*Business Strategy and the Environment*
*Bus. Strat. Env.* **22**, 285–305 (2013)
Published online 13 September 2012 in Wiley Online Library
(wileyonlinelibrary.com) **DOI:** 10.1002/bse.1741

# Convergence in Environmental Reporting: Assessing the Carbon Disclosure Project

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ABSTRACT
We perform content analysis on Carbon Disclosure Project (CDP) responses from 2003 to 2010, focusing on the extent to which firms account for indirect emissions and have exhibited convergence in carbon reporting. We also examine standardization in reporting and the variation of reporting behavior across industry and country. We find that the CDP has produced a mixed record of improved transparency. In some areas, such as Scope 2 emissions, the CDP has demonstrated an increase in transparency in later years. However, the transparency and quality of direct emissions and Scope 3 emissions have not improved over time. Japanese and European Union firms have increased transparency, while American firms have decreased transparency. Energy-intensive industries have either increased transparency or remained the same, while less energy-intensive industries have become less transparent. We demonstrate some evidence of a learning effect among firms after participating in the CDP survey.


*Received 24 January 2012; revised 17 April 2012; accepted 24 April 2012*

**Keywords:** information disclosure; voluntary environmental programs; environmental reporting; transparency; corporate sustainability; convergence

## Introduction

STRATEGIC RESPONSES TO CLIMATE CHANGE HAVE VARIED IMMENSELY ACROSS FIRMS. SOME FIRMS ARE TRANSPARENT AND release detailed emissions data to the public. Other firms remain opaque, keeping carbon emissions, electricity use, and other climate-related business activities removed from public scrutiny. A wide array of research has addressed the determinants of corporate disclosure of environmental performance, sustainability, and carbon emissions (Peters and Romi, 2010; Cormier *et al.*, 2005; Brammer and Pavelin, 2006; Kolk and Perego, 2010; Kolk, 2005; Haddock-Fraser and Fraser, 2008; Chen and Bouvain, 2009; Berthelot *et al.*, 2003). In this paper, we examine trends relating to carbon disclosure and report on the extent to which firms have increased transparency over time across a wide range of emissions-related activities. In particular, we focus on Scope 2 and Scope 3 emissions, which include a broad array of indirect business activity and product lifecycle impacts, which have received much less attention from formal institutions than have Scope 1 emissions (direct carbon emissions). Further, we examine the convergence and standardization of carbon reporting. We examine whether information reported by firms has become more standardized, as well as how transparency varies across industries. Additionally, we examine the extent to which firms have begun to use similar language regarding climate change. We demonstrate that the

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Carbon Disclosure Project (CDP) has produced a mixed record of improved transparency. On one hand, public disclosures have improved in quality, particularly for Scope 2 emissions. On the other hand, an increasing percentage of disclosures remain available only to institutional investors, and while an increasing number of firms have disclosed Scope 1 and Scope 3 emissions, the percentage of firms disclosing quality information has not substantially increased over time.

## Theory and Literature Review

### Motivations for Transparency and Disclosure

Significant attention has been paid to the relationship between information disclosure and transparency and improved management. For firm managers, improved information may lead to improved efficiency, reduction in waste, lower costs of capital, and improved shareholder value. For policymakers and government officials, improved transparency offers the opportunity to achieve low-cost environmental improvements without heavy-handed government intervention.

Empirical findings suggest that firms pursue an open disclosure policy due to investor (Reid and Toffel, 2009) or employee (Spence, 2009) pressure, legal liabilities and securities laws (Skinner, 1994), increased growth rates and shareholder value (Lev, 1992; Blacconiere and Patten, 1994), improved terms of trade with suppliers and customers (Lev, 1992), reduced regulatory intervention (Lev, 1992; Walker and Salt, 2006), and reduced cost and increased access to capital (Blacconiere and Patten, 1994; Botosan, 1997). For example, in Botosan and Plumlee (2002), the authors found that reduced capital costs are limited to disclosures in annual reports, and that timely disclosures lead to increased stock price volatility and an increase of capital costs.

One perspective suggests that an array of managerial and economic incentives drive firm transparency. Firms voluntarily disclose in order to improve shareholder value (Kim and Lyon, 2011; Barber, 2007). If firm managers do not provide credible information, investors will either assume the worst or will have to spend more time collecting information from other information sources and stock prices will decrease (Cormier and Magnan, 2003). On the other hand, releasing environmental information involves releasing proprietary information such as environmentally related capital expenditures, fuel use, environmental investments, and other environmental liabilities or commitments (Cormier *et al.*, 2005; Li *et al.*, 1997; Berry, 1984; Peters and Romi, 2010).

A second perspective relates firm transparency to external institutional pressures (Knox-Hayes and Levy, 2011). While international governance efforts and the increasing globalization of commerce have led multinational business to be thought of as 'global' and 'stateless', empirical evidence demonstrates that much of the variation in firms' reporting behavior can be attributed to national institutional characteristics, such as the stringency of the regulatory environment and the environmentalist culture of a country (Kolk, 2005; Walker and Salt, 2006; Peters and Romi, 2010). Industry factors are important as well. Industries that engage in more polluting activity tend to be more likely to voluntarily disclose environmental information (Brammer and Pavelin, 2006). Firm-specific factors (e.g. size, profitability, degree leveraged, media exposure, ownership dispersion, participation on the board of directors by external stakeholders) increase firms' likelihood of voluntarily disclosing environmental information (Cormier and Magnan, 2003; Brammer and Pavelin, 2006; Prado-Lorenzo *et al.*, 2009; Brammer and Pavelin, 2008; Stanny and Ely, 2008).

Previous research has demonstrated wide variations in strategic decision-making of firms related to carbon disclosure (Kolk and Pinske, 2004; Kolk and Pinske, 2005), carbon management (Kolk and Pinske, 2004; Kolk and Pinske, 2005; Sullivan, 2009), and investment in energy-efficient technologies (Hoffman, 2007). This variation can be explained by institutional, economic, and managerial determinants of information disclosure. While there is an emerging understanding of these pressures that lead to increased reporting, much less is known about the quality of firm reporting and the extent to which the disclosure of environmental performance leads to or reflects changes in behavior (Cormier *et al.*, 2005; Chen and Bouvain, 2009). Indeed, several authors have called for increased investigation into the content of environmental disclosure, as well as extensions beyond a simple dichotomous measurement of reporting behavior (Kolk and Perego, 2010; Chen and Bouvain, 2009; Stiller and Daub, 2007).



**DOI**: 10.1002/bse

### Convergence in Environmental Disclosure

Convergence in reporting standards and in discourses of CDP participants and major carbon-emitting firms facilitates transparency, comparability, and coordination. The standards and framing used in an arena can significantly impact firm operations and profits, as well as policy and political power. Carbon offset standards are an example of this (Gillenwater *et al.*, 2007; Millard-Ball and Ortolano, 2010; Bushnell, 2010). Hawley and Williams (2005) make clear this link between corporate governance and environmental concerns in the CDP's framing of disclosure and fiduciary obligations more broadly.

The sizable literature on standard-setting organizations (SSOs) also relates to this research. While the CDP is not a SSO, its effectiveness in fostering disclosure and accountability relies in part on standardized disclosed information. Much of the standardization process and its value have been observed in the technology and communications industries (e.g., Chiao *et al.*, 2007); (Schmalensee, 2009). SSOs can greatly impact investment decisions, firm coordination, and incentives to innovate, yet their policymaking process is less well understood. In the environmental arena, Boström and Hallström (2010) investigate power relations within global environmental SSOs and note how some non-governmental organizations like the CDP face major difficulties in setting standards in a global, multi-stakeholder context. They suggest that organizational evolution should mitigate those difficulties over time, but fundamental mismatches between NGO operations and the standard-setting process will limit the emergence of standards – even as the SSO still impacts partners.

According to institutional theory, rules and norms govern social behavior and shape interactions. Within this perspective, individuals or firm managers conform to the institutional symbols, rules, or regulations that they perceive to be external and objective (Cormier *et al.*, 2005). The emergence of an institution produces social structures, rules, and routines that constrain individual actions. For an individual manager or organization, a safe way to justify an action is to imitate the practice of another organization that is widely believed or perceived to be a model (Cormier *et al.*, 2005). This pressure is supported by socially acceptable beliefs and cultural frameworks. As firms attempt to conform to these beliefs and cultural frameworks, individual actions – such as environmental disclosure – become legitimized (Cormier *et al.*, 2005).

Firms may also benefit from transparency through the process of collecting information. Firms that implement environmental management systems are known to have improved compliance records and have improved environmental performance (Potoski and Prakash, 2005b; Potoski and Prakash, 2005a; Prakash and Potoski, 2006). As transparency becomes routine, it may become self-reinforcing, as well.

A role of transparency may be to help disseminate improved management behavior, especially in areas that are not seen as core strategic activities by firms (Lyon and Maxwell, 2007). According to Lyon and Maxwell (2004), firms participate in voluntary environmental agreements in order to deflect the enactment or enforcement of more costly, mandatory regulation. The sponsor of the program, however, has incentive to disseminate best practices across participating and non-participating firms, in order to improve environmental behavior. These best practices may disseminate even without the explicit intervention of government, due to industry laggards imitating industry leaders (Lange, 2009). Because energy efficiency is frequently not seen as a core strategic activity, firms do not object to the dissemination of these practices (Lyon and Maxwell, 2007). Supporting this hypothesis, a study on the convergence of human resources management across international firms suggested that imitation of best practices was more common in 'non-strategic' areas, such as human resources management, as opposed to finance and strategy (Carr and Pudelko, 2006).

Several studies have attempted to examine the convergence in reporting behavior and the content and standardization of disclosed information. It remains unclear whether environmental disclosure has increased over time, and whether firms have converged on specific reporting practices or standards. Considerable variation exists regarding reporting, the use of third-party assurance, and the content disclosed in corporate sustainability reports (Chen and Bouvain, 2009; Kolk, 2008; Kolk and Perego, 2010). Kolk (2005) finds that, despite trends of increasing transparency and reporting, firms have diverged in reporting practices and standards. In contrast, Cormier, *et al.* (2005) do not find increasing disclosure yet find within-industry convergence regarding the types of information disclosed. Brammer and Pavelin (2008) suggest that while convergence within industry is common, nearly all variation across firms is attributable to differences across industries. Nevertheless, inconsistent measurement techniques and standards, spotty verification practices, and a widely varying lexicon make the assessment of environmental reporting difficult.



**DOI**: 10.1002/bse

Due to globalization and the rise of the 'global stateless firm', it is unclear the extent to which firms conform to international standards that are common across countries, or whether national standards, laws, and institutions are more likely to dictate corporate transparency. Kolk (2005) finds increasing regionalization of reporting practices among firms that produce an environmental report.

### The Increasing Role of Scope 2 and Scope 3 Emissions

Greenhouse gas (GHG) emissions are measured as either direct or indirect. Direct emissions are emitted from sources immediately controlled or owned by the reporting firm, and indirect emissions originate from an external source as a result of the reporting firm's actions (WBSCD/WRI, 2011). Scope 1 emissions are equivalent to direct emissions, and indirect emissions are divided into Scope 2 and Scope 3 (WBSCD/WRI, 2004). While direct emissions have received most attention from government, carbon footprints, which include Scope 2 (indirect emissions from electricity use) and Scope 3 (emissions from product lifecycle, supply chain, and distribution), have received increasing attention in both technical and policy literature (Piecyk, 2010; Prakash, 2002)

Scope 3 GHG emissions are indirect GHG emissions that cannot be classified as Scope 1 or Scope 2. In CDP surveys, commonly listed sources of Scope 3 emissions are 'business travel', 'external distribution', 'use and disposal of products', and 'company supply chain'. In emissions reporting schemes, Scope 3 is often listed as an optional complement to the mandatory Scope 1 and Scope 2 emissions (Huang *et al.*, 2009; WBCSD/WRI, 2001; WBSCD/WRI, 2004).

Scope 2 and Scope 3 emissions may dwarf a firm's direct emissions, accounting for as much as 75% of a firm's carbon footprint, and the types of Scope 3 emissions that are important vary greatly by industry (Huang *et al.*, 2009). While Scope 2 and 3 emissions may be bigger than a firm's direct emissions, accounting procedures and standards remain highly variable and uncertain for these classes of emissions (Huang *et al.*, 2009; Piecyk, 2010; Kolk *et al.*, 2008). Research addressing Scope 2 and Scope 3 emissions has focused on two lines of research: how to calculate Scope 2 and Scope 3 emissions for a firm, industry, or geographical location (e.g. Kennedy *et al.*, 2010; Gentil *et al.*, 2009; Larsen and Hertwich, 2009; Stolaroff *et al.*, 2009; Piecyk, 2010), and whether or not firms are accounting for these emissions (Kolk *et al.*, 2008).

To date, most research on the CDP has focused on its role in facilitating the disclosure of carbon strategies and direct emissions or simply whether firms choose to participate or not (e.g. Kolk and Pinske, 2005; Kolk *et al.*, 2008; Kim and Lyon, 2011). While Kolk, *et al.* (2008) found that the CDP has generated increasing responses over time, the quality of responses was highly variable. They find that, although Scope 2 emissions tend to be reported in congruence with direct emissions, by 2007 both the quantity and quality of Scope 3 emissions reporting remained highly discretionary. Further, they note an array of competing standards and protocols used to account for Scope 3 emissions, such as the UK Department for Environment, Food and Rural Affairs (DEFRA), the Intergovernmental Panel on Climate Change (IPCC), the Environmental Protection Agency (EPA) Climate Leaders GHG Inventory Guidance, the International Petroleum Industry Environmental Conservation Association (IPECA), and the American Petroleum Institute (API), that complicates the comparability of any reported numbers. Kolk *et al.* (2008) note that some firms, such as the German utility E.ON, use different protocols and accounting standards in different countries. This heterogeneity of reporting demonstrates that carbon commensuration is not just a technical exercise, but a social and political process.

### Research Contributions

This research builds on earlier work on environmental reporting, carbon disclosure, and the CDP that has found significant variation in individual firms' behaviors (Sullivan, 2009) and variation in the quality of reporting and verification procedures (Cerin, 2002; Fonseca, 2010). Numerous researchers have called for research that assesses the impacts of global reporting standards and the use of text analytics software as a more reliable method of analyzing content than word counts or investigator coding, and work that 'examines the quality of assurance statements, rather than merely their adoption' (Kolk and Perego, 2010). Further, other researchers have bemoaned the lack of longitudinal assessments (Brammer and Pavelin, 2006; Brammer and Pavelin, 2008).



**DOI**: 10.1002/bse

We go further than existing research by taking advantage of CDP data to uncover the extent to which environmental behavior by firms has converged in the area of climate change. Further, we use quantitative methods to measure the extent to which the discourse and lexicon about carbon management has converged among major corporations. In contrast to existing research that largely employs dichotomous measurements (e.g. Kolk, 2005; Kolk, 2008; Peters and Romi, 2010; Kolk and Perego, 2010), we move beyond simple dichotomous indicators of disclosure by focusing on the types and quality of information disclosed. In contrast to cross-sectional data or two- or three-period data (e.g. Brammer and Pavelin, 2006; Brammer and Pavelin, 2008; Kolk, 2005; Kolk, 2008; Kolk *et al.*, 2008; Kolk and Perego, 2010), we take advantage of a longitudinal panel from 2003 to 2010. Additionally, in contrast to using coding mechanisms that rely on subjective measurements of disclosure behavior (e.g. Cormier and Magnan, 2003; Cormier *et al.*, 2005), we employ text analytics, similar to Chen and Bouvain (2009), in order to achieve a great deal of standardization in the content analysis and to allow us to assemble a larger sample of firms over many years. This approach allows us to draw substantive conclusions about carbon management and the standardization of measurement and management techniques across firms, both within and across industry, and to observe changes in the implementation of carbon management.

## Greenhouse Gas Reporting Standards

Responding firms report several GHG accounting methodologies in their responses. Appendix A describes several of these standards' important characteristics. We highlight four here: World Business Council for Sustainable Development/World Resources Institute (WBSCD/WRI) GHG Protocol, International Standards Organization (ISO) standards, IPCC, and DEFRA.

Developed in collaboration with multiple private, public, and non-governmental organizations, the WBSCD/WRI GHG Protocol is the most commonly listed response in all four years. It is distinguished by its universality and adaptability to most industrial sectors and reporting goals, as well as its classification of GHGs into the three 'scopes'.

Second, the ISO publishes ISO 14064 for GHG accounting. Part 1 of ISO 14064, organizational-level GHG reporting, closely corresponds with the WRI GHG Protocol (Weng and Boehmer, 2006). However, the WRI GHG Protocol details how to account for GHG emissions and ISO 14064 sets a minimum standard without detailing specific methods (Wintergreen and Delaney, 2007).

Established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), the IPCC is a scientific agency responsible for publishing the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Along with other IPCC publications, countries use this publication to report to the United Nations Framework Convention on Climate Change (UNFCCC). It is published in five volumes with specific methodologies for four sectors: energy, industrial processes and product use, agriculture, forestry, and other land use, and waste (IPCC, 2006).

Fourth, DEFRA publishes the 'Guidance on how to measure and report your greenhouse gas emissions'. This publication intends to help UK organizations of all sizes measure, reduce, and set reduction targets for GHG emissions. It was designed to be comparable to various other standards, such as ISO 14064 and the Carbon Trust Standard. At a basic level, DEFRA recommends calculating GHG emissions by multiplying activity data by emissions factors (DEFRA, 2009).

## Research Design

### Overview

Beginning in 2003, the CDP, an investor-led non-profit initiative, began surveying large firms regarding their carbon-related risks and strategies. Since 2006, the survey has been distributed to a wide range of firms across



**DOI**: 10.1002/bse

numerous industries. This study explores the content and convergence of firms' responses to the CDP over time through two primary techniques. First, we assess the content provided in firms' responses to emissions disclosure by using text analysis software to determine whether a firm provided a numerical response to emissions information. These data are useful in demonstrating trends related to the disclosure of types of emissions. Second, we assess firms' responses to open-ended questions about their emissions accounting standards and verification behavior. We use a Herfindahl–Hirschman index (HHI) to demonstrate the concentration of common keywords in firms' responses regarding emissions accounting methodology. We also track the frequency of numerous competing emissions reporting standards to assess the extent to which firms have converged on specific reporting techniques and standards and highlight the extent to which firms use similar methodologies over time.

### Data Description

Since 2003, firms have submitted completed CDP surveys each year before 31 May. The disclosed data usually come from one or two years prior to the survey deadline. Firms responding to the CDP were given the option of designating their responses as either publicly or privately accessible. Private responses are available exclusively to institutional investors. Only public responses were examined in this study. From 2003 to 2010, approximately 2900 unique firms publicly responded to the survey. Table 1 lists the responding firm counts for each year the survey was issued.

Responding firms from 2007 to 2010 represented eight sectors: consumer discretionary, consumer staples, energy, financials, health care, industrials, information technology, materials, telecommunications, and utilities. The sample includes industry leaders and other major firms worldwide.

### Assessing Convergence in Carbon Disclosure

First, to assess the extent of convergence in firm responses, we analyze firms' responses to questions pertaining to Scope 1, Scope 2, and Scope 3 emissions over time, as well as a question pertaining to whether or not these responses were externally verified. Undertaking a longitudinal study of the panel was difficult, due to the changing survey format of the questions over time. (This might explain why many studies rely on binary measurements of whether or not a firm responded to the CDP.) From 2003 to 2006, Scope 1 and 2 emissions data were combined into a single question, and no external verification question existed for these years. Also, until 2007, the responses to the emission questions were in an open-ended, multi-paragraph response format. For 2007, 2008, and 2010, the Scope 3 emissions question was divided into separate questions based on the type of Scope 3 emissions. And from 2007 to 2010, questions became numerical response questions.

In order to solve this problem, the four questions are analyzed with text analytics software. We define several categories for understanding the types of information that firms provided in the survey to the detailed questions regarding Scope 1, 2, and 3 emissions. From 2003 to 2006, the number of firms responding to each question are tallied: 'Numerical Responses', 'WRI GHG Protocol', and 'Unanswered'. 'Numerical Responses' refers to firms that used quantitative information in their answer. Our analysis counted any response that included a number as a

| CDP year | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| Public firms | 146 | 226 | 265 | 588 | 952 | 1061 | 1247 | 1513 |
| Total respondents | 221 | 295 | 355 | 922 | 1300 | 1538 | 1849 | 2049 |
| Targeted firms | 501 | 501 | 500 | 2166 | 2444 | 3055 | 3741 | 4792 |
| Per cent of targeted firms responding | 44.1% | 58.9% | 71.0% | 42.5% | 53.2% | 50.3% | 49.4% | 42.7% |
| Per cent of targeted firms responding publicly | 29.1% | 45.1% | 53.0% | 27.1% | 38.9% | 34.7% | 33.3% | 31.6% |
| Annual investors (firm count) | 35 | 95 | 155 | 225 | 315 | 385 | 475 | 534 |
| Combined investor assets (trillions of US$) | 4.5 | 10 | 21 | 31.5 | 41 | 57 | 55 | 64 |

***Table 1.*** Firm counts in carbon disclosure project sample by year



**DOI**: 10.1002/bse

'numerical response', which also included responses that mentioned a year (e.g. '1999'). 'WRI GHG Protocol' includes firms responding with keywords referencing the WRI's GHG protocol. 'Unanswered' counts the firms that left the question entirely blank. For 2007 to 2010, the categories are 'Numerical Responses' and 'Unanswered'.

In the questions pertaining to external verification, firms selected their response from a drop-down list supplied by the CDP. For 2007 and 2008, the categories in the list were 'Yes', 'No', and 'Unanswered'. In 2009, a category was added for the response, 'No information provided in applicable questions', referring to firms that did not provide any information in the emissions questions. In 2010, the CDP divided responses according to the three emissions scopes. Seven categories exist for each scope: 'Not Verified', 'More than 0%, but less than 20%', 'More than 20%, but less than 40%', 'More than 40%, but less than 60%', 'More than 60%, but less than 80%', 'More than 80%, but less than 100%', and 'Unanswered'. The number of firms included in each category is recorded. The percentage of firms responding to each category is calculated by dividing the number of responding firms by the total number of firms for that year. Below, we discuss trends from 2003 to 2010 in the disclosure and verification of carbon emissions, shown in Table 2.

A second technique in measuring response convergence is the use of a HHI. Originally, the HHI was developed to measure industrial concentration in markets (Hirschman, 1964). In this study, we employ the HHI to measure the concentration of the most frequently used keywords and phrases over time. Using the HHI, we determine whether the lexicon regarding climate change is converging based on changes in 'market share' among terms used in reporting.

The keywords and phrases are generated from responses to questions in CDP2007–CDP2010 that inquired about the accounting methodology the firms used to manage their GHG emissions. The CDP inquired about the Scope 1 and Scope 2 emissions methodology separately from the Scope 3 emissions. For this study, we aggregate responses for Scope 1, 2, and 3 emissions. After responses are aggregated for each firm, the responses are analyzed with SPSS Text Analytics for Surveys (STAS) software. We identify the top 200 'null concept patterns' for each year. As defined by STAS, 'concept patterns' are a combination of frequently occurring keywords and 'type', a group of similar keywords. 'Null concept patterns' (NCP) occur when a significant keyword occurs without the presence of a subsequent 'type'. A list of the overall top 200 NCPs is created by aggregating lists from 2007 to 2010. Of this list, the top 100 are retained for use in the HHI.

Typically, the HHI is calculated by summing the squares of the market share of every firm in a market. In this study, we analogously calculate the percentage share using each of the NCPs each year. Each of these yearly percentage shares are squared and summed to produce an annual HHI value. As lexicon concentration increases,

| | | Emissions information (no. of firms) | Emissions information (%) | Scope 3: products and services/supply chain (no. of firms) | Scope 3: products and services/supply chain (%) |
|---|---|---|---|---|---|
| CDP 2003 | Numerical response | 99 | 67.8 | 72 | 49.3 |
| | WRI GHG protocol | 11 | 7.5 | 4 | 2.7 |
| | Unanswered | 21 | 14.4 | 21 | 14.4 |
| CDP 2004 | Numerical response | 180 | 79.6 | 110 | 48.7 |
| | WRI GHG protocol | 36 | 15.9 | 9 | 4.0 |
| | Unanswered | 5 | 2.2 | 7 | 3.1 |
| CDP 2005 | Numerical response | 170 | 64.2 | 214 | 80.8 |
| | WRI GHG protocol | 17 | 6.4 | 17 | 6.4 |
| | Unanswered | 2 | 0.8 | 4 | 1.5 |
| CDP 2006 | Numerical response | 440 | 74.8 | 313 | 53.2 |
| | WRI GHG protocol | 143 | 24.3 | 16 | 2.7 |
| | Unanswered | 30 | 5.1 | 38 | 6.5 |

***Table 2.*** Disclosure to the Carbon Disclosure Project (CDP): 2003–2006
WRI, World Resources Institute; GHG, greenhouse gas.



**DOI**: 10.1002/bse

the HHI score also increases. We expect that the HHI score will increase as the language used in firm responses to the CDP converges.

## Results

We divide discussion of the results into two sections, 2003–2006 and 2007–2010, due to dramatic changes in the questionnaire and sample size.

### 2003–2006 (Table 2)

Between 2003 and 2006, the total number of firms answering the survey and providing quantitative responses to Scope 1, 2, and 3 increased. However, the percentage of firms providing quantitative responses increased only moderately. The quality of responses, at least for Scope 1 and 2 emissions, improved. Between 2003 and 2006, both the number and the percentage of firms referencing the WRI GHG Protocol in their accounting methodology increased, while the number and percentage of firms skipping the question or leaving it blank decreased. From 2003 to 2006, the share of firms referencing the WRI GHG protocol for Scope 1 and 2 more than tripled, and the share skipping the emissions questions fell by two-thirds. Interestingly, Scope 3 emissions did not follow a similar trend; Scope 3 emissions reporting remained flat.

### 2007–2010 (Tables 3–7)

Between 2007 and 2010, a complex picture of trends in transparency emerges. Despite a gradually increasing sample size of firms releasing responses publicly, the number and percentage of firms providing quality information for Scope 1, Scope 2, and emissions from employee business travel (part of Scope 3) increases. In contrast, the percentage of firms providing quality lifecycle analysis or supply chain data does not increase (though the total number of firms providing these data increases).

When the overall trends in the public disclosure of data and industry and country/region trends are considered, a more pessimistic view of transparency emerges. Between 2007 and 2010, the vast majority of new firms providing responses to the CDP survey did not make their responses public (see Table 1). Despite the number of firms responding to the CDP more than doubling from 2007 to 2010 (from 1449 to 3050 firms), the share of responses that were public fell from 63.4 to 43.2%.

Country and industry trends show similarly mixed patterns in transparency. Of firms providing a publicly available response, European Union (EU)-based firms and Japanese firms have generally increased the quality of

| | | Scope 1 direct GHG emissions (%) | Scope 2 indirect GHG emissions (%) | Scope 3 employee business travel (%) | Scope 3 external distribution (%) | Scope 3 product lifecycle (%) | Scope 3 company supply chain (%) |
|---|---|---|---|---|---|---|---|
| CDP 2007 | Numerical response | 55.6 | 48.6 | 17.8 | 9.7 | 8.2 | 6.1 |
| | Unanswered | 44.4 | 51.4 | 82.2 | 90.3 | 91.8 | 93.9 |
| CDP 2008 | Numerical response | 53.8 | 49.3 | 24.4 | 10.0 | 7.2 | 6.2 |
| | Unanswered | 46.2 | 50.7 | 75.6 | 90.0 | 92.8 | 93.8 |
| CDP 2009 | Numerical response | 74.8 | 71.3 | N/A | N/A | N/A | N/A |
| | Unanswered | 25.2 | 28.7 | | | | |
| CDP 2010 | Numerical response | 68.0 | 67.6 | 44.2 | 12.8 | 7.0 | 6.2 |
| | Unanswered | 32.0 | 32.4 | 55.8 | 87.2 | 93.0 | 93.8 |

***Table 3.*** Disclosure to the Carbon Disclosure Project (CDP) 2007–2010
GHG, greenhouse gas.



**DOI**: 10.1002/bse

| | CDP 2007 | CDP 2008 | CDP 2009 | CDP 2010 |
|---|---|---|---|---|
| Consumer discretionary | 51.4 | 49.6 | 69.8 | 56.4 |
| Consumer staples | 71.6 | 66.3 | 89.7 | 78.2 |
| Energy | 64.3 | 62.1 | 82.4 | 75.9 |
| Financials | 64.0 | 49.5 | 61.8 | 56.6 |
| Health care | 43.5 | 37.0 | 17.5 | 28.8 |
| Industrials | 45.0 | 48.1 | 77.4 | 69.7 |
| Information technology | 60.0 | 55.3 | 79.6 | 80.3 |
| Materials | 53.2 | 61.6 | 84.1 | 75.9 |
| Telecommunications | 51.1 | 44.7 | 19.2 | 27.0 |
| Utilities | 40.0 | 54.7 | 30.9 | 38.9 |

***Table 4.*** Scope 1 emissions reporting for the Carbon Disclosure Project (CDP) 2007–2010 (percentage by industrial sector)

| | CDP 2007 | CDP 2008 | CDP 2009 | CDP 2010 |
|---|---|---|---|---|
| Europe | 56.8 | 58.1 | 79.8 | 65.7 |
| Japan | 56.2 | 62.8 | 54.5 | 76.9 |
| Other | 60.2 | 43.0 | 67.6 | 62.0 |
| US | 58.4 | 58.2 | 81.8 | 24.6 |

***Table 5.*** Scope 1 emissions reporting for the Carbon Disclosure Project (CDP) 2007–2010 (percentage of firms reporting in region)

| | | |
|---|---|---|
| CDP 2007 | Unanswered | 15.8% |
| | No | 42.5% |
| | Yes | 41.7% |
| CDP 2008 | Unanswered | 29.6% |
| | No | 34.2% |
| | Yes | 36.2% |
| CDP 2009 | Unanswered | 17.3% |
| | No | 32.3% |
| | Yes | 43.8% |
| CDP 2010 | Unanswered | 20.8% |
| | No | 41.3% |
| | Yes | 44.4% |

***Table 6.*** External verification of emissions (2007–2010)
CDP, Carbon Disclosure Project.

| | HHI |
|---|---|
| 2007 | 0.184 |
| 2008 | 0.208 |
| 2009 | 0.171 |
| 2010 | 0.357 |

***Table 7.*** Herfindahl–Hirschman index (HHI) of top 100 keywords (2007–2010)



**DOI**: 10.1002/bse

responses. American firms, by contrast, increased the quality of responses through 2009, but in 2010 only 24.6% of firms provided numerical Scope 1 and Scope 2 data, in contrast to 58.4% in 2007 and 81.8% in 2009 (see Table 5). Industry trends reveal a mixed picture, as well as a lack of consistency. Materials, industrials, and information technology sectors have the largest gains of transparency – all with over 20% gains between 2007 and 2010. Energy firms and consumer staples remain highly transparent throughout the sample years. Financials, consumer discretionary, and utilities remain relatively unchanged, and telecommunications and health-care sectors decrease their transparency (see Table 4).

Table 6 does not show a clear trend towards increased verification of emissions data between 2007 and 2010 among those firms providing publicly available responses. The changing question formats over time limits the analysis of verification trends. In 2010, the question changed to exclude firms that did not provide information in the first place and to allow for partial verification of emissions. In 2010, 44.4, 38.4, and 21.0% of firms report at least partial verification of Scope 1, 2, and 3 emissions, respectively.

In order to determine whether there was a clear convergence of the discourse regarding carbon management and climate change, we examine our lexicon concentration measurement, which mimics the HHI methodology. We calculate the 'market share' of each keyword based on the list of the top 100 keywords and phrases used by respondents in the accounting methodology sections of the CDP surveys. As demonstrated in Table 7, from 2007 to 2010, the market share of the top 100 keywords and phrases increased from .184 to .357. Corporate discourse regarding climate change has converged recently. That the concentration or convergence in lexicon increased despite more firms participating in the CDP indicates an especially strong trend.

In addition, we demonstrate the total share of firms reporting the use of a wide variety of standards and carbon accounting methodologies. As Table 8 shows, usage of the WBSCD/WRI protocol increased from 45% in 2007 to 63% in 2010. More tellingly, however, the usage of the top four accounting methodologies has dominated the increase in use of accounting methodologies. WBSCD/WRI, IPCC, DEFRA, and ISO are the only standards to have garnered more than 10% of the total firms. Most of the other standards have failed to gain traction. Interestingly, only the top five standards, plus CCAR, received more than 1% market share and experienced a consistently increasing 'market share' of standards used over time. Appendix B offers a comparison of several of these methodologies, and Appendices C and D give region and industry breakdowns of the standards, respectively.

## Discussion

These results present a decidedly mixed perspective regarding the transparency of firms relating to carbon management and accounting, supporting previous studies that found similar characteristics within a smaller

| Year | WBSCD/ WRI | IPCC guidelines | DEFRA | ISO | EPA Climate Leaders | IEA | CCAR | ASAE | GRI | IPIECA/ API | EPA eGrid data | Kyoto | EU ETS | OGP | CAPP | CCX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | 44.9% | 4.0% | 4.7% | 1.4% | 3.6% | 1.4% | 0.8% | 3.4% | 1.6% | 2.4% | 0.4% | 0.9% | 1.8% | 0.3% | 0.3% | 0.2% |
| 2008 | 47.4% | 6.6% | 6.2% | 4.0% | 4.2% | 2.9% | 2.2% | 3.8% | 1.8% | 2.2% | 1.4% | 1.7% | 1.7% | 0.7% | 0.4% | 0.5% |
| 2009 | 59.7% | 10.7% | 9.4% | 9.0% | 6.5% | 5.0% | 4.6% | 4.6% | 3.9% | 3.5% | 3.3% | 3.2% | 2.8% | 0.8% | 0.8% | 0.7% |
| 2010 | 63.4% | 11.3% | 12.2% | 10.6% | 6.7% | 2.9% | 4.3% | 2.4% | 3.3% | 3.1% | 2.0% | 2.7% | 2.4% | 0.8% | 0.7% | 0.4% |

***Table 8.*** Implementation of selected standards by firms

WBSCD/WRI, World Business Council for Sustainable Development/World Resources Institute; IPCC, Intergovernmental Panel on Climate Change; DEFRA, UK Department for Environment, Food and Rural Affairs; EPA, Environmental Protection Agency; CCAR, ASAE, [Australian] Standards on Engagements IEA, International Energy Agency; CCAR, California Climate Action Registry; GRI, Global Reporting Initiative; IPIECA/API, International Petroleum Industry Environmental Conservation Association/ American Petroleum Institute; EU ETS, European Union Emissions Trading Scheme; OGP, International Association of Oil and Gas Producers; CAPP, Canadian Association of Petroleum Producers; CCX, Chicago Climate Exchange.



**DOI**: 10.1002/bse

sample (Sullivan, 2009). There are numerous signs of improved management by firms; there are also many signs that suggest that gains in transparency achieved by the CDP in the early years have failed to produce a lasting trend towards transparency. Responses from CDP participants in more recent years are overwhelmingly private, rather than publicly disclosed. There is little evidence that firms have increased external verification, and in the US the quality of emissions reporting decreased substantially in 2010 (perhaps in response to reduced political expectations of carbon regulation). These results are similar to other studies that suggest wide variation in assurance and verification quality (Fonseca, 2010; Cerin, 2002). Firms that have large Scope 1 and Scope 2 carbon footprints including materials, industrials, energy firms, and consumer staples have been most likely to disclose carbon-related data. Industries without large direct carbon impacts – such as hospitals, financials, and telecommunications – have been less forthcoming with data, consistent with theory suggesting that firms that have the most carbon-related regulatory risk ought to be the most likely to disclose data (Brammer and Pavelin, 2006). However, the largest emitters of all, utilities, continue to remain relatively opaque.

Among firms making their responses public, firms have been increasingly likely to employ a standardized accounting methodology and report numerical data in response to Scope 1, 2, and 3 emissions queries. This suggests that firms are paying closer attention to carbon management. Improved information is certainly a step towards improved management. It is unclear, however, whether increased transparency and better data are the result of the CDP or are simply reflecting broader changes in carbon management. It is possible that by asking firms to report certain information, firm managers begin to collect that information. This hypothesis is supported by data in 2005 and 2009, where large spikes of transparency are reported the year *after* the year of a big expansion of the sample size. Even though CDP participants may not know the answer to new reporting questions upon first encountering them they learn fast, and response rates are much higher the next time around.

For example, between 2003 and 2004, the number of firms increased by more than 50%, from 146 to 226 firms. This dramatic increase happened again between 2005 and 2006 (and again in 2007). In 2005, however, when the number of firms increased only slightly over 2004, 80.8% of firms provided quantitative responses to Scope 3 emissions, up from 49% in 2004. Only two (four) firms did not answer Scope 1 and 2 emissions (Scope 3 emissions), down from roughly double that number in the previous year. In 2009, another year where the sample size had not increased (it actually decreased), the response to Scope 1 emissions jumped from 53.8% in 2008 to 74.8% in 2009. Scope 2 emissions reporting jumped from 49.3% in 2008 to 71.3% in 2009. Thus, in the year after a spike in sample size, larger spikes in transparency appear.

The increase of transparency related to Scope 1 emissions is unsurprising. Mandatory regulations in Europe, Japan, Australia, and many US states have forced firms to at least report, if not control, Scope 1 emissions. In the EU, where a cap-and-trade program has been implemented through the EU Emissions Trading Scheme (ETS), most firms must control but do not have to disclose direct emissions publicly. Yet, even there, Scope 1 emissions reporting rates far exceed the US level.

More interestingly, reporting of Scope 2 emissions has burgeoned, and that of Scope 3 emissions has increased in some areas, while in others has remained relatively stable (again, suggesting an increase in the number of firms reporting, but a constant percentage). These trends suggest a more important role for the CDP. In 2007, 48.6% of firms reported indirect emissions, which includes electricity usage. By 2010, 67.6% of firms reported indirect emissions. Trends in Scope 3 emissions reporting have been more mixed. In 2007, 17.8% of firms reported emissions from business travel, increasing to 44.2% in 2010. The percentage of firms reporting distribution-related emissions increased by three percentage points, from 9.7 to 12.8%. Again, because these numbers are percentages of an increasing sample size, they mask the increase in the total number of firms reporting this sustainability data publicly.

Scope 2 and Scope 3 emissions speak to a broader sustainability role for carbon management. Because electricity use and fuel use are frequently substitutes and the product life cycle, supply chain, business travel, and distribution of products may have a much bigger carbon footprint than the direct emissions of a firm, these measurements provide important information to stakeholders and shareholders about the firm's carbon-related activities. The increase in reporting is an important sign that, at the very least, firms are beginning to pay attention to their carbon footprint, are defining their carbon footprint in a much broader sense than just direct emissions, and are thus considering how they might be able to manage their carbon footprint better.

The results from the HHI calculation of keyword and phrase concentration by firms points towards a convergence of management language. The types of keywords and phrases in this analysis generally refer to management



**DOI**: 10.1002/bse

techniques, measurement techniques, and reporting standards. The top 100 keywords and phrases were much more common in 2010 than they were in 2007, suggesting that the lexicon is becoming more standardized, and firms have moved towards similar measurement and reporting standards. This is supported, in part, by the increased use of the WRI GHG Protocol between 2003 and 2006 for Scope 1 and 2 emissions, and by the presence of the WRI GHG protocol as one of the top keywords between 2007 and 2010. Other standards and protocols received significant attention between 2007 and 2010, such as the IPCC, the DEFRA standards, and the ISO standards. This indicates that there might be institutional, regional, or industrial convergence towards competing standards. Regardless (and perhaps more importantly from a carbon management perspective), these 'competing' standards may not be all that competing. The DEFRA and ISO standards are designed to be relatively compatible with the WBSCD/WRI guidelines, which, in turn, were developed to be compatible with the IPCC guidelines. As these standards gain traction, it ought to make carbon management more transparent and bolster stakeholder faith in the numbers that are reported to the CDP.

Nevertheless, we were hampered by a CDP survey that changed nearly each and every year, as well as a changing sample. The CDP changed the types of information being requested over time, as well as the format in which the questions were asked. Sometimes, they provided drop-down menus. Sometimes, they dropped questions. In 2009, for example, the CDP did not ask, specifically, about Scope 3 emissions. Many times, they added questions or attempted to extract more specific information from investors.

On one hand, the changes in the CDP format often seemed reasonable. They have increasingly moved from open-ended responses, where firms often appear to cut and paste large amounts of (often irrelevant) information, to multiple choice answers that force firms to provide specific types and formats of answers. They have seemed to adapt to circumstances where firms were providing irrelevant information by structuring the questions differently and by asking for more specific types of information.

On the other hand, shifting the questions each and every year greatly complicates the tracking of data over time. Considering the time, effort, and sophisticated text analytics necessary just to extract comparable information across years (exclusive of time and expertise in analyzing it) at least calls into question the purpose of the CDP's disclosure or transparency program (Bae *et al.*, 2010). We had to align questions across years, and, even then, we still had to omit 2009 from part of the analysis, and 2003–2006 is not comparable to 2007–2010. This discord is evident in some of the survey responses themselves. While most firms have improved their responses over time, the changing nature of the survey seems to undermine the responses of others. Caterpillar, for example, provided very specific and detailed information early on in the survey, but in later years provided a nearly irrelevant corporate sustainability statement. Because firms are frequently graded on whether or not they respond to a question rather than the quality of their responses (partly due to the lack of standardization in the survey), and because responses may not be particularly useful to investors or researchers, there may be insufficient motivation to provide detailed information to the CDP.

## Conclusions and Directions for Further Research

In contrast to much existing research, this research engages in a longitudinal study of corporate transparency data and takes into account the quality of firms' responses. This research makes advances in both the quantity and quality of information assessed related to very specific disclosures of carbon-related activities.

The trend towards keeping responses private, rather than public, is potentially alarming from a perspective that sees transparency as a key to improved management. It also raises many questions regarding the quality of private responses versus those released publicly, as well as the potential impact on firms from awareness in the broader public, versus the impact from institutional investors.

If firms are graded simply on whether or not they answer a question, rather than the quality of their responses, firms will likely avoid the disclosure of quality information. The reasons behind the enormous and recent drop-off in quality responses from US firms are unclear. On the one hand firms may have anticipated changes in the political environment, leading them to strategically avoid disclosure. On the other, the Securities and Exchange Commission (SEC) has begun requiring a similar, but mandatory, disclosure, perhaps making the CDP obsolete. It is unclear the extent to which the SEC guidelines will mimic the CDP efforts. Similarly, mandatory reporting requirements in part of the EU ETS may obviate the need for a voluntary reporting database for Scope 1 emissions.



**DOI**: 10.1002/bse

These developments suggest a tradeoff between voluntary and mandatory reporting regimes. While mandatory reporting requirements may be an effective way to force disclosure of direct emissions, voluntary disclosure programs like the CDP may allow firms to engage with stakeholders such as investors and employees more directly than mandatory reporting requirements and serve as a way to improve internal management of GHGs (Stanny and Ely, 2008).

The decrease in transparency by US firms in 2010 raises many questions regarding the viability of a voluntary disclosure program. If firms participate in a voluntary program to deflect the enactment or enforcement of a more stringent mandatory program (Lyon and Maxwell, 2004), the success of a voluntary program is at best a second-best solution that is dependent upon political pressure for more stringent mandatory programs.

However, by encouraging voluntary reporting and disclosure, the CDP gives firms a way to distinguish themselves from competitors and gain recognition for going beyond compliance. In contrast, participation in a mandatory reporting environment, such as the EU ETS (which does not make direct emissions public), reduces incentives for moving beyond compliance. In addition, the CDP has a unique role in promoting the disclosure of Scope 2 and Scope 3 emissions, which are unlikely to be addressed through mandatory regulation or disclosure rules.

Finally, the CDP – as well as other efforts to encourage GHG reporting and verification – has helped establish norms for carbon accounting methodology. Some of the strongest evidence for convergence in this study related to the specific standards employed for carbon accounting methodology. That firms have converged to use specific methods for carbon accounting without the coercive force of government demonstrates an important role for voluntary initiatives like the CDP in achieving consensus regarding reporting standards. The learning process by participating firms seems especially promising, as reporting improves soon after joining.

Nevertheless, the complexity and changes to the CDP survey have made it particularly difficult to assess CDP responses, despite the rich information collected by the organization. A voluntary disclosure program, unlike a mandatory one, might allow for less uniformity and standardization and hamper comparability over time and across firms. (In contrast, the freedom afforded firms in reporting through the CDP allows us to observe the 'natural' convergence in reporting in a voluntary system.) We acknowledge that the CDP is attempting to improve its methodology and assessment techniques. The CDP has begun to grade firms based on the content of their responses, though too frequently this is still conducted as a binary measurement based on whether a firm has provided information in response to a question. More attention needs to be directed towards generating a survey and response system that is consistent over time and collects more usable information.

Due to our focus on improving the types of information gathered from the CDP survey and the challenges in extracting that information, we have not begun to parse patterns in the responses or the non-responses. Future research should seek to assess how individual firms change their responses over time and which firms withhold information. We can assess which types of firms are converging on different standards, and correlate the content of responses with shareholder value or measurements of observed environmental performance. Significant uncertainty remains regarding whether reporting and verification reflect actual firm behavior (Kolk and Pinkse, 2010; Fonseca, 2010), or whether they are simply an exercise in public relations (Cerin, 2002). Recent findings suggest that improved disclosure and management are correlated with higher toxic releases and lower environmental compliance (Delmas and Blass, 2010), suggesting that improved disclosures may not correlate with improved environmental performance.

We demonstrate a mixed trend towards increasing disclosure and increased transparency, with some areas – especially in the area of unregulated Scope 2 activity – suggesting improvements in transparency. Other areas – including the verification of disclosed information – suggest a lack of improvement. There is some convergence in specific accounting methodologies. This research contributes to previous findings that do not demonstrate increasing transparency over time, and contributes to the convergence/divergence debate. While on the whole we demonstrate convergence in the types of information supplied and the lexicon used by firms that make their responses publicly available, future research should seek to further parse convergence patterns.

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## Appendix A: Descriptions of Selected Protocols

### WBSCD/WRI Greenhouse Gas Protocol

The World Business Council for Sustainable Development/ World Resources Institute (WBSCD/WRI) GHG Protocol is developed in collaboration with multiple private, public, and non-governmental organizations to provide an internationally recognized standard for accounting and reporting GHGs (WBSCD/WRI, 2004). The GHG Protocol publishes standards for multiple aspects of GHG accounting, including the GHG Protocol Corporate Accounting and Reporting Standard, GHG Protocol Project Quantification Standard, and a recently released standard on Scope 3 emissions.

### International Standard on Assurance Engagements 3000 (ISAE 3000) from the International Federation of Accountants

The ISAE 3000 was created by the International Auditing and Assurance Standards Board (IAASB) to provide professional accounting instructions to public practitioners of accounting. It is not explicitly developed to address environmental management or GHG emissions, but the framework is adaptable. It seeks to establish convergence upon an international, professional accounting standard for assurance engagements other than audits or reviews of historical financial information (IAASB, 2008).

### International Organizations for Standardization (ISO)

The ISO is a Geneva-based non-governmental organization (NGO) made up of standards institutes from 162 countries. It claims to be the largest developer and publisher of international standards. ISO partners represent both private and public interests. They have published hundreds of standards at present, and many have been referenced in the CDP. All standards are voluntary and developed for areas where there is a definite market requirement (ISO, 2011).

### Global Reporting Initiative (GRI) Sustainability Reporting Guidelines

Though the Sustainability Reporting Guidelines, the GRI (established in 1997) seeks to promote sustainability by encouraging greater transparency of the impacts of firm activities. GRI develops its reporting framework through consultation with actors in a network of diverse stakeholders (business, investors, labor, civil society, accounting, academia, and others). Unlike other standards, this framework provides guidelines for accounting economic and social impacts, in addition to environmental impacts (Global Reporting Initiative, 2011).

### AA1000AS (2008) Assurance Standard from AccountAbility

In 2003, the AA1000 was published by AccountAbility as the world's first sustainability insurance standard. It was developed in collaboration with international stakeholders, such as investors, businesses, and NGOs. Sustainability insurance addresses the adherence to AA1000 accountability principles and the quality of disclosed information pertaining to sustainability. It is intended to be used by sustainability insurance practitioners, report preparers, and users of sustainability reports. AccountAbility is a non-profit, international network dedicated to encouraging accountability innovations related to sustainability (AccountAbility, 2008).

### EPA Climate Leader Standards

From 2002 to 2011, the EPA Climate Leaders program was a partnership between the EPA and private firms to improve the environmental performance of American businesses. The Climate Leaders program differed from the GHG Protocol as it was a program based out of the US dealing directly with setting environmental performance goals and recognizing related leadership and achievement of American businesses (Environmental Protection



**DOI**: 10.1002/bse

Agency, 2011), as opposed to international GHG reporting and accounting standards. After September 2011, the Climate Leaders program was ended in response to the maturity of alternate state and NGO operated climate programs, as well as a new EPA GHG Reporting Program (McCarthy, 2010).

### European Union Emissions Trading Scheme (EU ETS)

Inspired by the Kyoto Protocol, EU ETS was established in 2005 as a mandatory cap and trade system designed for EU member nations to reach their carbon reduction goals. As a carbon trading scheme, it quantifies carbon emissions through the use of a price mechanism. The total emission released by a firm is determined by how much carbon has been bought or sold (European Commission, 2009).

### California Climate Action Registry (CCAR)

Developed by the California Registry (transitioning to the Climate Registry) in 2001 to encourage GHG emissions reporting, CCAR was a voluntary program of special interest to public, private, and environmental organizations. In December 2010, CCAR was officially closed. During its time, it received 863 verified GHG emissions reports, including 972,802,087.81 metric tons $CO_2$ equivalent ($CO_2e$) of direct and indirect emissions(California Climate Action Registry, 2011).

### Chicago Climate Exchange (CCX)

Launched in 2003, CCX was the US's first carbon emissions cap and trade program. It reported 450 members and GHG emissions reductions of 700 million tons. In 2010, it ended its carbon emission program but launched the CCX Offsets Registry Program in January 2011 (Chicago Climate Exchange, 2011; Gronewold, January 3, 2011).

### Standards on Engagements (ASAE)

ASAE is a product of the Australian Government Auditing and Assurance Standards Board (AUASB). As dictated by Australian law, the AUASB publishes the ASAE to establish 'mandatory requirements and provides explanatory guidance for undertaking and reporting on assurance engagements other than audits or reviews of historical financial information covered by Auditing Standards (ASAs) or Auditing Standards on Review Engagements (ASREs)' (AUASB, 2007).

### Intergovernmental Panel on Climate Change (IPCC) Guidelines

Established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the international community with scientific information pertaining to climate change, IPCC is responsible for publications pertaining to GHG emissions accounting methodology, which are utilized by some responding firms (Intergovernmental Panel on Climate Change, 2011).

### Carbon Trust Standard

Since 2008, the Carbon Trust Standard has been produced by the Carbon Trust to promote accounting, management, and reduction of GHG emissions of both public and private organizations. It is influenced by WRI's GHG Protocol and ISO 14064–1 and was developed with the help of major private and public organizations (Carbon Trust, 2011).

### Environmental Management Systems (EMS)

EMS is produced by the US EPA to provide guidance to firms trying to reduce their environmental impact. It is designed to help firms develop affordable environmental management programs (EPA, 2012)



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### Third-Party Verification Standards

Some firms mention, by name, a third-party contractor responsible for externally verifying their response. Common third parties include: Price Waterhouse Coopers, Det Norske Veritas, Deloitte, KPMG, and Bureau Veritas.

## Appendix B: Characteristics of Selected Protocols

| Standard | Required information | Primary goal(s) |
|---|---|---|
| WBSCD/WRI GHG Protocol | • Description of the company and inventory boundaries<br>• Separate Scope 1 and 2 emissions data<br>• Separate data for all six GHG emissions in metric tons and tons of $CO_2e$<br>• Separate data for direct carbon emissions from biologically sequestered sources<br>• Methodologies used in calculation<br>• Specific mention of excluded sources, facilities, and operations. | 'To develop internationally accepted greenhouse gas [GHG] accounting and reporting standards for business and to promote their broad adoption' (WBSCD/WRI, 2004) |
| ISO 14064-1 | • Organizational-level reporting<br>• Project-level reporting<br>• Validation and verifications | • To encourage and promote consistency, transparency, and credibility in GHG reporting<br>• To allow organizations to identify their sources of GHG emissions<br>• To enable the trade of GHG allowances and credits<br>• [To] 'support the design, development and implementation of comparable and consistent GHG schemes or programmes' |
| IPCC | • Varies by sector<br>Activity data × emissions factors = GHG emissions* | IPCC aims to assist the parties to the UNFCCC in 'fulfilling their commitments under the UNFCCC on reporting on inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol, as agreed by the Parties' (IPCC, 2006) |
| DEFRA | Activity data × emissions factors = GHG emissions*<br><br>12 Recommendations:<br>1. 'Apply your chosen approach consistently and for most organisations this will be the financial control approach'<br>2. 'Measure or calculate your emissions on a global basis'<br>3. Report Scope 1 and 2. Scope 3 is optional<br>4. 'Measure or calculate emissions from the six GHGs covered by the Kyoto Protocol'<br>5. 'Where your organisation is using standard emission factors, you should use the DEFRA/DECC GHG conversion factors for UK emissions'<br>6. 'Report total GHG emissions as a gross figure in tonnes of $CO_2e$'<br>7. 'Report purchased or sold emissions reductions that meet the "good quality" emission reduction | To assist UK organizations in:<br>• Reducing contributions to climate change<br>• Setting GHG reduction targets<br>Measuring total GHG emissions (DEFRA, 2009) |

*(Continues)*



**DOI**: 10.1002/bse

## Appendix B (Continued)

| Standard | Required information | Primary goal(s) |
|---|---|---|
| | criteria. Then report a net figure in tonnes of $CO_2e$, in addition to the gross figure'<br>8. 'Report on total Scopes 1 and 2 emissions using an intensity ratio'<br>9. 'Provide supporting explanations'<br>10. 'Choose and report on a base year. Your base year should be either the earliest year that verifiable emissions data is available for [or] a single year, or a multi-year average (e.g. 2006–2008)'<br>11. 'Develop a base year recalculation policy'<br>12. 'Set a reduction target and choose the approach to use' | |

*'Activity data' is human activity involved in creating emissions. Emissions factors are the quantifications of emissions units produced per unit of activity data.
$CO_2e$, $CO_2$ equivalent; UNFCCC, United Nations Framework Convention on Climate Change. See Table 8 and Appendix 1 for other abbreviations

## Appendix C: Implementation of Standards by Region

| Year | CCAR | DEFRA | EPA Climate Learder | EU ETS | GRI | IPCC guidelines | IPIECA/API | ISO | WBSCD/WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0% | 10.7% | 0% | 3.6% | 1.6% | 3.6% | 1.3% | 1.3% | 41.1% |
| 2008 | 0.4% | 12.8% | 0% | 3.6% | 3.0% | 6.2% | 1.6% | 4.2% | 47.7% |
| 2009 | 1.2% | 20.0% | 0.2% | 5.9% | 6.9% | 9.6% | 2.4% | 10.0% | 54.7% |
| 2010 | 0.4% | 23.7% | 0.8% | 5.1% | 5.7% | 8.9% | 1.9% | 8.3% | 66.8% |

Europe

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0% | 0% | 0% | 0% | 0% | 2.7% | 0% | 0% | 30.1% |
| 2008 | 0% | 0% | 0% | 0% | 0% | 2.6% | 0% | 2.6% | 30.8% |
| 2009 | 0% | 0% | 0% | 0% | 0% | 1.8% | 0% | 2.7% | 10.7% |
| 2010 | 0.8% | 1.7% | 0.0% | 0.0% | 0.8% | 4.1% | 0.0% | 5.8% | 28.9% |

Japan

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 2.9% | 0% | 13.5% | 0.4% | 0.8% | 2.9% | 4.1% | 0% | 55.5% |
| 2008 | 8.2% | 1.6% | 17.0% | 0.9% | 0.9% | 6.3% | 3.8% | 0.3% | 61.0% |
| 2009 | 16.2% | 1.3% | 26.4% | 0.7% | 1.7% | 10.6% | 5.6% | 2.6% | 71.3% |
| 2010 | 15.1% | 3.9% | 27.0% | 0.0% | 1.6% | 6.9% | 5.6% | 3.0% | 74.3% |

United States



**DOI**: 10.1002/bse

## Appendix D: Implementation of standards by industry

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0% | 6.8% | 2.7% | 0% | 1.4% | 4.1% | 0% | 2.7% | 45.9% |
| 2008 | 1.6% | 6.3% | 4.7% | 0% | 0.8% | 6.3% | 0% | 3.9% | 48% |
| 2009 | 0% | 15.1% | 7.5% | 0.9% | 3.8% | 8.5% | 0% | 7.5% | 58.5% |
| 2010 | 0.6% | 21.3% | 10.4% | 0.6% | 3.0% | 11.0% | 0% | 9.1% | 62.8% |

Consumer Discretionary

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0% | 6.2% | 6.2% | 1.2% | 1.2% | 8.6% | 0% | 0% | 54.3% |
| 2008 | 4.0% | 4.0% | 6.9% | 3.0% | 3.0% | 9.9% | 0% | 1.0% | 66.3% |
| 2009 | 5.0% | 9.0% | 12.0% | 4.0% | 4.0% | 16.0% | 0% | 4.0% | 64.0% |
| 2010 | 8.0% | 13.0% | 14.0% | 0.0% | 4.0% | 16.0% | 0.0% | 10.0% | 79.0% |

Consumer Staples

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 1.4% | 1.4% | 0% | 7.1% | 7.1% | 1.4% | 31.4% | 2.9% | 51.4% |
| 2008 | 4.9% | 1.0% | 0% | 7.8% | 5.8% | 6.8% | 27.2% | 3.9% | 47.6% |
| 2009 | 2.4% | 3.5% | 0% | 10.6% | 5.9% | 9.4% | 43.5% | 8.2% | 47.1% |
| 2010 | 6.0% | 4.8% | 1.2% | 7.2% | 4.8% | 6.0% | 42.2% | 10.8% | 44.6% |

Energy

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0% | 9.9% | 2.0% | 1.0% | 2.5% | 1.5% | 0% | 2.0% | 38.4% |
| 2008 | 0.3% | 13.4% | 2.1% | 0.3% | 1.7% | 3.8% | 0% | 4.8% | 41.9% |
| 2009 | 0.7% | 15.4% | 2.6% | 0.4% | 2.6% | 4.5% | 0% | 6.4% | 46.1% |
| 2010 | 2.1% | 17.9% | 5.1% | 0.4% | 3.4% | 9.8% | 0.0% | 8.1% | 66.0% |

Financials

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 2.2% | 0% | 6.5% | 0% | 2.2% | 0% | 0% | 0% | 56.5% |
| 2008 | 5.6% | 1.9% | 9.3% | 0% | 0% | 1.9% | 0% | 5.6% | 57.4% |
| 2009 | 6.5% | 4.8% | 12.9% | 0% | 3.2% | 6.5% | 0% | 8.1% | 67.7% |
| 2010 | 6.2% | 4.6% | 13.8% | 0.0% | 1.5% | 6.2% | 0.0% | 4.6% | 70.8% |

Health Care



**DOI**: 10.1002/bse

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0.7% | 4.0% | 4.6% | 1.3% | 1.3% | 1.3% | 0% | 0.7% | 41.1% |
| 2008 | 0.8% | 5.8% | 5.0% | 0% | 1.7% | 4.1% | 0% | 3.7% | 44.0% |
| 2009 | 4.7% | 11.1% | 4.7% | 1.7% | 5.1% | 8.5% | 0% | 10.3% | 54.7% |
| 2010 | 3.3% | 15.9% | 3.8% | 0.4% | 3.8% | 7.5% | 0.0% | 10.0% | 60.3% |

Industrials

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 3.1% | 0% | 9.2% | 0% | 0% | 12.3% | 0% | 0% | 52.3% |
| 2008 | 2.6% | 1.3% | 11.8% | 0% | 0% | 14.5% | 0% | 5.3% | 61.8% |
| 2009 | 5.6% | 5.6% | 13.9% | 0.9% | 1.9% | 18.5% | 0% | 16.7% | 65.7% |
| 2010 | 3.9% | 5.5% | 11.8% | 0.8% | 1.6% | 21.3% | 0.0% | 22.8% | 75.6% |

Information Technology

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0% | 1.1% | 2.1% | 2.1% | 0% | 9.6% | 0% | 3.2% | 47.9% |
| 2008 | 1.6% | 1.6% | 2.4% | 1.6% | 2.4% | 9.6% | 0.8% | 4.8% | 37.6% |
| 2009 | 2.3% | 2.3% | 3.8% | 3.0% | 3.0% | 16.7% | 1.5% | 6.1% | 52.3% |
| 2010 | 1.9% | 4.4% | 3.2% | 5.1% | 2.5% | 13.3% | 0.6% | 9.5% | 60.1% |

Materials

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 2.2% | 4.4% | 0% | 0% | 0% | 2.2% | 0% | 2.2% | 37.8% |
| 2008 | 4.3% | 4.3% | 2.1% | 0% | 0% | 4.3% | 0% | 4.3% | 55.3% |
| 2009 | 7.7% | 0% | 7.7% | 0% | 3.8% | 7.7% | 0% | 13.5% | 57.7% |
| 2010 | 5.6% | 8.3% | 5.6% | 0.0% | 2.8% | 8.3% | 0.0% | 16.7% | 69.4% |

Telecommunications

| Year | CCAR | DEFRA | EPA Climate Leaders | EU ETS | GRI | IPCC Guidelines | IPIECA/API | ISO | WBSCD / WRI |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 1.3% | 3.8% | 5.0% | 6.3% | 0% | 3.8% | 0% | 0% | 40.0% |
| 2008 | 3.8% | 5.7% | 6.6% | 7.5% | 0.9% | 13.2% | 0% | 3.8% | 38.7% |
| 2009 | 12.7% | 7.3% | 7.3% | 10.0% | 6.4% | 15.5% | 4.5% | 12.7% | 40.0% |
| 2010 | 13.9% | 7.4% | 3.7% | 12.0% | 5.6% | 13.0% | 4.6% | 9.3% | 50.0% |

Utilities



**DOI**: 10.1002/bse