An investigation of voluntary corporate greenhouse gas emissions reporting in a market governance system

Australian evidence

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Abstract
Purpose – Institutional governance theory is used to explain voluntary corporate greenhouse gas (GHG) reporting in the context of a market governance system in the absence of climate change public policy. This paper seeks to hypothesise that GHG reporting is related to internal organisation systems, external privately promulgated guidance and EU ETS trading.
Design/methodology/approach – A two-stage approach is used. The initial model examines whether firms' GHG disclosures are associated with internal organisation systems factors: environmental management systems (EMS), corporate governance quality and environmental management committees as well as external private guidance provided by the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) for 187 ASX 300 firms. EU ETS trading is also included. Determinants of the extent and credibility of GHG disclosure is examined in the second stage where an index constructed from the GHG reporting standard "ISO 14064-1" items for a sub-sample of 80 disclosing firms as the dependent variable.
Findings – Firms that voluntarily disclose GHGs have EMSs (uncertified and certified), higher corporate governance quality and publicly report to the CDP, tend to be large and in the energy and mining and industrial sectors. The credibility and extent of disclosures are related to the existence of a certified EMS, public reporting to the CDP, and use of the GRI. Firms that disclose more credible information are more likely to be large and in the energy and mining, industrial and services sectors.
Originality/value – The paper shows that some proactive but pragmatic Australian firms are disclosing their GHGs voluntarily for competitive advantage in the current market governance system in the absence of public policy.
Keywords GHG emissions disclosure, Environmental management systems, Governance, Carbon
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1. Introduction

Scientific evidence indicates that greenhouse gas (GHG) emissions from human related activities exacerbate global warming and associated harmful climate change (IPCC, 2007; United Nations, 1992). The United Nations developed the Kyoto Protocol (United Nations, 1997) – an international treaty that provides comprehensive mechanisms to address climate change through a mix of public policy, industry innovations and the introduction of a market value for carbon (Griffiths et al., 2007). The Australian government signed the Kyoto Protocol in 2007, yet a national policy framework to deal with global warming and associated climate change risks is yet to be implemented even though sections of Australian business and a majority of public opinion call for government action (Pearse, 2010)[1].

Distinguished economist Nicholas Stern makes the case for strong and urgent action to deal with climate change because the costs of early action will be lessened by avoiding the impact of climate change (Stern, 2006; Dietz et al., 2007) even though Australia currently has the highest per-capita emissions in the developed world and was one of only a few countries granted an increased emissions target under the1997 Kyoto Protocol (Pearse, 2009, p. 20). Australian industries are major contributors of GHG (GHG) emissions but little public policy has been successfully promulgated to guide large companies in addressing climate change (Pearse, 2009, 2010). Additionally, stakeholders, including shareholders and consumers, are pressuring companies to reduce their GHG emissions (Jeswani et al., 2008; Weinhofer and Hoffman, 2010). GHG

disclosures are therefore fundamental for corporate transparency to inform their investors, stakeholders and the public about how companies are mitigating risks and employing opportunities associated with climate change (CDP, 2009).

We introduce institutional governance systems theory (Griffiths et al., 2007) to examine hypothesised links between voluntary Australian corporate GHG disclosures, internal organisational systems (Adams, 2002) and private regulation that guide GHG disclosures as evidence of reported corporate response to climate change. Examples of influential private regulation of voluntary corporate GHG disclosures are the Carbon Disclosure Project (CDP) and the Global Reporting Initiative (GRI). In this study we evaluate how Australian corporations have responded to climate change by examining voluntary GHG emissions disclosure in 2007 – a point in time where global warming and climate change risks are acknowledged on the international stage as a significant issue for corporations (Griffiths et al., 2007; Lash and Wellington, 2007; Pearse, 2009; Pearse, 2010), and when a cap and trade scheme had been proposed, but before any mandatory reporting of corporate GHGs to a government agency pursuant to the National Greenhouse and Energy Act 2007 (NGER Act 2007) was required in 2008.

Using a two-stage process we first examine factors associated with the propensity of ASX 300 companies to disclose GHG emissions in a voluntary setting (model 1).

Second we test whether relationships exist between the extent and credibility of voluntary corporate GHG emissions disclosures, internal organisational systems and external factors likely to impact on GHG emissions disclosure (model 2). The credibility and extent of GHG emissions are measured by designing an index based on the guidance provided in ISO 14064-1 Greenhouse Gases – a standard that details guidance for GHG reporting "to enhance the credibility, consistency and transparency of GHG quantification, monitoring and reporting" (ISO, 2006, p. v)[2]. How the index is devised is discussed in section 5.

We find evidence of proactive corporate GHG disclosures within the "market governance system" in existence in Australia in 2007 where companies operated in a public policy vacuum in relation to climate change (Griffiths et al., 2007). Results of our two model analyses indicates that firms which disclose GHG emissions information (model 1) are more likely to have also implemented an environmental management system (EMS), have stronger governance systems, make publicly available disclosures to the CDP, are larger, and operate in either the energy and mining, or industrial sector. When we examine the extent and credibility of disclosures by the sub-sample of 80 firms that disclose GHG emissions data (model 2), we find they are more likely to have an EMS that is ISO 14001-certified, use the Global Reporting Initiative (GRI) to guide sustainability disclosures, and disclose to the CDP with those disclosures being publicly available.

In addition, larger firms in the mining and energy and industrial sectors are also more likely to disclose credible GHG emissions information guided by ISO 14064-1. Given the limited public policy at the time to assist companies in preparing for a low carbon economy, these results suggest that some Australian companies have taken a proactive stance motivated by addressing multiple risks posed by climate change (Dietz et al., 2007), thus maintaining international competitive advantage (Griffiths et al., 2007; Lash and Wellington, 2007) and "green" firm specific advantage (Kolk and Pinkse, 2008). These proactive but pragmatic companies have implemented internal organisational systems but also rely on external private guidance provided by CDP and GRI to publicly report their responses to climate change risks including GHG emissions data.

This research makes a number of contributions to the literature. It presents preliminary findings in an area where little evidence exists – the investigation of internal organisation systems, governance and use of private guidance (CDP and GRI), as determinants of GHG emissions reporting in a voluntary setting. The research also uses institutional governance systems theory – an emerging theoretical construct in the field – to develop an understanding about factors that are linked to corporate GHG emissions disclosure. This study also presents a more rigorous measure of disclosure than commonly used content analysis in prior research based on corporate disclosure guidance from, for example the GRI sustainability reporting guidelines. The GRI provides broader sustainability guidance for disclosure but includes only a small section on GHG emissions. Our study develops a comprehensive index using the specific guidance provided in ISO 14064 to assess the extent and credibility of GHG emissions disclosure.

Our study also contributes to public policy development by providing a better understanding of the current extent and credibility of public GHG reporting by the Australian corporate sector. The results point to evidence of a growing number of Australian firms proactively addressing climate change risks (Dietz et al., 2007) by implementing internal organisational systems (Adams, 2002) and voluntarily complying with non-government guidance to deal with GHGs, thus adapting to a carbon constrained society to maintain international competitive advantage (Griffiths et al., 2007; Lash and Wellington, 2007). It also highlights the diversity in disclosure practices in Australian firms under the voluntary setting that currently exists. Our results add weight

to the accounting profession's call for a regulatory framework to develop appropriate reporting and verification standards (CPA Australia, 2008).

Finally, business can benefit from evidence about the extent to which instituting an EMS, quality of governance, including an environmental management committee and use of the GRI to guide sustainability reporting can assist in developing a credible GHG emissions reporting system.
The paper proceeds as follows. Section 2 provides background to Australia's political response to climate change. An overview including the limited prior research into GHG emissions disclosure is discussed in section 3. Section 4 introduces institutional governance systems theory (Griffiths et al., 2007; Griffiths and Zammuto, 2005), which is used to explain Australian corporate GHG reporting in response to the challenge of transforming and adapting to a constrained carbon future, and the resulting hypotheses to be tested. Section 5 describes the sample, multivariate research design and data sources used, with the results of our two model analyses being reported in the penultimate section. The final section concludes with limitations and opportunities for future research.

2. Background: Australia's political response to climate change

Australian public policies to deal with global warming have been, so far, ad hoc and incoherent compared to countries that have more proactive climate change policies such as Germany and The Netherlands (Griffiths et al., 2007). Adams (2002) makes the point in her study of German companies that country of origin influences the nature and extent of corporate social responsibility disclosures or non-disclosures. The following examines the Australian political context for corporate disclosures regarding climate change.
While the Australian Labor Government (1982-1996) was ready to sign the Kyoto Protocol in 1997, it lost the 1996 election. Together with the US, the succeeding Coalition government (1996-2007) chose not to ratify the Kyoto Protocol, arguing that it did not present an effective long-term solution to reducing GHG emissions (Griffiths et al., 2007). The government was also under heavy influence of the fossil fuel lobby (Pearse, 2009; Sachs, 2009). The Coalition government's national response to climate change was minimal (Pearse, 2009). After public pressure, including from some sections of business, the government in 2006 proposed an emissions trading scheme (ETS) originally mooted for introduction in 2010 (Garnaut, 2008). To support the proposed ETS the NGER Act 2007 was introduced by the Coalition government just prior to a change of government in November 2007. From July 2008, large corporations are required to self-report their GHG emissions annually to the government regulator through the Online System for Comprehensive Activity Reporting (OSCAR)[3]. The incoming Labor government ratified the Kyoto Protocol on 3 December 2007 to enact their election promise to deal with climate change (Franklin et al., 2007). The government's central policy to tackle global warming was a proposed cap and trade scheme or the Carbon Pollution Reduction Scheme (CPRS) (Wong, 2008) originally developed by economist Professor Ross Garnaut (Garnaut, 2008). The proposed CPRS is a market-based solution to reduce GHG emissions through price signalling, thus encouraging business to invest in GHG reduction (Garnaut, 2008). The CPRS had many detractors however, particularly from the powerful mining and energy lobby who argued that their industries would lose competitive advantage if GHGs were priced (Pearse, 2009). After several amendments to the CPRS to appease the mining and energy industries, the revised CPRS was not supported by the federal Green party and many conservation groups, who argued that industrial polluters received too much compensation and too many free permits (Saulwick, 2009) – also a major weakness of the European Union emissions trading scheme (MacKenzie, 2009). Consequently, the legislation failed to pass parliament (Shanahan, 2010). The government has since set up a multi-party climate change committee, in addition to a separate business roundtable to develop a GHG reduction policy (Coorey, 2010) with the aim of introducing a carbon price in 2012.

3. Corporate disclosure of GHG emissions – an overview

Several studies have examined voluntary social and environmental disclosure (see for example, Patten, 1992; Roberts, 1992; Deegan and Rankin, 1996; Brown and Deegan, 1998; Deegan et al., 2000; Alciatore and Dee, 2006; Cho and Patten, 2007; Gibson and O'Donovan, 2007)[4]. Much of this work has been explained by legitimacy theory, and aims to understand corporate disclosures as a way to conform to societal expectations (Owen, 2008) or as a way of maintaining or regaining legitimacy. Owen (2008, p. 248) notes this work often offers "plausible interpretations of managerial motivations for disclosure with no attention paid as to how such disclosure may, or may not, promote transparency and accountability towards non-capital provider stakeholder groups".
Few studies, however, have specifically examined the link between organisational factors and GHG emissions disclosure in company reports. Stanny and Ely (2008) investigate US companies' responses (or not) to the CDP

questionnaire, Clarkson et al. (2008) examine the relationship between corporate environmental performance and the level of environmental disclosures, including carbon disclosures of large US polluting firms from a voluntary disclosure perspective. Prado-Lorenzo et al. (2009) also analyse factors underlying corporate disclosure of GHG emissions. Stanny and Ely (2008) utilise a dichotomous measure of disclosure, however Clarkson et al. (2008) and Prado-Lorenzo et al. (2009) develop a disclosure index based on GRI (2002) Sustainability Reporting Guidelines. As such their assessment of GHG emissions disclosure information is limited. We contribute to this work by developing a more robust index of GHG emissions disclosure from the guidance presented in ISO 14064.

Rather than responding to a changing "social contract", credible GHG emissions measurement and disclosure is one way companies can take a proactive stance in climate change risk reduction. The limited prior research that has examined GHG emissions disclosures have either done so in the context of broader environmental disclosures (e.g. Clarkson et al., 2008), disclosure to the CDP (e.g. Stanny and Ely, 2008) or have used the GRI to develop a measure of GHG emissions disclosure (e.g. Prado-Lorenzo et al., 2009). Our study makes a significant contribution to this prior work by improving the measure of GHG disclosures. We use a constructed index based on ISO 14064-1 to measure both the extent and credibility of GHG emission disclosures.

ISO 14064-1 Greenhouse Gases – Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals is the international standard that provides guidance at the organisational level for the quantification and reporting of GHG emissions. It details principles and requirements for designing, developing, managing and reporting organisational level GHG inventories (Weng and Boehmer, 2006).

Disclosure of GHG emissions has attracted increased public attention since the United Nations' Kyoto Protocol was issued, as a way to reduce GHG emissions associated with anthropogenic global warming and climate change. Stern (2006) argues that climate change is about risk and uncertainty. In fact BHP Billiton stated its concerns about personnel, physical, business and reputation risks resulting from climate change extreme weather events (CDP, 2007, p. 45):

> Our offshore petroleum assets are concerned about the potential for increased severity and frequency of storm events, which presents risks including impacts on personnel, as well as loss of business continuity, production interruption, lost or damaged facilities and reputation impact.

Bebbington et al. (2008) proposed that reputation risk management plays a plausible role corporate social responsibility reporting in the context of their analysis of Shell's (2002) report, since a corporation's reputation represents a valuable asset to attract and maintain powerful economic stakeholders (Unerman, 2008). Bebbington et al. (2008) also point to the complexity of measuring reputation that is often integral to the corporate brand, an intangible asset. Adams (2008) contends, however, that legitimacy like reputation is subjective as stakeholders make judgements about the company in terms of corporate social responsibility and reporting. Moreover, stakeholders' perceptions about a corporate reputation are often impression managed by corporate public relations; for example Origin energy employs a corporate reputation manager (see www.originenergy.com.au).

BHP Billiton's above statement, however, appears to give pragmatic priority to personnel and physical risks because of the direct impact on its operations, even survival of the business. For example, BHP Billiton (2007, p. 11) point to more specific and direct corporate risks and impacts of climate change in the following:

> The potential physical impacts of climate change on our operations are highly uncertain, and will be particular to the geographic circumstances. These may include changes in rainfall patterns, water shortages, changing sea levels, changing storm patterns and intensities, and changing temperature levels. These effects may adversely impact the cost, production and financial performance of our operations.

BHP Billiton see their exposure to climate-change risks as business risks that can be managed and mitigated while seeking new opportunities for profit, at the same time generating a competitive advantage over rivals in a carbon constrained future (Lash and Wellington, 2007). In a business-as-usual scenario, "executives typically manage environmental risk as a threefold problem of regulatory compliance, potential liability from industrial accidents, and pollutant release mitigation. But climate change presents business risks that are different in kind because the impact is global, the problem is long-term, and the harm is essentially irreversible" (Lash and Wellington, 2007, p. 3). BHP Billiton recognises the challenging business risks presented by climate change and have begun addressing climate change from a business perspective to enhance their future survival and growth (Kolk and Pinkse, 2008).

In summary, most prior research is framed within legitimacy theory to explain disclosure aimed at regaining or maintaining legitimacy. We introduce institutional governance systems framework (Griffiths et al., 2007; Griffiths and Zammuto, 2005) that examines contextual features of international competitive advantage to help understand the motivations of proactive corporate response to the challenges of climate change.

4. Theoretical framework and hypotheses development

4.1 Institutional governance systems theory

Griffiths et al. (2007, p. 416) argue that institutional governance systems "impact on, shape and are shaped by corporations and industry responses to climate change". An institutional governance system is defined as:

> [. . .] the configuration of state and private organizations and institutional arrangements that impact and create mechanisms by which economic and social outcomes in nations are produced (Griffiths et al., 2007, p. 416).

The authors note the global variations in national and industry response to climate change, and present the institutional governance systems perspective as a way to explain these differing responses for competitive advantage. They present the theory as a framework that can provide insights into corporate strategies for achieving GHG reductions by examining the role that institutional governance systems play in transforming these activities mainly for competitive advantage.

Their generalisable framework uniquely brings "politics, economics and other disciplinary traditions back into the study of national industrial competitiveness" (Griffiths and Zammuto, 2005, p. 839). The strategic management literature views decision making as operating through market forces or value chain integration, while the political economy literature sees it as occurring through state involvement (Griffiths and Zammuto, 2005; Griffiths et al., 2007). These perspectives are generally treated as competing; however the authors see them as parallel and complementary explanations of how governance systems are shaped regarding climate change decisions. The result is four institutional governance systems that can explain patterns of industry engagement and climate change decisions: market governance, state governance, corporate governance and joint governance (Griffiths et al., 2007)[5]. They propose the existence of a relationship between different governance systems and climate change action in terms of the institutional framework that affects the development of policies and capabilities to innovate, adapt and maintain international competitive advantage. In this study we apply this institutional governance framework to explore corporate GHG disclosures in the Australian context.

The Australian government's approach to climate change is one of a market governance system, which relies on market forces with minimal regulation anticipating corporate decision makers to achieve change and adapt to climate change voluntarily (Griffiths et al., 2007). A national policy framework based on voluntarism means that firms pursue individual climate change approaches at the prerogative of management to volunteer in industry or government sponsored sustainability programs (Griffiths et al., 2007). Firms, however, often view climate change activities as a cost rather than an opportunity (CDP, 2007, 2009). The lack of government policy allows industry and corporate lobbying of governments to protect resource access. Innovation to encourage GHG reduction is hampered by uncertainty created by a national policy framework based on volunteerism (Griffiths et al., 2007). Given the ad hoc and incoherent public policy response to climate change at this time, Australian companies have had little public authority or government-initiated regulation to guide their disclosure of climate-related activities including the measuring and reporting of GHG emissions.

In this political vacuum, a group of proactive corporate CEOs formed the Australian Business Roundtable on Climate Change in collaboration with the Australian Conservation Foundation urging government action to deal with climate change. The joint CEO statement in "The business case for early action" (Australian Business Roundtable on Climate Change, 2006, pp. 2-3) argued their concerns about the impacts of climate change on business[6]. The Roundtable suggested that business and governments work together to frame policies on three fronts:

(1) design a "long, loud and legal" framework to establish a carbon price signal;
(2) encourage innovation and investment in emerging and breakthrough technologies;
(3) build national resilience to the impacts of climate change.

The activities of corporations, reflected by the Australian Business Roundtable on Climate Change (2006), suggest a move may be imminent in Australia from a market governance system to a corporate governance system (Griffiths et al., 2007). In fact, the BHP Billiton chief executive recently stated that the company wants a predictable and gradual transition to a carbon price favouring a combination of a carbon tax, land use actions and limited carbon trading. He told the Australian Chamber of Commerce that:

> If we get a global price for carbon and we have got a carbon-intensive generation centre, companies like BHP Billiton that consume the energy will eventually lose their competitiveness because it will pay a higher price for its energy (Young, 2010).

In a corporate governance system, corporations take the lead role in dealing with climate change through economic activities "influenced by the market, the loss of reputation, [and] shareholder activism" (Griffiths et al., 2007, p. 419). The State may minimally intervene by establishing a carbon trading market or carbon tax. Under this system firms can reduce their risk, improve their reputational performance or seek carbon trading markets elsewhere. There is high corporate involvement in industry governance on climate change but with a focus on voluntary initiatives. Although corporations are more proactive in a corporate governance system, adaption to climate change is slow (similar to market governance) with little direct government regulation (Griffiths et al., 2007).

With minimal public policy guidance currently, some Australian companies have proactively implemented standards developed privately by non-government organisations such as the International Standards Organization (ISO), the CDP and the GRI. Companies such as BHP Billiton have been persuaded by the evidence that climate change is global crises that will impact on the survival of their business. These proactive companies are attempting to manage and mitigate climate change risks by implementing strategies and policies to deal with gas emissions and to develop specific initiatives that "green" firm specific advantages (Kolk and Pinkse, 2008).

These initiatives can also include internal governance responses such as an environmental committee, an environmental management system, or stronger corporate governance. It could also include private regulation developed by non-government organisations (NGOs) or initiated by concerned investor groups (Reid and Toffel, 2009) that support corporate GHG accounting and disclosure (Green, 2009). Examples of private or non-government guidance comes in the form of the GRI, ISO certification of an EMS (ISO 14001) and the CDP. Our study therefore examines evidence of the extent to which both internal and private or non-government guidance has influenced the measurement and disclosure of GHGs by Australian companies in the current market governance system that provides little public policy guidance (Griffiths et al., 2007).

Specific internal organisational systems are vital to enable companies to credibly monitor, measure and record emissions levels to mitigate risk associated with future regulatory requirements and changing societal expectations. For example, firms are likely to implement an EMS to provide systematic, credible information to be disclosed in company reports. Malmborg (2002) argues that an EMS not only provides companies with an environmental management tool, but also facilitates the company's communication to external stakeholders. Having an environmental committee as part of board committee structure is an important internal factor to provide governance to address climate change (Adams, 2002). In addition, these governance factors are also disclosure requirements of the Global Reporting Initiative [7] (GRI, 2006, see A1 Governance structure and management systems).

4.2 Hypotheses development

Few studies have examined internal organisational systems (Adams, 2002; Herschovis et al., 2009); we argue, however, that the credibility of corporate GHG emissions reporting relies on internal organisational systems such as environmental management systems (EMS) and the presence of an environmental committee, a subcommittee of the board. For companies to provide credible GHG disclosure, appropriate internal organisational systems are necessary to manage, monitor, measure, and report emissions.

4.2.1 EMS and GHG disclosure. Voluntary implementation of an EMS suggests a firm's commitment to better monitor, manage, measure and report environmental matters – including GHG emissions. Further, an EMS should assist enterprises in conducting cleaner production and better management of carbon emissions (Thornton and Hsu, 2001). Those firms with an EMS and associated cleaner production also shape public perceptions about their activities to reduce global warming. They are also in a better position to address business risks associated with climate change (Lash and Wellington, 2007) such as the mandatory reporting for the NGER Act 2007 and the potential impact of a proposed carbon price.

Thornton and Hsu (2001) contend that companies dealing with global warming need to introduce and develop their EMSs to gain better control of GHG emissions. Herschovis et al. (2009) view the EMS as a proxy for corporate strategy in line with a broader governance vision as indicated in the GRI as well as a similar to an internal control system used to support the veracity of financial reports.

A number of studies have investigated the link between EMS implementation and environmental performance (see for example Melnyk et al., 2003; Anandale et al., 2004; Khanna and Anton, 2002; Montiel and Husted, 2009); little research has examined the adoption of an EMS as a tool to enable measurement and disclosure of

GHGs. While prior research has found that the adoption of an EMS is primarily driven by external pressures such as powerful stakeholders (Anandale et al., 2004; Khanna and Anton, 2002), Malmborg (2002) emphasises that the EMS is a tool not only important for an organisation's environmental management tasks, but also for communicative action and organisational learning. An essential communicative role of the EMS is to provide information to enhance communication regarding a company's environmental and sustainable development in response to community concerns (Malmborg, 2002). Therefore the existence of a company EMS implies that environmental management accounting systems will serve both managerial and external reporting processes in response to both internal and increasing societal environmental concerns including investors.
EMS early adopters are more able to collect their emissions-related information to better measure, manage and report their GHG emissions (Montiel and Husted, 2009). Such firms with GHG emission information are more likely to be in an advantageous position to communicate their efforts about GHG emissions' reduction to powerful stakeholders such as investor institutions (Anandale et al., 2004) and the public generally. Accordingly, firms with an EMS are more likely to be in a position to voluntarily disclose GHG emissions data. Further, they are likely to be able to present more credible GHG information than those firms without an EMS.

> H1a. Firms that have voluntarily established an environmental management system (EMS) are more likely to voluntarily disclose credible GHG emissions information in their reports.

In addition to implementing an EMS, firms can seek external certification of their EMS through ISO 14001 to further demonstrate the quality of their management systems as well as providing more environmentally friendly products to their consumers (Adams, 2002). Provision of a variety of institutionalised practices to lessen pollution, such as ISO 14001 certification, represent management use of non-government guidance to demonstrate to stakeholders a proactive approach to climate change. Further, Morrow and Rondinelli (2002, p. 170) found in their survey of German companies that:

EMS implementation and certification do help companies to integrate their environmental, health and safety management systems and in some cases their environmental and quality management systems. Perhaps because EMS certification requires strong employee participation and environmental training programs, many firms report increased employee awareness of the environmental aspects of their jobs and of their responsibilities for reducing negative impacts. ISO 14001-certified companies also report environmental performance improvements, especially in the areas of waste recycling, air and waste emissions reductions, materials reuse, energy and water conservation, and environmental and safety incidence reduction.

ISO 14001 requires certifying companies to establish and maintain communication, both internally and externally. The external communication, which aims to manage a firm's relationship with external stakeholders, can be performed by providing disclosures in a number of different media, including the annual report, stand-alone sustainability report and internet (Whitelaw, 2004a, b). This is acknowledged by Patten and Crampton (2004), who provide evidence that companies' involvement in ISO 14001 leads to a higher level of environmental disclosures. Another requirement of ISO 14001 is to continuously update an EMS to cover current environmental issues related to the adopted firm. Consequently, increased stakeholders' concerns on climate change and associated GHG emissions are more likely to be addressed by firms with an ISO 14001 certified EMS in place than an uncertified EMS. Having a certified EMS is also more likely to address risk concerns of stakeholders:

> H1b. Firms that have voluntarily implemented ISO 14001 certified EMS are more likely to voluntarily disclose credible GHG emissions information in their reports.

4.2.2 Corporate environment committee and GHG disclosure. The presence of a company environment committee suggests a firm's concern about managing GHG emissions to enhance their environmental reputation (Neu et al., 1998) particularly in the eyes of powerful stakeholders (Anandale et al., 2004). A company's environment committee, however, shows evidence of proactive corporate governance to guide the organisational long-term strategy towards a more carbon constrained future.
Hence a major aim of an environment committee is to motivate a firm to implement policies and practices to measure and report on GHG emissions levels. The environment committee is likely to see the importance of this GHG reporting to their public, government and financial stakeholders, amongst others and as a way of reducing risk associated with increased regulation and business operations related to global warming. Firms with an environment committee are also more likely to publicly disclose their emissions levels, and present

more credible disclosure, in a voluntary disclosure regime to indicate their commitment to climate change (Ashforth and Gibbs, 1990). Cowen et al. (1987) provide evidence of specific committee-disclosure relationships, finding an association between the existence of a corporate social responsibility committee and human resource disclosure:

> H2. Firms that have voluntarily introduced environment committees as part of the board are more likely to voluntarily disclose credible GHG emissions information in their reports.

4.2.3 Governance and GHG disclosure. Corporate governance practices are of significant importance when considering the extent to which companies are to proactively address the climate change agenda. Corporate governance relates to the development of long-term strategy in addition to information disclosure and transparency, and responses to strategic issues such as climate change (Galbreath, 2010). It also impacts on the uses to which organisational resources will be deployed (Galbreath, 2010; Hendry and Kiel, 2004; Kiel and Nicholson, 2005). Galbreath (2010) finds that how boards are structured appears to affect how well governance practices address climate change. The author also observes that the institutional environment will impact on the quality of climate change governance, and encourage firms to be proactive in pursuing avenues to address climate change. Following this, we hypothesise that the quality of board governance will affect the disclosure of GHG emissions data, with companies having strong governance being more proactive in their disclosure strategies:

> H3. Corporate governance quality is positively associated with credible GHG emissions information.

4.2.4 Use of GRI and GHG disclosure. The GRI was launched in 1997 as an initiative to develop a globally accepted reporting framework to enhance the quality of sustainability reporting (GRI, 2006) with the aim to enhance transparency, comparability and clarity, amongst other principles. We argue that firms that utilise the GRI as guidance to produce sustainability information are proactive in subscribing to private regulation, and are more likely to also embrace climate change as an issue addressing their organisation. They are consequently more likely to demonstrate their commitment to climate change by disclosing more credible GHG emissions in their publicly available reports:

> H4. Firms that report sustainability information in accordance with the GRI are more likely to voluntarily disclose credible GHG emissions information in their reports.

4.2.5 Disclosure to the CDP and GHG disclosure. Firms are challenged by the social, environmental and regulatory pressures as stakeholders including institutional investors voice their concerns about the economic, financial and regulatory risks of global warming (CDP, 2009). This study is undertaken in a currently uncertain regulatory setting prior to any mandatory reporting of emissions by Australian companies; hence non-government organisations such as the CDP attempt to increase and improve corporate reporting associated with climate change through civil regulation. In effect, the CDP is a voluntary effort to encourage standardised reporting procedures for companies to provide investors relevant information relevant about the business risks, opportunities from climate change (Kolk et al., 2008). The CDP represents several large investors with assets of over $US55 trillion and is supported by institutional investors such as the Investor Group on Climate Change, Goldman Sachs JB Were, Catholic Super and Booz and Company (CDP, 2009). These investors are concerned about the risks associated with climate change, thus are calling for more information about how companies are addressing the challenges of climate change. CDP questions companies about their disclosure policies particularly in regard to lowering emissions and climate change resilience.

Recent research has shown that the CDP has influenced corporate GHG disclosure; for example Okereke (2007) observed that the top UK companies began to disclose their actions to reduce GHG emissions as a result of increased pressure from powerful institutional investors supported by institutions such as the CDP, the Sustainable and Responsible Investment (SRI) Fund and the Institutional Investors Group on Climate Change (IIGCC). Using global governance, institutional and commensuration theories, Kolk et al. (2008) analysed company disclosures of greenhouse gases in response to the CDP questionnaire for years 2003-2007. They found responses to the CDP are impressively growing and corporate GHG disclosure has achieved some progress in technical terms, but acknowledge the problems of self-reporting, the lack of rigorous GHG disclosure guidelines and associated global regulation.

We argue that firms responding to the CDP, a form of private regulation comprising institutional investor pressure (Kolk et al., 2008), are more likely to publicly disclose their GHG emissions information to the public.

In addition, these firms are more likely to be in a position to present more credible information, given the measurement and reporting practices they currently have in place to be able to respond to the CDP:

> H5. Firms that voluntarily respond to the CDP are more likely to present more credible GHG emissions information in their reports.

4.2.6 EU emissions trading scheme and GHG disclosure. Although Australia does not require GHG emissions company disclosure yet, firms that have sites subject to the European Union Emissions Trading Scheme (EU ETS) are required to report their emissions to that jurisdiction. EU ETS in effect represents indirect regulation of these participating firms regarding emissions internal policies and disclosure. We anticipate that these companies are more likely to have systems in place to measure and report GHG information across the corporation, and will disclose more credible information in their public reports:

> H6. Firms that trade in the EU ETS are more likely to voluntarily report more credible GHG information in their reports.

5. Research design

5.1 Data and sample

To test our hypotheses relating to proactive approaches of S&P ASX300 Australian companies in a voluntary setting, annual reports and stand-alone environment or sustainability reports for the year 2007 are examined for this archival study [8]. The year 2007 is prior to mandatory reporting for Australian companies [9], hence represents a voluntary company reporting context. The NGER Act 2007 requires eligible Australian firms to report GHGs by 1 July 2008.

The sample includes a cross-section of Australian firms participating in the S&P ASX300 index, in line with the mandatory reporting requirements detailed in the NGER Act 2007. The initial sample consisted of the 295 firms [10] recorded in the ASX300 as at 26 August 2008. A total of 108 companies were removed from the sample for a number of reasons including: the company is not listed for the entirety of 2007 (four firms); the company is a subsidiary of another firm already represented in the sample (12 firms); or insufficient data are available for all testing requirements (92 firms). A final sample of 187 firms results from this process, of which 80 companies (42.8 per cent) report GHG emissions in their 2007 company reports.

5.2 Measurement of variables

5.2.1 Dependent variable – disclosure index based on ISO 14064-1. Where companies disclose GHG emissions information, the extent and credibility of that disclosure is measured using a disclosure index (see also Prado-Lorenzo et al., 2009; Clarkson et al., 2008; Stanny and Ely, 2008; Freedman and Jaggi, 2005). An index is constructed based on guidance presented in ISO 14064-1 Greenhouse Gases – Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals. The ISO 14064 range of standards were published in 2006 to provide government and industry with a set of tools aimed at measuring and reducing carbon gas emissions, as well as set the basis for emissions trading (Standards Australia, n.d.). ISO 14064-1 presents a more comprehensive guide to quantification and reporting of GHG emissions data than the GRI, which is aimed at a broader range of sustainability reporting. As such, the ISO 14064-1 guidelines present the most appropriate basis on which to develop an index of credible and consistent GHG emissions disclosure. The index is based on disclosure requirements outlined in Section 7 of ISO 14064-1, which presents guidance on what should be included in a publicly available GHG report. The contents of a GHG report are outlined in Section 7.3 of ISO 14064-1. The index is presented in Appendix, Table AI.

Points were allocated for all items included in section 7.3 of the ISO guidelines, with the exception of some generic items such as: a description of the reporting organisation (7.3.1 a); and a range of disclosures that were only required if deemed appropriate by the company under Section 7.3.2 such as: CO_2 emissions from the combustion of biomass; purchased or developed GHG emission reductions and removal enhancements; a description of applicable GHG program requirements; and if quantified, other indirect GHG emissions. As these items are not likely to relate to all sample firms they are not included in the index.

The range of items represented in the index include: the reporting period covered; documentation of organisational boundaries; quantification of both direct and indirect GHG emissions; the historical base year selected; a description of the organisation's GHG policies, strategies or programs; a statement describing assurance or verification of the GHG report or inventory; and assessment of performance against relevant internal and/or external benchmarks. A value of one was attributed to those items where the guidelines

indicated they should be included, but did not indicate any further explanation is required. An example of this would be 7.3.1 c – the reporting period covered. Where the ISO guidelines indicate some explanation is required, an assessment of the extent and/or quality of description is assessed/weighted using a scale of 1 to 5. An example of this is 7.3.1 h – an explanation for exclusion of any GHG sources or sinks from quantification. The maximum score available is 36 points.

We used two steps to ensure reliability when applying the disclosure index. Initially all members of the research team applied the index to a sample of ten corporate reports then compared their results. Any discrepancies were discussed and a consensus reached on the most appropriate application. Once one researcher had completed the collection of data a further sample of ten reports was reviewed by a second team member to ensure the index had been applied as initially agreed. Both researchers agreed within one point in this instance.

5.2.2 Independent variables. To assess the hypothesised factors of GHG disclosure a range of internal systems and governance factors, and potential external influences on disclosure are measured. To address Hypotheses 1a and 1b, the existence of an environmental management system (EMS) is measured as a categorical variable where firms are classified into three groups: firms with no EMS; firms having a non-certified EMS; and firms having an ISO 14001-certified EMS. In coding the EMS variable, the definition of an EMS provided by the United Nations was used. It describes EMS as "systematic planning, implementation and control activities in order to achieve continual improvement of corporate environmental performance" (United Nations, 2001, p. 176). Data are derived from either annual report or sustainability report disclosures [11].

The presence of an environmental committee (ENV_COM) is measured as a dichotomous variable, with information gained from the Directors' report.

To measure corporate governance we use the WHK Horwath Corporate Governance Report for 2008[12]. The report documents the results of a well-known (Linden and Matolcsy, 2004) corporate governance scoring scheme. It was first produced in 2002 as a way of providing an independent assessment of the corporate governance structures of Australia's largest 250 companies (Horwath, 2008). It focuses on the independence of the board and its committees, using publicly available information and related-party disclosures as its primary sources (Linden and Matolcsy, 2004). The report relies on the definition of corporate governance provided by the ASX Corporate Governance Council (2007) and examines systems and processes that can help companies to: monitor and assess risk; optimise performance; create value; and provide accountability (Horwath, 2008). Companies are ranked individually according to clarity of corporate governance disclosures in addition to a range of factors identified in national and international best practice, including: the USA Blue Ribbon Committee Report (Blue Ribbon Committee on Improving the Effectiveness of Audit Committees, 1999); the UK Hampel Report (Hampel Committee (Committee on Corporate Governance), 1998); the OECD Report (OECD, 2001); the UK Higgs Report (Higgs, 2003); the Australian Ramsay Report (Ramsay, 2001), Investment and Financial Services Association of Australia Corporate Governance Guide (Investment and Financial Services Association, 2003) and the ASX Corporate Governance Council Report (2007) (Howarth, 2008). Central to the Horwath scoring system is the level of independence of the board of directors, their associated committees and external auditor (Horwath, 2008). The Horwath report has been used by a number of studies as an indication of governance quality (see for example Beekes and Brown, 2006; Gallery et al., 2008; Goodwin et al., 2009). The Governance score (GOV) ranges between 1 allocated to sample firms with the strongest governance, and 250 to those with the weakest.

Companies which utilise the Global Reporting Initiative (GRI) guidelines to report sustainability information are anticipated to provide a greater level of credible carbon emissions information. While carbon emissions disclosures plays a relatively small focus in the GRI requirements, and therefore the GRI guidelines are not used as a measure of carbon emissions disclosure in the development of our index, we do examine use of the GRI as a determinant of carbon disclosures as it represents corporations embracing sustainability reporting as an important organisation goal, and hence the move towards a "corporate governance" system from a "market governance" system. GRI is a dichotomous variable which indicates firms which use the GRI to guide the production of sustainability reports as one; and zero otherwise. Disclosure to the CDP and trading on the EU ETS are external factors likely to impact on sample firms' recording and reporting of GHG emissions information. The CDP web site makes available companies' responses to their questionnaire. In addition it documents where companies have provided a response but wish it to remain not available to the public, as well as those firms who did not respond to the questionnaire. Disclosure to the CDP is a categorical variable where firms are categorised as not responding; responded to the CDP but wish their response to be not publicly available; and provided a publicly available response.

Whether a sample firm has sites subject to the EU ETS was determined from a number of sources. A search of the Community Independent Transaction Log on the European Commission EU ETS web site revealed a

number for sample firms with installations subject to the EU ETS. In addition, a search of company annual reports, stand-alone reports and web sites, and responses to the CDP revealed further data.

5.2.3 Control variables. Firm size, industry, and two performance measures – return on assets and leverage – are used as control variables in the study. Larger companies are more likely to provide voluntary disclosures as they undertake more activities that affect the environment, thus attracting greater public and government scrutiny (Stanny and Ely, 2008; Prado-Lorenzo et al., 2009). Moreover these large firms generally have more shareholders who may be interested in the firm's social and environmental activities (Cowen et al., 1987). Consequently, as larger firms attract greater scrutiny from stakeholders, we argue they are more likely to provide voluntary GHG emission disclosures to alleviate the potential future regulation risks. In addition, we propose they are likely to present more credible disclosures.

Other studies have demonstrated the size-disclosure association (see for example Patten, 1991, 1992; Hackston and Milne, 1996; Patten and Crampton, 2004; Walden and Stagliano, 2004; Alciatore and Dee, 2006; Clarkson et al., 2008). Larger firms are more likely to voluntarily discloseGHGemissions, and are likely to attract more scrutiny from financial and other stakeholders with regards to riskiness of investment. Powerful stakeholders will be concerned about the effect of global warming on future operations and consequent resource flows (Hybels, 1995). The natural logarithm of market capitalisation for sample firms is used to represent firmsize (SIZE) to alleviate the impact of outliers and the high level of skewness of the raw data (Tabachnick and Fidell, 2007).

Some industries are more likely to generate greater public and regulatory concern; particularly those industries where business operations emit greater levels of harmful GHGs (see PWC, 2008). Control of GHG emissions more directly affect the extractive and energy industries, or those industries which rely on fossil fuels, including coal, oil, automobiles, power generation and airlines (Kolk et al., 2008) As such they face greater business risk in this regard. Firms in the energy sector also face significant competitive risk as a result of research and development to low emission technologies (Kolk and Pinkse, 2008). Other energy-intensive sectors include cement, paper, agriculture and aluminium (Kolk et al., 2008) – all included in our "industrials" category.

Mixed evidence is presented by studies of industry categories and their association with environmental disclosures. Patten (1991), Roberts (1992), Hackston and Milne (1996), and Patten and Crampton (2004) have all demonstrated an industry-disclosure association. Industry (IND) is categorised for analysis purposes into four industry groups based on similarities in the nature of the industry, as illustrated in Table I. Industry categories and all financial data utilised in this study are collected from the Aspect Huntly FinAnalysis database.

Return on assets (ROA) is a proxy for firm financial performance (Clarkson et al., 2008) and is measured as the ratio of income before interest and tax at the end of the period to total assets at the beginning of the period. Lang and Lundholm (1993) note firms that have performed well are more likely to "announce" their superior performance to the financial market. Consequently Clarkson et al. (2008) conclude that profitable firms are more likely to provide environmental disclosures. Conversely, Neu et al. (1998) find that unprofitable companies tend to utilise environmental disclosures for legitimacy purposes.

Leverage (LEV) is included to control for the likelihood that firms with high leverage provide greater levels of discretionary disclosures (Clarkson et al., 2008). Roberts (1992) suggests that firms should manage creditors" impressions, as creditors are vital stakeholders. The more a firm relies on funding from creditors, the more likely the firm is to address creditors' expectations regarding corporate responsibility activities by using voluntary disclosures. Alciatore and Dee (2006) also support the relationship between high leverage firms and higher levels of environmental disclosures. Leverage is measured as the ratio of total debt to total assets at the end of fiscal year 2007 (Clarkson et al., 2008).

Table I. Industry categories

	Total sample	
Industry group	Frequency	Per cent
Energy and Mining	61	32.6
Industrials	33	17.6
Consumer	36	19.3
Services	57	30.5
Total	187	100

5.3 The models

In our study we present two models. The initial model measures the propensity for firms to disclose (or not) GHG emissions, hence a binary-choice logit model is used. The second model, which comprises the index based on the ISO 14064-1, previously outlined, represents a more complex measure of the dependent variable that captures the extent and credibility of GHG reporting by those firms which disclose GHG emissions. The initial binary-choice logit model (model 1) testing a dichotomous measure of VEmD on the whole sample of 187 firms is as follows:

$$\begin{aligned} \mathrm{VEmD} = f(\alpha + \beta_1 \mathrm{EMS} + \beta_2 \mathrm{D}_{\mathrm{ENV\_COM}} + \beta_3 \mathrm{GOV} + \beta_4 \mathrm{D}_{\mathrm{GRI}} \\ + \beta_5 \mathrm{CDP} + \beta_6 \mathrm{D}_{\mathrm{EUETS}} + \beta_7 \mathrm{SIZE} + \beta_8 \mathrm{IND} + \beta_9 \mathrm{ROA} + \beta_{10} \mathrm{LEV} + \varepsilon) \end{aligned} \quad (1)$$

where:

VEmD = Adichotomous variable of GHG emissions disclosure which equals 1 if the firm voluntarily discloses GHG emissions; and 0 otherwise.
EMS = a vector of EMS category variables, which includes n = 3 categories: firms having no EMS, having a non-certified EMS and having an EMS that is ISO 14001 certified.
D_{ENV_COM} = dummy variable of environment committee which = 1 if the firm has a specific environment committee, 0 otherwise.
GOV = the Governance score allocated by the Horwath (2008) report.
D_{GRI} = dummy variable of GRI which = 1 if the firm uses the GRI to guide sustainability reporting, 0 otherwise.
CDP = a vector of CDP category variables, which includes n = 3 categories: no reporting to CDP, reported but not publicly available and a report to the CDP which is publicly available in 2007.
D_{EUETS} = dummy variable which= 1 if firm participates in the EU ETS, 0 otherwise.
SIZE= natural logarithm of market capitalisation.
IND = a vector of industrial category variables, which includes n = 4 categories: energy and mining, industrials, consumer and services.
ROA = return on assets, measured as the ratio of income before interest and tax at the end of fiscal year 2007 and total assets at the end of fiscal year 2006.
LEV= leverage, measured as the ratio of total debt divided by total assets at the end of fiscal year 2007.

The second stage of our study uses an OLS regression to examine the link between the extent and credibility (as described in the ISO 14064-1 standard) of voluntary GHG emissions disclosure and the independent variables of interest for the sub-sample of 80 firms that disclose GHG emissions data. The use of only firms that disclose GHG emissions introduces sample selection bias into our model as a result of a self-selection bias (Heckman, 1979). To correct for sample selection bias, the Heckman correction factor (LAMBDA) is calculated in accordance with Heckman (1979), and following guidance by Smits (2003). Model 2 is as follows:

$$\begin{aligned} \mathrm{CredVEmD} = \alpha + \beta_1 \mathrm{EMS} + \beta_2 \mathrm{D}_{\mathrm{ENV\_COM}} + \beta_3 \mathrm{GOV} + \beta_4 \mathrm{D}_{\mathrm{GRI}} + \beta_5 \mathrm{CDP} \\ + \beta_6 \mathrm{D}_{\mathrm{EUETS}} + \beta_7 \mathrm{SIZE} + \beta_8 \mathrm{IND} + \beta_9 \mathrm{ROA} + \beta_{10} \mathrm{LEV} \\ + \beta_{11} \mathrm{LAMBDA} + \varepsilon \end{aligned} \quad (2)$$

where:

CredVEmD = the extent and credibility of voluntary GHG emissions disclosure based on ISO 14064-1.
a = constant term.
EMS = a vector of EMS category variables, which includes n = 3 categories: firms having no EMS, having a non-certified EMS and having an EMS that is ISO 14001 certified.
D_{ENV_COM} =dummy variable of environment committee which = 1 if the firm has a specific environment committee, 0 otherwise.
GOV = the Governance score allocated by the Horwath (2008) report.
D_{GRI} = dummy variable of GRI which ¼ 1 if the firm uses the GRI to guide sustainability reporting, 0 otherwise.
CDP = a vector of CDP category variables, which includes n = 3 categories: no reporting to CDP, reported but not publicly available and a report to the CDP which is publicly available in 2007.
D_{EUETS} = dummy variable which = 1 if firm participates in the EU ETS, 0 otherwise.
SIZE = natural logarithm of market capitalisation.

IND = a vector of industrial category variables, which includes n= 4 categories: energy and mining, industrials, consumer and services.
ROA = return on assets, measured as the ratio of income before interest and tax at the end of fiscal year 2007 and total assets at the end of fiscal year 2006.
LEV = leverage, measured as the ratio of total debt divided by total assets at the end of fiscal year 2007.
LAMBDA = the Heckman correction factor which accounts for sample selection bias.
1 = error term.

6. Results

6.1 Descriptive statistics

Tables II–IV reveal summary details of the dependent variable employed in the study.

Table II shows that 80 of the total 187 sample of ASX 300 firms (42.8 per cent) voluntarily disclose GHG emissions information. This is substantially greater than Simnett and Nugent's (2007) observations of 10 per cent of firms disclosing emissions in 2005.

A total of 59 per cent of firms in the energy and mining sector, and 45.5 per cent of industrial firms provided some form of GHG emissions disclosure (see Table III). This is substantially higher than firms in the consumer or services industries, where GHG emissions information was provided by 30.6 per cent and 31.6 per cent of sample firms respectively. This confirms a suggestion by PWC (2008) that firms in the energy and mining sectors are better prepared to move towards meeting mandated government measurement and disclosure requirements in the future.

Summary statistics relating to the extent and credibility of these disclosures, pursuant to the disclosure index is presented in Table IV. Points gained range from 1 to a maximum of 28, with a mean of 5.56 points. The disclosures are heavily skewed to the lower range, and indicate a large variability in the extent and credibility of GHG emissions disclosure (skewness of 5.989 points). Disclosures range from merely discussing firm awareness of GHGs issues; through policy and plans to reduce GHGs emissions, to including quantitative information comprising the amount of GHGs emissions and GHGs reduction achievements compared to a predefined target. Consistent with surveys conducted by the GRI, we find that a number of the disclosing firms acknowledge the importance of the climate change issue.

Table II. Characteristics of dependent variables – voluntary emissions disclosure (VEmD)

	Frequency	Per cent
No GHG disclosure	107	57.2
Provided GHG disclosure	80	42.8

Note: n=187

Table III. Characteristics of dependent variables – voluntary emissions disclosure by industry

		Disclosed emissions		No emissions disclosure	
Industry	n	Frequency	Per cent	Frequency	Per cent
Energy and Mining	61	36	59.0	25	41.0
Industrials	33	15	45.5	18	54.5
Consumer	36	11	30.6	25	69.4
Services	57	18	31.6	39	68.4

Note: n=187

Table IV. Characteristics of dependent variables – disclosure statistics for disclosing sample – ISO14064-1 Index (CredVEmD)

Mean	SD	Maximum	Minimum	Skewness	Kurtosis
5.560	5.989	28	1	1.867	3.351

Note: n=80

Tables V-VII present descriptive statistics for the independent variables, with the exception of industry, which was presented in Table III. Nominal independent variables are reported in Table II. Of the 187 observed firms, a total of 80 (42.8 per cent) have an EMS in place with 29 firms (15.5 per cent of the total sample) having ISO

14001 certification. When the disclosing sample of 80 firms was considered however, 68.8 per cent had implemented an EMS, with 22 firms (27.5 per cent of disclosing firms) achieving ISO 14001 certification. Only 18.7 per cent (35 firms) possess a specific environment committee to deal with environmental issues; however this reflects 31.3 per cent of sample firms that disclose emissions information. Firms which use the GRI as a guide to inform sustainability reporting account for 16.6 per cent of the total sample (31 firms), however they account for 33.7 per cent of disclosing firms. A total of 49 sample firms (26.2 per cent) present information to the CDP, with 21.4 per cent (40 companies) making their response publicly available. When the 80 GHG disclosing firms are considered, the proportion that provides a response to the CDP increases to 47.5 per cent, with 40 per cent (32 firms) making their responses publicly available. A small proportion of sample firms (5.9 per cent of the total sample and 10 per cent of the disclosing sample) trades on the EU ETS.

Table V. Characteristics of independent variables – nominal variables

	Full sample ($n = 187$)		Disclosing firms ($n = 80$)	
	Frequency	Per cent	Frequency	Per cent
Environmental management system (EMS)				
No EMS	107	57.2	25	31.3
Have an uncertified EMS	51	27.3	33	41.3
Having an ISO14001 certified EMS	29	15.5	22	27.5
Environment Committee (ENV_COM)				
Not having an environment committee	152	81.3	55	68.8
Having an environment committee	35	18.7	25	31.3
Uses GRI for sustainability disclosure (GRI)				
No GRI	156	83.4	53	66.3
Uses GRI	31	16.6	27	33.7
Disclosure to Carbon Disclosure Project (CDP)				
No response to CDP	138	73.8	42	52.5
Response to CDP not publicly available	9	4.8	6	7.5
Response to CDP publicly available	40	21.4	32	40.0
Trade on EU ETS (EU ETS)				
Do not have a site subject to EU ETS	176	94.1	72	90.0
Have a site subject to EU ETS	11	5.9	8	10.0

Notes: Gov=governance index score; SIZE=firm size measured as log of market capitalisation; ROA=return on assets; LEV=leverage

Table VI. Characteristics of independent variables – continuous variables – full sample

Variable	Mean	SD	Maximum	Minimum	Skewness	Kurtosis
GOV	110.11	70.227	250	1	0.103	−1.151
SIZE	21.455	1.336	26.035	19.724	0.969	0.619
ROA	0.156	0.257	2.180	−0.326	3.698	22.912
LEV	0.299	0.222	1.272	0.001	1.136	1.796

Notes: n=187; Gov=governance index score; SIZE=firm size measured as log of market capitalisation; ROA=return on assets; LEV=leverage

Tables VI and VII present descriptive statistics for continuous variables for the full sample and disclosing firms respectively utilised in the analysis. Governance scores for sample firms ranged from 1 (highest quality) to 250 (lowest quality), indicating substantial variation across the sample. The average governance score of the total sample was 110 and the disclosing sample was 87. The firms range in size from a market capitalisation of around $37 million to $203 billion (unreported), indicating a high variability in firm size. A similarly high variability was shown in the level of return on assets (ROA) and leverage (LEV). On average the sample firms booked 15.6 per cent return on assets (ROA) in 2007. Interestingly, firms in the disclosing sample had a lower mean of 12.6 per cent. On average, 30.5 per cent of the sample firm assets were funded by debt (LEV). ROA and LEV indicated high levels of positive skewness in their distribution. In addition, ROA and LEV recorded high and positive kurtosis. Waternaux (1976) and Tabachnick and Fidell (2007), however, note that in a large sample deviations of skewness and kurtosis values from normality often do not cause an essential impact in analysis. Moreover, Leech et al. (2008) and Tabachnick and Fidell (2007) emphasise that this distributional

assumption is not required for logistic regression. Accordingly, non-normal distributions of predictor variables are not likely to affect the analysis for the full sample; however results of OLS analysis of the disclosing sample will need to be viewed with caution with regards to these variables.

Table VII. Characteristics of independent variables – continuous variables – disclosing firms

Variable	Mean	SD	Maximum	Minimum	Skewness	Kurtosis
GOV	86.710	62.482	232	1	0.407	−0.838
SIZE	22.039	1.460	26.035	19.809	0.572	−0.057
ROA	0.126	0.114	0.571	−0.147	1.216	2.759
LEV	0.305	0.219	1.272	0.001	1.804	4.782

Notes: n=80; Gov=governance index score; SIZE=firm size measured as log of market capitalisation; ROA=return on assets; LEV=leverage

6.2 Multivariate analysis

Results of multivariate analysis, using logit to examine the factors related to the likelihood of providing voluntary GHG emission disclosures are presented in Table VIII. Goodness-of-fit tests were also conducted to determine if the model significantly predicted the likelihood of the hypothesised variables predicting voluntary emissions disclosure. The chi-square value of 80.923 is significant at p . 0:000, suggesting that the model was able to distinguish those Australian firms that disclosed GHG emissions from those that did not. More than 77 per cent of cases (77.5 per cent) were correctly classified by the model. Pseudo R^2 values show that the model was able to explain between 35.1 per cent (Cox and Snell R^2) and 47.2 per cent (Nagelkerke R^2) of the variance in the voluntary GHG emissions disclosing status of the sample firms.

The voluntary emissions disclosure model in the initial stage of analysis offers evidence that the existence of an EMS, a certified EMS, quality governance, public disclosure to the CDP, firm size, and operating in the energy and mining and industrials sectors explain those firms' decision to disclose. The results indicate the firms are more likely to present voluntary emissions disclosures when they have an EMS in place. In addition, firms with ISO 14001 certified EMSs are more likely to voluntarily provide GHG emissions disclosure than those with either no EMS or an uncertified EMS. Corporate governance is associated with the decision to disclose GHGs, where firms with quality governance being more likely to disclose. The board having an environmental sub-committee is not associated with the decision to disclose. Firms which provide publicly available data to the CDP are more likely disclose GHG emissions data.

Table VIII. Logistic regression voluntary GHG emissions disclosure full sample

	Pred. sign	B	SE	Wald	Sign. (p)
Uncertified EMS	+	0.912	0.481	3.589	0.058*
Certified EMS	+	1.186	0.611	3.775	0.052*
ENV_COM	+	−0.253	0.574	0.195	0.659
GOV	−	−0.006	0.003	3.292	0.070*
GRI	+	0.982	0.698	1.979	0.159
CDP not public	+	0.569	0.984	0.334	0.563
CDP public	+	0.569	0.660	3.291	0.070*
EUETS	+	0.364	0.892	0.166	0.683
SIZE	+	0.407	0.198	4.217	0.040**
IND_Energy&Mining	+	1.476	0.641	5.304	0.021**
IND_Industrials	+	1.104	0.657	2.823	0.093*
IND_Services	+	−0.350	0.615	0.323	0.570
ROA	+/−	−0.598	0.933	0.411	0.521
LEV	+	0.528	0.937	0.318	0.573
Constant	+/−	−2.736	4.931	0.308	0.579

n=187; *$p > 0.1$; **$p > 0.05$ (two-tailed); EMS=a vector of EMS category variables, which includes n=3 categories: firms having no EMS, having a non-certified EMS and having an EMS that is ISO 14001 certified; D_{ENV_COM}=dummy variable of environment committee which =1 if the firm has a specific environment committee, 0 otherwise GOV=the Governance score allocated by the Howarth (2008) report ; D_{GRI}=dummy variable of GRI which =1 if the firm uses the GRI to guide sustainability reporting, 0 otherwise; CDP=a vector of CDP category variables, which includes n=3 categories: no reporting to CDP, reported but not publicly available and a report to the CDP which is publicly available in 2007; D_{EUETS}=dummy variable which =1 if firm participates in the European Union Emissions Trading Scheme (EU ETS), 0 otherwise; SIZE=natural logarithm of market capitalisation; IND=a vector of industrial category variables, which includes n=4 categories: energy and mining, industrials, consumer and services; ROA= return on assets, measured as the ratio of income before interest and tax at the end of fiscal year 2007 and total assets at the end of fiscal year 2006; LEV=leverage, measured as the ratio of total debt divided by total assets at the end of fiscal year 2007; Chi-square (sig.)=80.923 (0.000); Log likelihood=174.402; Cox and Snell R^2=0.351; Nagelkerke R^2=0.472; Classification table – overall percentage correct=77.5

In addition, larger companies are more likely to disclose their emissions. This finding is consistent with the argument that larger firms are more exposed to public and government scrutiny, thus encouraging mechanisms to enable voluntary disclosure of their GHG emissions as a means to mitigate this pressure. Although the NGER Act 2007 requiring Australian firms to report on GHG emissions applies to all industries that meet certain thresholds from 1 July 2008, the energy and mining industry and to a lesser extent industrial firms have a greater propensity than other industries to voluntarily disclose the information ahead of this compulsory reporting. Firms in high emitting industries are likely to view measurement and disclosure of GHG emissions as a way of mitigating risk associated with GHG emissions. Rio Tinto Ltd (2007, p. 10) points to this in their annual report where they note:

> [the] increasing regulation of GHG emissions, including the progressive introduction of carbon emissions trading mechanisms, in numerous jurisdictions in which the Group operates could [. . .] have an adverse effect on the demand for the Group's products.

Two control variables – ROA and LEV – were found to be insignificant predictors of GHG emissions disclosure in this sample of Australian firms.

The second phase of analysis entailed conducting an OLS regression to assess the relative explanatory power of the independent variables on the extent and credibility of disclosure based on GHG reporting standard ISO 14064-1 for the sub-sample of 80 disclosing firms shown in model 2. Results of this analysis are presented in Table IX. As previously indicated, the model also includes a Heckman factor to account for sample selection bias (Heckman, 1979).

The model is significant and explains 52.5 per cent of the variation in disclosure level and credibility. Collinearity diagnosis was performed to ensure data met the underlying assumption of both the logistic and OLS regressions. Reported tolerance and VIF values are within acceptable ranges of greater than 0.10 and less than ten respectively, indicating no multicollinearity problem in the tested model (see Dewberry, 2004 and Pallant, 2007).

Consistent with H1b and the initial logistic model explaining the propensity to disclose GHG emissions information, firms with an ISO 14001 certified EMS produce more credible emissions information. While governance quality impacted on the likelihood of firms disclosing GHG emissions data, the credibility of disclosures for our sample of disclosing firms is not determined by governance. We do however find that firms which use the GRI to present sustainability disclosures (H4) are likely to present more credible GHG emissions information. While the GRI does not focus on GHG disclosures to any great extent, firms which utilise the GRI as a benchmark also present greater levels of GHG information. In support of H5, disclosure to the CDP which is publicly available leads to greater levels of GHG emissions disclosure. Trading on the EU ETS did not impact on the decision to disclose nor the extent and credibility of GHG reporting for the sample of firms examined in both models.

The credibility and extent of emissions data varies with both firm size (SIZE) and leverage (LEV). Firms in the energy and mining and industrial sectors present more credible information, consistent with the likelihood they are exposed to higher regulatory and market risks from GHG emissions. Firms in the services industry are also likely to provide more credible disclosure. This group includes the banking and financial sector, which is increasingly acknowledging the importance of risk associated with GHG emissions in their investment and lending decisions.

Table IX. OLS regression credible voluntary GHG emissions disclosure based on ISO 14064-1 disclosing sample

	Pred. sign	Coeff.	*t*-stat	Collinearity statistics Tolerance	VIF
Uncertified EMS	+	3.002	1.551	0.613	1.632
Certified EMS	+	5.099	2.456**	0.640	1.562
ENV_COM	+	0.428	0.308	0.513	1.948
GOV	−	−0.006	−0.505	0.453	2.209
GRI	+	4.788	3.043***	0.385	2.598
CDP not public	+	2.605	1.127	0.575	1.738
CDP public	+	3.757	1.979*	0.426	2.379
EUETS	+	0.623	0.346	0.731	1.368
SIZE	+	1.479	2.470**	0.527	1.828
IND_Energy&Mining	+	5.600	2.569**	0.363	2.753
IND_Industrials	+	4.638	2.033**	0.458	2.185
IND_Services	+	3.612	1.969*	0.411	2.434
ROA	+/−	−2.391	−0.499	0.724	1.382
LEV	+	4.158	1.668*	0.727	1.375
LAMBDA	+/−	4.309	1.126		
Constant	+/−	−40.498	−2.538**		

Notes: n=80; *$p > 0.1$; **$p > 0.05$; ***$p > 0.01$ (two-tailed); EMS=a vector of EMS category variables, which includes n=3 categories: firms having no EMS, having a non-certified EMS and having an EMS that is ISO 14001 certified; D_{ENV_COM}=dummy variable of environment committee which =1 if the firm has a specific environment committee, 0 otherwise; GOV=the Governance score allocated by the Howarth (2008) report; D_{GRI}=dummy variable of GRI which =1 if the firm uses the GRI to guide sustainability reporting, 0 otherwise; CDP=a vector of CDP category variables, which includes n=3 categories: no reporting to CDP, reported but not publicly available and a report to the CDP which is publicly available in 2007; D_{EUETS}=dummy variable which =1 if firm participates in the European Union Emissions Trading Scheme (EU ETS), 0 otherwise; SIZE=natural logarithm of market capitalisation; IND=a vector of industrial category variables, which includes n=4 categories: energy and mining, industrials, consumer and services; ROA=return on assets, measured as the ratio of income before interest and tax at the end of fiscal year 2007 and total assets at the end of fiscal year 2006; LEV=leverage, measured as the ratio of total debt divided by total assets at the end of fiscal year 2007; LAMBDA=the Heckman correction factor which accounts for sample selection bias; Adjusted R^2=0.525; F statistic=6.814; Significance=0.000

7. Summary and conclusions

Increasing community and business awareness of human-induced global warming and associated harmful climate change has changed firm disclosure behaviour in light of climate change risks associated with GHG emissions. The inception of organisations such as the Australian Business Roundtable for Climate Change appears to have had some influence in encouraging corporate action in a predominantly market governance system (Griffiths et al., 2007) where Australian Federal and State governments have to date provided little regulatory guidance (Pearse, 2009, 2010).

We find evidence of proactive corporate GHG disclosure within the current market governance system in Australia where companies operate in a public policy vacuum regarding climate change (Griffiths et al., 2007). Results of model 1 comprising 187 ASX 300 firms show that firms disclosing GHG emissions information (Table VIII) are more likely to have also implemented an environmental management system (EMS), have quality governance systems, make publicly available disclosures to the CDP, are larger, and operate in either energy and mining, or industrial sectors.

When we examine the extent and credibility of GHG emissions disclosures by the sub-sample of 80 firms (model 2, Table IX), we find these firms are more likely to have an ISO 14001-certified EMS, use the GRI to guide sustainability disclosures, and disclose to the CDP with those disclosures being publicly available. In addition, larger firms, in the mining and energy and industrial sectors are also more likely to disclose credible GHG emissions information guided by ISO 14064-1.

Given the current limited public policy to assist companies in preparing for a low carbon economy, these results suggest that some Australian companies have taken a proactive but pragmatic stance motivated by addressing multiple risks posed by climate change (Dietz et al., 2007) to maintain international competitive advantage (Griffiths et al., 2007; Lash and Wellington, 2007) as well as firm specific advantage (Kolk and Pinkse, 2008). Furthermore, these companies recognise the long term and global impacts of climate change on their survival and growth of their businesses. These proactive companies have implemented internal organisational systems such as environmental management systems as well as using external NGO guidance provided by CDP and the GRI standard to report their responses about climate change risks.

Internal organisational systems were found to relate to both the propensity to disclose GHG emissions data and to the extent and credibility of those disclosures for those sample firms who did disclose in 2007. Firms having an environmental management system (EMS) were more likely to disclose GHGs as shown in model. In particular a certified ISO 14001 EMS demonstrates a proactive approach to companies disclosing their GHG information to their stakeholders by presenting an increased level and credibility of emissions information shown in model 2. The quality of corporate governance also relates to the decision to disclose GHG information but had no relationship to the extent and credibility of GHG reporting. Larger firms are also more

likely to disclose more credible GHG emissions information. Similarly, firms which had instituted an environmental committee are more likely to provide more credible disclosures.
CDP and the GRI are also related to the extent and credibility of GHG emissions reporting for the 80 disclosing firms indicating that institutional investors and stakeholders have influenced some firms' reporting practices. Our study shows that without government regulation that mandates all ASX firms to report their management and mitigation of climate change risks then corporate disclosures will remain at the discretion of management (Griffiths et al., 2007).
Firms in the Australian mining and energy, and industrial sectors considered as "emitters" (Burgess, 2007) have a higher propensity to voluntarily report more credible GHG emissions information than other industries. These results suggest that these firms are proactively addressing regulatory, physical and reputational risks associated with climate change for pragmatic reasons such as international competitiveness (Griffiths et al., 2007; Lash and Wellington, 2007) as well as firm specific advantage (Kolk and Pinkse, 2008). PricewaterhouseCoopers (PWC, 2008, p. 19) recently reported that: "there is a high level of concern about imminent compliance obligations". Our research indicates an increasing number of Australian business leaders are considering business risks and opportunities by factoring the impact of climate change into their business systems and disclosures. However, policy makers will have to recognise that in a voluntary reporting setting there are in the business community:

> Those who deny the importance of strong and urgent action on climate change essentially offer one of, or a combination of, the following arguments. First, there are those who deny the scientific link between human activities and global warming; most people, and the vast majority of scientists, would find that untenable given the weight of evidence. Second, there are those who, while accepting the science of anthropogenic climate change, argue that the human species is very adaptable and can make itself comfortable whatever the climatic consequences; given the scale of the outcomes that we now have to regard as possible or likely under business-as-usual (BAU), this must be regarded as reckless. Finally, there are those who accept the science of climate change and the likelihood that it will inflict heavy costs, but simply do not care much for what happens in the future beyond the next few decades; most would regard this as unethical (Dietz et al., 2007, pp. 121-2).

There are some limitations. First the measurement of our dependent variable – the credibility of GHG emissions disclosures – is based on the construction of an index, which necessarily implies some judgement. We have attempted to reduce the subjectivity of our measure by using multiple researchers to apply the index, however there is still a degree of subjectivity evident, and results should be considered in light of this limitation. While this study found evidence of proactive corporate behaviour in public disclosure through company reports, qualitative research is suggested to explore more fully the underlying motivations and management practices of those proactive firms addressing climate change in the current unregulated "market governance system".

Notes

1. After a previous failed attempt to introduce an emissions' trading scheme in 2009 the Australian Government has announced that a carbon price will be introduced in July 2012 (Department of Climate Change and Energy Efficiency, 2011).
2. Prior research (e.g. Prado-Lorenzo et al., 2009) has utilised the Global Reporting Initiative (GRI) guidelines to develop an index of GHG emissions disclosure. However ISO 14-64 presents a more comprehensive guide to quantification and reporting of GHG emissions data than the GRI, which is aimed at a broader range of sustainability reporting.
3. "OSCAR is a web-based data-gathering and benchmarking tool designed to enable organisations to input and update their energy and greenhouse data online. OSCAR standardises the calculation of greenhouse gas emissions to produce comparable datasets. Environmental performance for organisations, industry or government sectors can be measured and trended over time" (Department of Climate Change and Energy Efficiency, 23 March).
4. A comprehensive review of this literature is beyond the scope of the current paper. Recent studies by Gray (2002), Parker (2005), Deegan and Soltys (2007) and Owen (2008) present critical reviews of this vast body of literature. Adams (2002) also provides an overview of corporate social reporting based on interviews with German executives, particularly regarding organisational factors.
5. Refer to Griffiths et al. (2007) for a full discussion of each category.
6. The joint CEO statement was signed by the President of BP Australasia, and the CEOs of Australian Insurance Group, Origin Energy, Swiss Re Australia and NZ, Visy and Westpac. These CEOs founded the independent organisation, The Australian Business Roundtable on Climate Change in 2004 as businesses concerned about global warming.
7. Established in 1997, the Global Reporting Initiative is a joint initiative of the Coalition of Environmentally Responsible Economies (CERES) and the United Nations Environment Program (UNEP). Its aim is to provide a global and credible framework for sustainability reporting that can be used by all organisations (GRI, 2006).
8. The ASX300 represents around 81 per cent of the Australian share market by market capitalisation (Standard & Poors, 2007).

9. The EU ETS commenced operation in 2005 (Europa, 2008), thus may impact on some Australian companies with subsidiaries or operations in the EU. In addition, during April 2006 the Australian government conducted a national stakeholder consultation as part of developing a nationally consistent framework for greenhouse and energy reporting by industry (Parliament of the Commonwealth of Australia: Senate, 2007). These situations are more likely to raise awareness of Australian firms with regards to measuring their GHG emissions and collecting related data in preparation for the forthcoming mandatory reporting.
10. There were less than 300 stocks in the ASX300 because the S&P does not replace stocks removed from the list until the ASX300 index rebalancing process in March and September. The stock removal from ASX 300 between the rebalance dates may be due to firm takeover or merger cases (Standard & Poors, 2008).
11. While it could be argued that report disclosure of the existence of an EMS is not independently verifiable, we believe that it is highly unlikely sample firms would not accurately represent the existence or certified status of an EMS, however this poses a limitation for the study.
12. We use the 2008 report as one was not produced in 2007 due to a change in contractual arrangements (Horwath, 2008), and the data contained in the 2008 report are derived from the 2007 Annual Report and web based disclosures of top 250 companies (Horwath, 2008).

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Appendix

Table AI. GHG disclosure index based on ISO 14064-1 requirements

Sect.	GHG reporting index	Max score	Score
7.3.1 Description of GHG inventory			
b	Person responsible	1	
c	Reporting period covered	1	
d	Document organisational boundaries	1	
e	Direct GHG emissions (tonnes of CO2e)	1	
f	Description of how CO2 emissions from the combustion of biomass are treated in GHG inventory	5	
g	If quantified, GHG removals, quantified (tonnes CO2e)	1	
h	Explanation for exclusion of any GHG sources or sinks from quantification	5	
i	Energy indirect GHG emissions associated with generation of imported electricity, heat or steam (tonnes CO2e)	1	
j and k	Historical base year selected and base-year GHG inventory	1	
l and m	Reference to or description of quantification methodologies	1	
n	Reference to or documentation of GHG emission or removal factors used	1	
o	Description of impact of uncertainties on accuracy of GHG emissions & removals data	1	
p	Statement that prepared in accordance with ISO 14064	1	
q	Statement describing GHG inventory, report or assertion has been verified	1	
Subtotal		22	
7.3.2 Other issues to be considered			
a	Description of policies, strategies and programs	5	
f	GHG emissions or removals disaggregated by facility	1	
h	Uncertainty assessment description and results (incl. measures to manage or reduce uncertainties)	1	
i	Description of and presentation of additional indicators (e.g. efficiency or GHG emission intensity)	1	
j	Assessment of performance against internal and/or external benchmarks	1	
k	Description of GHG info management and monitoring procedures	5	
Subtotal		14	
Total		36	