soon recognised that the narrow focus of the guidance documentation does not necessarily reflect an inadequacy, but more a realistic indication of current data availability. For example, in evaluating the potential for LCA to be integrated into the carbon management strategy of the construction sector, the production cycle at AMEC was reviewed (figure 5.2). However, energy consumption was neither estimated nor considered at any point in this five-stage process, making the management of carbon emissions difficult.

Delineating operational boundaries was completed with the auditee in a comprehensive and systematic approach, by following a checklist of potential emissions sources (figure 5.3). This process identified importing or producing electricity, heat or steam, and transportation as the only operations that could be scoped into the audit. However, even within these narrow limits, full data sets were not always available. For example, BAA had traffic counts going into the Terminal One area of Heathrow airport. However, these were not disaggregated according to
private or commercial vehicles and did not give any indication of the distances travelled which reduced the usefulness of this information for estimating their carbon emissions.

A discussion of these sources in the interview ultimately led to a consideration of the methods that would be used to measure carbon emissions. As outlined in figure 5.1, all data collection methods energy and transport emissions focused around the use of activity data and the subsequent application of conversion factors.

This practical application of the second stage of the carbon audit framework found that the incremental approach to data collection provided a feasible and pragmatic approach to
measuring carbon emissions in light of poor data availability. By using the checklist approach, it ensured that all sources of carbon would, in time, be scoped into the carbon management strategy. Thus, in any phase two audit framework, an incremental approach with a checklist to delineate operational boundaries should form the core component of planning the carbon audit.

5.2.3 Undertaking the audit

Based on the defined organisational and operational boundaries in addition to the agreed audit methodology, data was collected on carbon emissions to complete the third stage of the carbon audit framework.

Following this framework, a procedure was initially established for setting a baseline carbon performance datum within each organisation, against which to benchmark performance. However, this was more difficult than anticipated owing to the lack of complete historical data sets and changes in the structure of the company for those years for which data was available. For example, in the case of AMEC, the earliest year for which they had the most complete records of electricity and gas use was 2000. However, to use this baseline, the operational boundaries had to be extended to take into account recent divestitures. The supports the need for a flexible approach to undertaking the audit as specified in the carbon audit framework.

A potential problem found with the collected baseline and current performance data surrounds it reliability. For example, MacRonald (2003, pers comm) highlighted that many of the energy bills used to estimate carbon emissions from Aviva’s Norwich Island Site were derived from estimates, which may not accurately portray the energy consumption of the organisation. This becomes particularly pertinent when evaluating changes in energy consumption from the implementation of energy efficiency measures. Thus, before future carbon audits, it is recommended that the energy supplier is contacted to arrange meter readings to coincide with the audit dates.

A further recommendation from this stage in the carbon audit framework is the use of an audit protocol to guide the audit procedure. Humphrey and Hadley (2000) argue that such a protocol provides a basis for the critique of the audit, by providing a means of ensuring that all relevant steps have been accomplished. Not only would this record any changes taken in the scope of the audit, but would also increase the comparability of audits taken in different organisations. This protocol could form an adapted version of figure 5.3.
5.2.4 Evaluating the findings

In presenting data on carbon emissions, it was found particularly informative to tabulate them according to emissions source to identify the significance of individual operations. Emissions from each operation measured against the three case studies audited are illustrated in table 5.1. This table clearly demonstrates the limited sources of carbon emissions which are currently monitored at the corporate level.

With the exception of Aviva, which is served by green tariff electricity, table 5.1 indicates that the largest source of carbon emissions is derived from energy consumption. Clearly, these should be targeted in any carbon reduction implementation plan. Having outlined current emissions levels and related them a historic performance datum, targets can then be established for their reduction. It is only after this initial measurement process that national level carbon reduction programmes, policies and protocols can be employed. Using these national policy levers will ultimately support the UK Government’s long-term reduction goal.

Table 5.1 Carbon emissions measurements data disaggregated according to source. Units are in Kg CO₂.

<table>
<thead>
<tr>
<th>Sources of carbon</th>
<th>AMEC plc⁴</th>
<th>Aviva plc⁵</th>
<th>BAA plc⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid electricity use</td>
<td>288,282.9</td>
<td>310,153.1</td>
<td>157,492,076.2</td>
</tr>
<tr>
<td>Electricity from CHP</td>
<td>92,520.9</td>
<td>101,885.8</td>
<td>45,467,500.3</td>
</tr>
<tr>
<td>Gas consumption</td>
<td>2,733.7</td>
<td>2,733.7</td>
<td>2,753,482.2</td>
</tr>
<tr>
<td>Heating from CHP</td>
<td>27,918.7</td>
<td>27,918.7</td>
<td>2,047,159.5</td>
</tr>
<tr>
<td>Gas oil use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions saved through efforts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video conferencing</td>
<td>9,355.2</td>
<td>1977.6</td>
<td>2,603,271.2</td>
</tr>
<tr>
<td>Green tariff electricity</td>
<td></td>
<td>5,466,154.0</td>
<td>2,504,011.8</td>
</tr>
<tr>
<td>Total carbon emissions</td>
<td>411,456.2</td>
<td>442,691.3</td>
<td>242,039,088.4</td>
</tr>
</tbody>
</table>

⁴ Data is for the AMEC facility at Great Yarmouth.
⁵ Data is for Aviva’s Norwich Island Site.
⁶ Data is for facilities included within the perimeter fence at Heathrow airport.
5.2.5 Report and verify

As the organisations did not initiate the audits, this was the final stage that was performed. Following the audit framework, the principal aim of this stage was to convey the findings using leading indicators. Expressing the results using the concept of a carbon footprint was found particularly useful as it allowed comparisons to be made between organisations. Adapting the methodology outlined by Barrett and Scott (2003), who applied the ecological footprint concept to passenger transport in Merseyside, the carbon footprints of the case studies are illustrated in table 5.2. These figures illustrate the hectares of forest that are needed in one year to sequester the carbon emitted from the organisation (Wackernagel and Rees, 1996). It must be noted however, that this land also includes the area required to provide a population with all its food and materials (Barrett and Scott, 2003).

This concept can be extended by comparing the current carbon footprint of the organisation to a target footprint. By outlining the ways in which the organisation aims to meet that target, these operational performance indicators are translated into managerial performance indicators and, as such, have a higher value to stakeholders (Marshall and Brown, 2003).

5.3 Summary

By following the carbon audit framework within its real-life context, a number of conclusions can be made surrounding its applicability at the sub-national level. The principal limitation to comprehensively completing the framework focused on the poor availability of data, which supports the findings from the current practice review. However, it is hoped that, by using an incremental approach to gradually increase the scope of carbon emissions, this limitation will be overcome.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Current carbon footprint</th>
<th>Baseline carbon footprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMEC plc</td>
<td>289.8</td>
<td>311.8</td>
</tr>
<tr>
<td>Aviva plc</td>
<td>1142.1</td>
<td>1160.2</td>
</tr>
<tr>
<td>BAA plc</td>
<td>189,133.3</td>
<td>170,450.1</td>
</tr>
</tbody>
</table>

Table 5.2 The carbon footprints of the organisations. Based on a sequestration rate of 1.42 tonnes of CO₂ per hectare of forest in one year (Wackernagel and Rees, 1996)
A number of recommendations can be made to improve this audit framework. Initially, it is essential that organisational boundaries are explicitly outlined both at the start of the audit process and in the presentation of the findings. In addition, to facilitate the on-site activities, an audit protocol should be developed to ensure that all relevant steps have been accomplished. Finally, data quality issues should be addressed when evaluating and disclosing emissions data, by fully acknowledging potential uncertainties.
The overall drive behind this project has been to develop environmental auditing techniques to formulate a comprehensive carbon audit framework. This approach has been focused at the sub-national level in order to support the implementation and evaluation of corporate level carbon reduction strategies. This drive has been addressed through three aims which will now be discussed.

Initially, current carbon reporting and management practices have been evaluated. These have depicted a low level of activity in addressing carbon emissions within environmental reports and, as such, have highlighted a poorly developed reporting process. However, not all aspects of this process are disclosed to a comparable level. For example, strengths have focused on the completeness with which carbon related aspects and impacts are identified. However, the expression of carbon emissions performance data is limited as they are principally described through lagging indicators. In addition, corporate level carbon emissions management targets and strategies are not currently addressing national level reduction targets.

Despite these findings however, there is much potential for extending these analyses. For example, additional reports could be evaluated and further environmental managers could be interviewed from diverse organisational sectors. It would be interesting to apply the review package to a range of organisations, such as small to medium sized enterprises (SMEs), or corporations from different countries.

Secondly, criteria were identified using the findings of the current practice review to underpin the development of the carbon audit framework. It was found that these criteria promoted the feasibility and applicability of the framework. The extent to which these criteria addressed the aim can be elucidated by the evaluation of the carbon-audit framework. Although positive aspects of this framework were identified, recommendations also surfaced. For example, an audit protocol may have improved the consistency and organisation of the on-site activities of the audit.

The final aim of the project was to apply the audit framework to three distinct organisational sectors to evaluate the applicability of a single generic approach across the three case studies.
The framework promoted comparability between organisations within this generic approach, but sector specific variations were still taken into consideration when defining operational boundaries. Although this approach worked for the case studies audited, few sector specific emissions were evaluated owing to the lack of available data. As such, the framework needs further rigorous testing in the context of other case studies.

The carbon audit framework has demonstrated that the key limitation to comprehensively managing carbon emissions centres on the lack of sources for which measurements are currently available. This limits the use of national level carbon reduction policies and protocols within organisations, ultimately inhibiting progress towards the Government’s carbon reduction targets. This supports the need for a paradigm shift in the management of carbon emissions to one focused at the sub-national level.


References


PERI (2002). The Public Environmental Reporting Initiative Guidelines:


Appendices

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Appendix 1  Review package to assess the level of carbon reporting within an environmental report  74
Appendix 2: The coding system for assessing the environmental reports  80
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Appendix 4: Interview schedule  82
Section 1. Details of the reporting organisation.

• Name of the reporting organisation.
• Sector of the reporting organisation.
• Type of environmental report published.
• Year of the latest report’s publication.
• Signatory of any industrial, national or international reporting charters.

Section 2. The context of the carbon reporting process.

1. Outline the environmental context.

1.1 Identify climate change as an issue of business concern.
   1.1.1 Address climate change issues in the environmental report.
   1.1.2 Describe the implications of climate change to the organisation.
   1.1.3 Actively address the challenges of climate change through voluntary initiatives.
      1.1.3.1 Participation in research and development programmes.
      1.1.3.2 Development of a carbon sequestration agenda.

1.2 Integrate carbon emissions management into business planning.
   1.2.1 Incorporate climate change issues into organisational decision-making processes.
   1.2.2 Foster co-operation between facilities or operations in managing carbon emissions.
   1.2.3 Integrate energy and fleet administration into the overall management system of the reporting organisation.

1.3 Employ market-based carbon emissions reduction mechanisms such as those outlined by the Kyoto protocol or the UK’s climate change programme.
   1.3.1 Place the carbon report in the context of Government targets.
   1.3.2 Identify potential opportunities to use carbon reduction schemes.
   1.3.3 Describe the current use of market-based carbon reduction mechanisms.
2. Define the organisational context.

2.1 Delineate the organisational boundaries of the carbon reporting process.
   2.1.1 Scope in all facilities owned or controlled by the reporting organisation.
   2.1.2 Incorporate the equity share of emissions from jointly controlled facilities.
   2.1.3 Explicitly acknowledge all assumptions made in the boundary settings.

2.2 Delineate the operational boundaries of the carbon reporting process.
   2.2.1 Define those operations which emit carbon. At a minimum, all activities releasing direct emissions or requiring imports of energy should be incorporated.
   2.2.2 Catalogue each operation according to facility, site and country classifications.
   2.2.3 Explicitly acknowledge all assumptions made in the boundary settings.

Section 3. The carbon reporting process.

3. Identify environmental aspects and impacts.

3.1 Inventory all carbon risks and opportunities. The following scopes should be identified:
   3.1.1 Direct emissions from sources owned or controlled by the reporting organisation.
       3.1.1.1 The production of electricity, heat or steam.
       3.1.1.2 Physical or chemical processing.
       3.1.1.3 The transportation of materials, products and wastes.
       3.1.1.4 Fugitive emissions from equipment leaks.
   3.1.2 Indirect carbon emissions from imports of electricity, heat or steam.
       3.2.2.1 Imported energy for company sites and facilities.
       3.2.2.2 Imported energy segmented by source.
       3.2.2.3 Use of bilateral contracts to purchase electricity from renewable sources.
   3.1.3 Other indirect carbon emissions sources.
       3.1.3.1 Employee business travel and commuting.
       3.1.3.2 Outsourced activities, contract manufacturing and franchises.
       3.1.3.3 The production of imported materials.
       3.1.3.4 Emissions from the use and end-of-life phases of the products or services.

3.2 Scope in and justify the significant carbon risks and opportunities identified from the inventory. Basic carbon reporting principles require that these should encompass:
   3.2.1 Energy consumption.
       3.2.1.1 Grid electricity.
       3.2.1.2 Natural gas.
3.2.1.3 Diesel oil or petrol fuel.

3.2.2 Process-related emissions.
   3.2.2.1 Industry-specific chemical or physical processes releasing carbon.
   3.2.2.2 Refrigeration and air conditioning plants.

3.2.3 Transport-related emissions.
   3.2.3.1 Freight movements by road, rail, air or sea.
   3.2.3.2 Business travel by road, rail, air or sea including international travel.

4. Develop environmental performance indicators linked to the significant impacts.

4.1 Describe the environmental performance of the organisation in relation to all core carbon related performance indicators.
   4.1.1 Total tonnes of carbon emissions released per annum or per unit output.
   4.1.2 Direct energy consumption per annum or per unit output. This refers to all energy that enters the reporting organisation’s operational boundaries.
      4.1.2.1 Imported primary energy, such as natural gas used for heating.
      4.1.2.2 Intermediate energy forms, such as purchased electricity.
   4.1.3 Indirect energy consumption per annum or per unit output. This refers to energy consumed outside the reporting organisation’s operational boundaries in order to supply their intermediate energy products.
      4.1.3.1 Energy consumed to generate and deliver purchased electricity.
      4.1.3.2 Energy utilised to produce purchased district heating or cooling.
   4.1.4 Financial expenditure on carbon reduction schemes per annum.

4.2 Where feasible, report on carbon related additional indicators. These include:
   4.2.1 Transportation of raw materials, products and employees in kilometres per annum.
   4.2.2 Initiatives to increase energy efficiency.
      4.2.2.1 Programmes to produce or purchase renewable energy.
      4.2.2.2 Proportion of electricity and heat requirements met through combined heat and power cogeneration.
   4.2.3 The local or regional concentration of carbon in the ambient air.
   4.2.4 The energy consumption footprint of the product or service which encompasses all emissions produced at each stage of its life-cycle.
      4.2.4.1 The lifetime energy requirements of items produced in the reporting year.
      4.2.4.2 Projected lifetime energy savings of energy-efficient products.
4.3 Justify any omissions of core indicators.

4.3.1 Outline those core indicators that have not been reported against.

4.3.2 Relate those omissions to the business goals.

4.3.2.1 Limited relevance of the indicator to the reporting organisation.

4.3.2.2 The lack of data or cost of collecting data for an indicator.

4.3.2.3 Reporting against an indicator may compromise business confidentiality.

5. Set objectives and targets against the performance indicators.

5.1 Determine the historic carbon performance datum (the base-year emissions) in order to compare emissions over time and against which objectives and targets can be set.

5.1.1 Choose and justify a base-year for which verifiable data is available.

5.1.2 Relate the establishment of the historic performance datum to the business goals.

5.1.2.1 To report against publicly set carbon reduction objectives and targets.

5.1.2.2 To achieve certified emissions reduction targets.

5.1.2.3 To satisfy internal management goals.

5.1.3 Describe the base-year emissions adjustment policy. This maintains comparability in light of structural changes in the organisation such as mergers or acquisitions.

5.1.4 Articulate the basis for making any base-year emissions adjustments.

5.2 Establish carbon-reduction objectives and targets. These should be:

5.2.1 Quantified.

5.2.2 Set to a time-scale.

5.2.3 Specific.


6.1 Identify the sources of carbon scoped into the report from step 3.

6.1.1 Record emissions sources for each significant carbon risk and opportunity against four categories: stationary combustion, mobile combustion, process emissions and fugitive emissions.

6.1.1.1 The power industry may have direct emissions from all source categories.

6.1.1.2 Office based organisations may not have direct process emissions unless they own refrigeration and air-conditioning equipment.

6.2 Collect data for each source and state the calculation approach employed.

6.2.1 State the method of data collection for each carbon source.

6.2.1.1 Purchased quantities of commercial fuels.
6.2.1.2 Metered electricity consumption.

6.2.2 Outline the methodology employed to estimate carbon emissions.
   6.2.2.1 Direct monitoring systems.
   6.2.2.2 Emissions factor method.

6.2.3 Describe any calculation tools used to quantify the carbon measurement.

6.3 Aggregate each source to produce a corporate level carbon measure.
   6.3.1 Outline the method of roll-up to the corporate level.
      6.3.1.1 Individual sites calculate their carbon emissions.
      6.3.1.2 Sites report data to the corporate level, where calculations are performed.
   6.3.2 Outline management measures to standardise reporting procedures to ensure that reporting between business units and facilities is consistent.

6.4 Normalise the data against denominators. Principal denominators include:
   6.4.1 Organisational turnover.
   6.4.2 Number of employees.
   6.4.3 Unit of production.
   6.4.4 Added value over a given period.

6.5 Manage sources of uncertainty in the measurement process.
   6.5.1 Identify sources of uncertainty.
      6.5.1.1 Use of ‘average’ factors not perfectly matched to specific circumstances.
      6.5.1.2 Imprecise measurement of the emissions-producing activity.
      6.5.1.3 Insufficient frequency of measurement to account for natural variability.
   6.5.2 Characterise the level of uncertainty for individual sources.
      6.5.2.1 Note the direction and relative magnitude of sources of uncertainty.
      6.5.2.2 Use an ordinal ranking system to characterise uncertainty levels.
      6.5.2.3 Provide quantitative estimates of uncertainty using confidence intervals.
   6.5.3 Develop a strategy to control or minimise uncertainty.
      6.5.3.1 Identify and prioritise areas where accuracy needs to be improved.
      6.5.3.2 Establish steps to improve inventory accuracy such as undertaking regular accuracy checks or periodic internal audits.

7. Evaluate current performance and develop an action plan
   7.1 Relate the organisation’s carbon performance to the objectives and targets.
      7.1.1 Report the current position of the organisation with respect to its objectives.
      7.1.2 Highlight areas of success and weakness.
7.2 Develop an action plan to reduce carbon emissions.
   7.2.1 Identify solutions to reduce carbon emissions.
   7.2.2 Describe the commitment and resources necessary for plan implementation.
   7.2.3 Outline potential obstacles to the plan.
   7.2.4 Monitor and commit to continuous improvement.

8. Draft, verify, publish and distribute report

8.1 Where feasible, describe greenhouse gas impacts in a separate section of the report.

8.2 If appropriate, verify the carbon emissions measurements.
   8.2.1 Develop the emissions measurement in a way that it can be verified in the future.
   8.2.2 Define the objectives in commissioning independent verification.
      8.2.2.1 To add credibility to publicly reported information.
      8.2.2.2 To improve carbon accounting and reporting practices.
      8.2.2.3 To meet the requirements of carbon trading programmes.
   8.2.3 Identify the scope of the verification procedure.
      8.2.3.1 The complete carbon reporting process.
      8.2.3.2 Specific parts of the measurement procedure such as geographic
            locations, business units or types of emissions.
      8.2.3.3 Managerial issues such as availability of resources or review procedures.

8.3 Integrate considerations from the carbon reporting process into the environmental policy.
   8.3.1 Express a commitment to address climate change in the environmental policy.
   8.3.2 Integrate the objectives, targets and the action plan developed from the reporting
      process into the environmental policy.
# Appendix 2

The coding system for assessing environmental reports

<table>
<thead>
<tr>
<th>Topic</th>
<th>Principle</th>
<th>Coding system</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td><strong>Relevance</strong></td>
<td>0. No disclosure.</td>
</tr>
<tr>
<td>1.4</td>
<td></td>
<td>1. An ambiguous or evasive reference of limited use.</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>2. Brief summary of the topic, but inadequate treatment or significant omissions of relevant aspects hinder its usefulness.</td>
</tr>
<tr>
<td>2.1</td>
<td></td>
<td>3. Pertinent discussion of most relevant aspects providing a useful examination of the topic.</td>
</tr>
<tr>
<td>2.2</td>
<td></td>
<td>4. Best practice approach encompassing all relevant considerations.</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td><strong>Completeness</strong></td>
<td>0. No disclosure.</td>
</tr>
<tr>
<td>3.3</td>
<td></td>
<td>1. An ambiguous reference to the topic.</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>2. Incomplete summary of the topic with significant omissions of many important aspects.</td>
</tr>
<tr>
<td>4.1</td>
<td></td>
<td>3. Comprehensive discussion of most aspects of the topic.</td>
</tr>
<tr>
<td>4.2</td>
<td></td>
<td>4. Best practice approach encompassing all significant considerations.</td>
</tr>
<tr>
<td>4.3</td>
<td><strong>Comparability</strong></td>
<td>0. No disclosure.</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>1. An ambiguous reference to the topic inhibiting comparability.</td>
</tr>
<tr>
<td>5.1</td>
<td></td>
<td>2. Outline of the topic but its language or presentation prevents meaningful comparisons to be made between reports or organisations.</td>
</tr>
<tr>
<td>5.2</td>
<td></td>
<td>3. Articulate approach to or presentation of the topic facilitating comparisons between statements, reports and organisations.</td>
</tr>
<tr>
<td>5.3</td>
<td></td>
<td>4. Best practice approach facilitating the benchmarking of performance.</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td><strong>Accuracy</strong></td>
<td>0. No disclosure.</td>
</tr>
<tr>
<td>6.4</td>
<td></td>
<td>1. An ambiguous and potentially unreliable reference to the topic.</td>
</tr>
<tr>
<td>6.5</td>
<td></td>
<td>2. Brief summary of the topic but significant omissions question the reliability of the information presented.</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>3. A balanced and unambiguous discussion of most aspects of the topic supported by evidence or detailed descriptions.</td>
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<td>7.1</td>
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<td>4. Best practice approach outlining the degree of exactness of the topic.</td>
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<td><strong>Transparency</strong></td>
<td>0. No disclosure.</td>
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<td>1. An ambiguous reference inhibiting transparency.</td>
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<td>8.5</td>
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<td>2. Brief summary of the topic but an inadequate treatment of important aspects inhibits its accountability.</td>
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<td>8.6</td>
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<td>3. A balanced discussion addressing the topic in a factual and coherent manner supported by evidence or detailed descriptions.</td>
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<td>4. Best practice approach to the topic based on a clear audit trail.</td>
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Section 1. Assessing current practice.

1. Defining the boundaries of the case study.

2. Within the discussed operational boundaries, classify the following potential sources of carbon emissions from your organisation according to the coding system.

   0. No emissions of carbon generated.
   1. Carbon emitted but constitutes an insignificant source.
   2. Significant carbon emissions, but data availability is limited or inaccurate.
   4. Unsure of the quantity or significance of the carbon emitted.

2.1 Direct emissions from sources owned or controlled by your organisation.
   2.1.1 The production of electricity, heat or steam, including CHP plants.
   2.1.2 Any physical or chemical processing (including, air conditioning).
   2.1.3 The transportation of materials, products, wastes or passengers.
   2.1.4 Fugitive emissions from equipment leaks.

2.2 Indirect emissions from imports of electricity, heat or steam.
   2.2.1 Imported energy for company sites and facilities.
      2.2.1.1 Imported electricity.
      2.2.1.2 Natural gas.

2.3 Other indirect carbon emissions sources.
   2.3.1 Employee business travel and commuting.
   2.3.2 Outsourced activities, contract manufacturing and franchises.
   2.3.3 The production of imported materials.
   2.3.4 Emissions from the use and end-of-life phases of products or services.

2.4 Any other sources of carbon emissions. If so, please specify.

3. Which sources of carbon are currently being monitored by your organisation? Please specify using the following coding system.
0. No monitoring of the carbon source.
1. Limited monitoring of isolated components of the source.
2. Monitoring of several significant components of the source.
3. Comprehensive monitoring for all significant components of the source.
4. Unsure of the level of current monitoring.

3.1 Direct emissions from sources owned or controlled by your organisation.
   3.1.1 The production of electricity, heat or steam, including CHP plants.
   3.1.2 Any physical or chemical processing (including air conditioning).
   3.1.3 Transportation of materials, products, wastes or passengers.
   3.1.4 Fugitive emissions from equipment leaks.

3.2 Indirect emissions from imports of electricity, heat or steam, including:
   3.2.1 Imported energy for company sites and facilities.
      3.2.1.1 Electricity.
      3.2.1.2 Natural gas.

3.3 Other indirect carbon emissions sources:
   3.3.1 Employee business travel and commuting.
   3.3.2 Outsourced activities, contract manufacturing and franchises
   3.3.3 The production of imported materials.
   3.3.4 Emissions from the use and end-of-life phases of products or services.

3.4 Monitoring of any other sources of carbon emissions. If so, please specify.

4. How are the sources of carbon monitored or measured? Please specify using the coding system.

   0. No measurement of the carbon source.
   1. Measured by direct monitoring systems.
   3. Other measurement techniques. Please specify.
   4. Unsure of the measurement technique.

4.1 Direct emissions from sources owned or controlled by your organisation.
   4.1.1 The production of electricity, heat or steam, including CHP plants.
   4.1.2 Any physical or chemical processing (including air conditioning).
   4.1.3 Transportation of materials, products, wastes or passengers.
   4.1.4 Fugitive emissions from equipment leaks.

4.2 Indirect emissions from imports of electricity, heat or steam, including:
4.2.1 Imported energy for company sites and facilities.
   4.2.1.1 Electricity.
   4.2.1.2 Natural gas.

4.3 Other indirect carbon emissions sources:
   4.3.1 Employee business travel and commuting.
   4.3.2 Outsourced activities, contract manufacturing and franchises
   4.3.3 The production of imported materials.
   4.3.4 Emissions from the use and end-of-life phases of products or services.

4.4 Measurement of any other sources of carbon emissions. If so, please specify.

5. What are the motivations for carrying out this monitoring? Please assess the potential reasons against the following coding system.

   0. Not a motivating factor.
   1. A factor of limited importance for carrying out the monitoring.
   2. A contributory factor to the overall monitoring programme.
   3. A driving factor resulting in the monitoring programme.
   4. Unsure about the importance of the factor.

5.1 Legislative requirements, such as regulatory or government reporting.
5.2 To achieve certified carbon reduction targets to take part in market based mechanisms such as those outlined in the Kyoto protocol or the UK’s climate change programme.
5.3 To report against publicly set carbon reduction objectives and targets.
5.4 To satisfy internal management goals.
5.5 To manage the greenhouse gas risk of the organisation.
5.6 Other. If so, please specify.

6 Is there a difference between the level of monitoring that is being carried out internally and that which is externally reported? If so, what are principal reasons for this? Please specify using the following coding system?

   0. Not a realistic reason.
   1. A factor of limited importance.
   2. A contributory factor to the disparity.
   3. The driving factor resulting in the disparity.
   4. Unsure about the importance of the factor.
6.1 Reporting the data compromises business confidentiality.
6.2 A lack of data across the whole organisation prevents consistent reporting.
6.3 The cost of assembling the data across the whole organisation inhibits the full disclosure of information.
6.4 Other. Please specify.

Section 2. Evaluating the applicability of a carbon audit framework.

1. Is there a need for such a management tool to support the translation of national carbon reduction targets to the corporate level within your organisation and in your sector?
   • Is there a gap which needs bridging or are current reporting initiatives and guidelines and individual company programmes sufficient to facilitate this translation?

2. What obstacles, both at the strategic and practical level, can you foresee in employing this proposed carbon audit framework in the monitoring systems of a company such as yours?

3. Can you identify any benefits to your company in working through such a framework or do you think you already have sufficient mechanisms and plans in place to manage your current and future carbon risks and opportunities?

4. Is this view specific to your company, your industry or to businesses sector-wide?

5. Do you think that it is feasible to propose a single generic framework to manage carbon emissions for all companies across all sectors, or do inherent variations in the specific sources of emissions in different organisations demand a sector-specific approach?