Modeling the impacts of corporate commitment on climate change

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Abstract

The aim of this paper is to propose an integrative framework for understanding the determinants of business strategies to reduce greenhouse gas emissions and the impact of these determinants on performance. The proposed structural equation model is based on a survey of 319 Canadian manufacturing firms. The study calls into question the traditionally positive relationship between a firm's environmental commitment and its economic motivations. However, the results also show a win-win relationship between the commitment to reduce greenhouse gas emissions and financial performance. This study contributes to the understanding of the motivations underlying the efforts manufacturers make to tackle climate change and their economic benefits.

Keywords: climate change; corporate strategy; environmental commitment; GHG performance; motivations; stakeholder pressures

Introduction

Climate change is a major social issue that is of increasing concern to governments, the public and businesses, especially for those industries considered as large emitters of greenhouse gases (GHGs). In the past, international discussions have focused on the scientific issues surrounding the causes and the extent of climate change, but increasingly such debates are concerned with establishing GHG reduction targets, how to reach those targets, and the economic implications of that process. The Copenhagen summit in December 2009 was a case in point: the main source of resistance to committing to the proposed policies was no longer the willingness of the countries and industries involved to recognize the reality of climate change, but rather their concern about the potential impacts of the proposed policies on international competitiveness. On the one hand, the leaders of most developed countries are reluctant to commit to more substantial efforts to reduce GHG emissions, arguing that this could result in a loss of competitiveness relative to countries that do not commit to such efforts. On the other hand, the leaders of developing countries such as India or China have pointed to the costs of efforts to reduce GHG emissions and their lack of financial and technological resources to commit to such efforts (Helm, 2008; Falkner et al., 2010).

This political context – in which different countries have different positions concerning the future of international climate policies after 2012 – exposes companies to a very high level of regulatory uncertainty (Kolk and Pinkse, 2005; Hoffmann et al., 2009; Engau and Hoffmann, 2011b). It is difficult to predict how the regulatory framework will change when India, China, and the United States – three of the five largest emitters of GHGs – are still reluctant to make binding commitments (Harrison, 2007; Engau and Hoffmann, 2011b; Falkner et al., 2010). In light of this, some companies have a tendency to take a 'wait and see' approach until the rules of the game become clearer (Kolk and Pinkse, 2005; Boiral, 2006; Jeswani et al., 2008). This attitude is reinforced by uncertainty about the economic impacts of the actions companies can take to reduce GHG emissions. Surprisingly, these impacts remain relatively little studied despite the international debate over this highly controversial issue. The dimension most often addressed in the literature is the motivation for companies to reduce GHG emissions. Most studies have surveyed managers or used company reports to examine the role of various types of motivation (see, e.g., Deloitte and Touche, 2006; Grant Thornton, 2007; Okereke, 2007; Sprengel and Busch, in press; Jeswani et al., 2008; Ernst & Young, 2010). The literature suggests that corporate commitment to reducing GHG emissions is influenced by a series of internal and external factors, ranging from pressure from stakeholders to economic and social motives. However, few studies have empirically examined the impact of these factors on corporate commitment. The majority have been limited to description or have only partially explored the various dimensions. Moreover, no integrative framework has yet been presented to simultaneously study the determinants and consequences of corporate commitment to reduce GHG emissions.

Although it is critical for businesses to assess the economic impacts of efforts to reduce GHG emissions, this dimension remains relatively unexplored. Most work on this issue is limited largely to theoretical discussions (Dunn, 2002; Lash and Wellington, 2007; Nitin et al., 2009) or to descriptions of the risks and opportunities that could result from addressing climate change (Schultz and Williamson, 2005; Porter and Reinhardt, 2007). In most cases, the findings of these studies emphasize the economic benefits that could result from the reduction of GHG emissions by businesses. However, such optimistic assessments are rarely supported by empirical studies on the relationship between the implementation of GHG reduction strategies and their measurable impacts. Indeed, according to Weinhofer and Hoffmann (2010), this could be a particularly fruitful avenue of research. In addition, several studies have shown that while the vast majority of executives are aware of the strategic implications of the impacts of climate change on their company, the policies and measures actually implemented generally remain limited relative to the stakes (KPMG, 2008b; Deloitte & Touche, 2006; Ernst & Young, 2010). This gap between the rhetoric concerning the importance of corporate commitment to reducing GHG emissions and the actual implementation of strategies adds to the uncertainty about the nature and implications of such strategies. As a result, the ongoing heated debates on the economic implications of efforts to reduce GHG emissions tend to be based more on political or ideological positions than on empirical data.

In light of this scarcity of information, the current study was undertaken to analyze the determinants of implementation of strategies to reduce GHG emissions and their impact on performance, based on a survey of 319 industrial firms in Canada. The development of an integrative framework tested using structural equation modeling (SEM) makes it possible to explore the complex connections among many aspects of climate change strategies and their impacts. This approach also enables us to establish a general synopsis of the literature on the subject and simultaneously test several hypotheses put forward in other studies. This paper thus contributes to assessing the current major trends in the literature on climate change strategies and integrates a number of issues that are usually addressed separately into a single model.

For economic and political leaders, the results of this study will help predict the main impacts of businesses making a commitment to reducing GHG emissions. Failure to take these issues into account exposes companies to risks that can no longer be ignored by corporate leaders (Lash and Wellington, 2007; Nitin et al. 2009; Porter and Reinhardt, 2007; Kolk and Pinkse, 2004). Indeed, these risks could threaten the legitimacy or even the continuation of the company (Griffiths et al., 2007; Dunn, 2002; Boiral, 2006). In addition, the biophysical impacts of climate change pose risks for many sectors of activity (Kearney, 2010; Nitin et al., 2009; KPMG, 2008a; Winn et al., 2011). This is the case for the agricultural sector, where harvests may be affected by shifting climate patterns. For example, wine production is already being affected by ongoing climate change, in the form of a northward shift in the growing zones of certain grape varieties, the emergence of new competitors, changes in key phases of the production cycle and grape harvest, reappraisal of certain terroirs or appellations, and so on (Jones et al., 2005). The same types of observations have been made in the fishing industry, which is increasingly affected by the movement of certain food species into new waters and by the threat climate change poses to biodiversity (Brander, 2007).

The remainder of this paper is organized as follows. The next section presents a review of the literature and the conceptual framework. The subsequent two sections present the methodological aspects and the main findings, respectively. A discussion of the results, along with their implications for future research and managerial practices, is presented in the last section.

Theoretical Framework and Hypotheses

Research on GHG reduction strategies has improved our understanding of the motivations of businesses, the institutional context of their commitment, the type of commitment they make and the possible impacts. Nonetheless, the various facets of climate change strategies, and particularly their complex interactions, have been subject to relatively little empirical scrutiny.

In general, despite the intensity of the debates on the Kyoto Protocol and the considerable economic stakes of GHG reduction efforts, studies of the issue have mainly demonstrated the complexity of the subject and the lack of certainty regarding the nature and impact of business strategies. Indeed, most research on climate change strategies remains theoretical and is based on classical models of environmental management or environmental economy (Lash and Wellington, 2007; Nitin et al., 2009; Porter and Reinhardt, 2007; Kolk and Pinkse, 2007 a). Paradoxically, while the economic stakes appear to be the main obstacle to government commitments on climate change (Environment Canada 2007; Whalley and Walsh, 2009), the actual impacts of proactive climate change strategies remain largely unexplored. The lack of conclusive studies on the issue tends to increase uncertainty and hence the reluctance of some leaders to set out clear policies and measures to deal with it. Interestingly, most of the existing studies adopt a fairly optimistic view of the supposed economic benefits of GHG reduction efforts (Porter and Reinhardt, 2007; Dunn, 2002; Schultz and Williamson, 2005; Hoffman, 2006), while executives interviewed on the subject seem to suggest otherwise, emphasizing instead the costs of such efforts (The New Economics Foundation, 2004). This apparent contradiction can be partly explained by the complex and contingent nature of the possible impacts of these strategies. Thus, it is clear that some companies will gain competitive advantage through their GHG reduction efforts while others will lose out (Lash and Wellington, 2007, Porter and Reinhardt, 2007). The current uncertainty about the targets to be reached and possible future regulations, however, makes it very difficult to make realistic forecasts. Most recent studies have highlighted that this prevailing uncertainty and the lack of substantial commitment from some governments encourages a 'wait and see' approach (Jones and Levy, 2007; Luo, 2004; Boiral, 2006; The Economist Intelligence Unit, 2008), although some authors dispute this link (Hoffmann et al., 2009; Engau and Hoffmann, 2009; Engau and Hoffmann, 2011a). In any event, it is difficult to generalize from the conclusions of these studies because of differences in the sectors examined as well as geographical and socio-political variation.

Another limitation of the findings in the current literature is a lack of integration of the various aspects of GHG reduction strategies. Most studies focus on a single aspect (e.g. external pressures, motivations, the level of corporate commitment, or the impacts of that commitment) or address these issues using theoretical hypotheses about the supposed links between certain variables. The complexity of the interrelationships between the various facets of GHG reduction strategies necessitates the use of more comprehensive analytical models which incorporate multiple, non-linear interactions between the diverse variables that shape these strategies and their possible impacts. The model proposed in this study makes it possible to explore the links between the various aspects using a SEM approach (Figure 1).

Determinants of GHG Commitment

The growing media coverage of climate change, its impacts, and the efforts that must be made to substantially reduce global GHG emissions focuses ever greater attention on corporate responsibilities and climate change strategies. In some countries like Canada, large industrial emitters account for more than half of GHG emissions. In light of this, it is clearly impossible to achieve international targets for reducing GHG emissions without the active involvement of businesses: they are thus both part of the problem and a key part of the solution to climate change. At a time when the lack of clarity in the corporate response and the apparent inconsistencies between talk and action are often criticized (Hoffman and Woody, 2008; Sussman and Freed, 2008; Boiral, 2006; Jones and Levy, 2007; Ihlen, 2009), many studies have examined the nature of corporate commitments to reduce GHG emissions and the implemented strategies and have tried to identify the underlying motivations and pressures.

In general, these analyses of corporate climate change strategies are based on the classic distinction between proactive and defensive approaches to environmental issues (Lawrence and Morell, 1995; Berry and Rondinelli, 1998; Sharma and Vredenburg, 1998; Aragon-Correa and Sharma, 2003; González-Benito and González-Benito, 2006). However, several have proposed models or classifications of business commitments on climate change (Nitin et al., 2009; Kolk and Pinkse, 2005). For example, in their study of the response of British and Pakistani businesses to climate change, Jeswani et al. (2008) identified four major clusters, based on operational and management activities: indifferent, beginner, emerging, and active. For their part, Kolk and Pinkse (2005) proposed representing the strategic options facing businesses as a matrix in two dimensions: strategic intent (innovation or compensation) and the form of the organization (degree of interaction: internal, vertical, or horizontal). More recently, Weinhofer and Hoffmann (2010) presented a model incorporating a temporal perspective to categorize three types of strategies: CO_2 compensation, CO_2 reduction, and carbon independence. Other studies have focused not on different kinds of corporate responses, but on the various ways climate change strategies are implemented (Schultz and Williamson, 2005; Boiral, 2006). For example, Hoffman (2006) delineates five steps for implementing these strategies: assess carbon exposure, compare exposure with the competition's, assess mitigation options, assess strategies to gain competitive advantage, and develop a strategic plan.

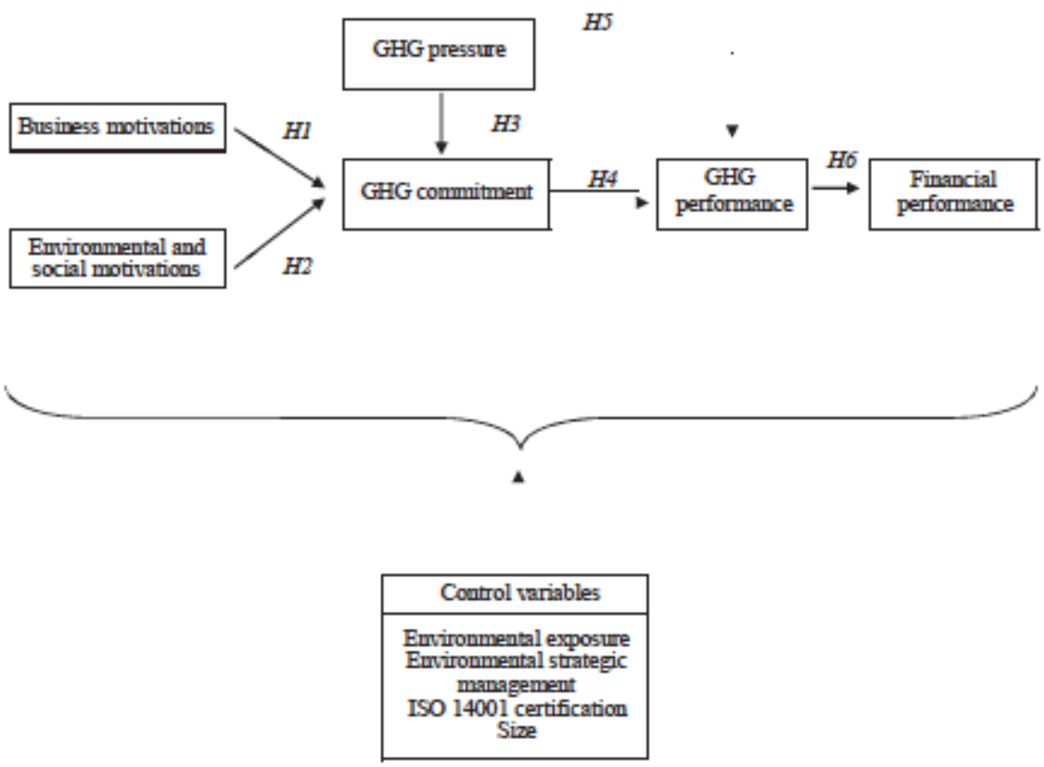

Figure 1. Conceptual framework (H1–H6 refer to hypotheses one to six described in the text)

The first determinant of corporate commitment to GHG reduction addressed in the literature is motivation. Most studies on motivation stress the importance of educating corporate leaders on these issues and analyze the economic, environmental, and social reasons that would justify a commitment on climate change (Hoffman, 2006; Kearney, 2010; Okereke and Russel, 2010) These reasons are interdependent rather than mutually exclusive (Okereke and Russel, 2010). The economic motivations are linked to the potential financial benefits that may result, directly or indirectly, from reducing GHG emissions. Environmental and social motivations for businesses are centered on the importance of complying with societal expectations and demonstrating their commitment to climate change issues. In general, corporate environmental commitments depend not only on economic incentives but also on the values held by the company's executives and the social responsibility of the company (Bansal and Roth, 2000; Bansal, 2003; Boiral, 2005).

Thus, the main trends in the literature suggest two hypotheses concerning motivations to reduce GHG emissions:

> **H1:** Economic motivations (reduction of production costs, consumer demands, etc.) positively influence the commitment of companies to reduce GHG emissions;
>
> **H2:** Social and environmental motivations (social responsibility, reducing pollution, etc.) positively influence the commitment of companies to reduce GHG emissions.

The second determinant of corporate climate change commitments addressed in the literature is pressure from various stakeholders. Indeed, pressure from stakeholders to reduce GHG emissions is generally perceived as one of the main drivers of corporate commitment (Okereke, 2007; Griffiths et al. 2007; Hoffman, 2006; Sprengel and Busch, in press). Governments, investors, environmental groups, customers and the general public are all increasingly aware of these issues and are putting increasing pressure on sectors with high carbon emissions such as the cement, oil, and transportation industries. The companies in these and other sectors considered to be large GHG emitters are thus particularly vulnerable to social pressures and new emission-control regulations.

In addition, such pressures vary from one geographic region to another and can change quite quickly. To anticipate long-term changes, some studies attempt to analyze possible future scenarios by assessing the potential risks and consequences to companies (Ralston, 2008; Nitin et al., 2009). Pressure from the European Union to reduce industrial emissions of GHGs has led some companies to revise their strategies to comply with the new regulations or benefit from the new carbon emissions allowance market, established in 2005 (Pinkse, 2007; Okereke, 2007; Boiral, 2006; Pinkse and Kolk, 2009). In contrast, in countries that have not ratified the Kyoto Protocol or put in place substantive measures to address emissions, companies appear more inclined to adopt a 'wait and see' approach (Kolk and Pinkse, 2004, 2007a; Pinkse, 2007). More broadly, the institutional system of governance in each country or region influences the degree to which measures to reduce GHG emissions are coercive and the consequent level of business autonomy (Griffiths et al., 2007; Brouhle and Harrington, 2009; Galbreath, 2010). The institutional and social pressures for reducing GHG emissions do not depend solely on public policy and relations between companies and governments. Various stakeholders can also exert significant influence on the implementation of emission-control measures. Business associations, professional societies, and chambers of commerce, for example, often participate in lobbying efforts and assist industries in implementing self-regulatory mechanisms (Martin and Rice, 2010; Kolk and Pinkse, 2007b; Jones and Levy, 2007). Environmental groups can also influence the commitments made by companies, by publicly questioning the legitimacy of corporate actions (Lawrence and Morell, 1995; Sprengel and Busch, in press). Financial markets and insurance companies are also exerting increasingly strong pressure in favor of addressing climate change within business strategies (Lash and Wellington, 2007; Kolk and Pinkse, 2007a; Deloitte and Touche, 2006). Finally, customers and suppliers can play an important role in efforts to reduce

GHG emissions. Companies that rely on independent suppliers must also rely on those suppliers to reduce GHG emissions in the supply chain, whereas companies that are highly vertically integrated have more direct control (Kolk and Pinkse, 2007a). The intensity of pressure from all stakeholders influences both the views of corporate executives and the strategic responses of companies to environmental issues (Sprengel and Busch, in press; Murillo-Luna et al., 2008).

Cumulatively then, the literature suggests that diverse stakeholder pressures strongly influence corporate commitments to reduce GHG emissions. Consequently, the following hypothesis can be formulated:

> **H3:** The intensity of pressure from stakeholders to reduce GHG emissions positively influences the commitment of businesses to do so (support for the Kyoto Protocol, implementation of proactive strategies, etc.).

Determinants of GHG Performance

The determinants of GHG performance (i.e. the actual reduction of GHG emissions) are still relatively unexamined by empirical means, in particular because of the newness of the strategies that have been implemented, their long-term effects, and the difficulties of rigorously measuring performance. The complexity of measuring environmental performance has often been stressed because of the multidimensional nature of environmental issues and lack of standardization (Lober, 1996; Hoffmann et al., 2009; Delmas and Blass, 2010; Cowan and Deegan, 2011; Kolk et al., 2008). Measuring GHG emissions appears to be more narrowly focused and specific standards such as ISO 14064 for GHG accounting and verification have been developed. In addition, industrial emissions are increasingly monitored for enforcement of regulatory standards and through corporate surveillance, such as that conducted by the Carbon Disclosure Project, which compiles information about the carbon emissions of large companies (Kearney, 2010). However, evaluating and comparing the carbon performance of companies is a complex process which can be based on many different indicators (Hoffmann et al., 2009).

Although there is relatively little research to date on the determinants of GHG performance, two factors have been clearly identified in the literature. The first of these is pressure from stakeholders. Indeed, pressure from stakeholders to reduce GHG emissions is generally perceived as one of the main drivers not only of corporate commitment, but also of improved carbon performance (Okereke, 2007; Griffiths et al., 2007; Hoffman, 2006; Sprengel and Busch, in press). However, in the absence of mandatory regulations with specific targets for reducing GHG emissions, pressure from stakeholders can be quite ineffective and lead to superficial corporate responses or implementation of measures that do not really improve performance. This type of disconnect between institutional pressure and the true efficacy of the measures put in place in response to those pressures has been highlighted by various schools of thought, particularly the neo-institutional theory (DiMaggio and Powell, 1983; Boiral, 2006). According to this view, in response to external pressures, companies adopt measures that are intended primarily to improve their social legitimacy without necessarily re-examining their internal practices. Thus, corporate climate change strategies often seem more akin to coercive or mimetic isomorphisms (DiMaggio and Powell, 1983), intended to respond to external pressures or to imitate the most active competitors. In a survey of voluntary environmental agreements in the

United States, Delmas and Montes-Sancho (2010) showed that the last companies to enter a program make rather symbolic commitments, whereas the first participants take substantial action to reduce their environmental footprint. This difference can be explained by the varied intensities of institutional pressures (Delmas and Montes-Sancho, 2010). Any examination of the determinants of GHG performance thus needs to examine both the intensity of the pressure companies face and the concrete commitment these companies make.

The above arguments suggest that the GHG performance of companies is determined by their level of commitment and by pressure from stakeholders, which is thought to lead to substantive changes in organizations. Thus, it is possible to formulate two hypotheses:

> **H4:** A company's level of commitment positively influences its GHG performance.
>
> **H5:** The intensity of external pressure on a company positively influences its GHG performance.

Relationship Between GHG Performance and Financial Performance

The analysis of the relationship between GHG performance and financial performance is polarized around two main approaches that reflect those used in studies examining the links between environment and economy in general. The first approach, which appears to dominate in international debates about national commitments to reduce GHG emissions, is based on win-lose reasoning (Environment Canada, 2007; Whalley and Walsh, 2009). In this view, the efforts companies make to reduce their carbon emissions result in costs that could detract from their competitiveness. The second approach is based on win-win reasoning, which argues that efforts to reduce GHG emissions help improve corporate competitiveness (Jones and Levy, 2007; Schultz and Williamson, 2005; Boiral, 2006; Hoffman; 2006; Okereke and Russel, 2010). This win-win logic is now dominant in the literature and probably explains, to a large extent, the current research focus on the economic motivations for efforts to reduce GHG emissions.

In general – depending on the region, the business sector, and the implemented measures – climate change strategies can lead to quite varied economic benefits, including improved access to capital, satisfaction of customer expectations, and access to government subsidies and certain public contracts (Jeswani et al., 2008; Deloitte and Touche, 2006; Esty, 2007). The benefit most often cited is the reduction of energy costs associated with minimizing the use of fossil fuels (Jeswani et al., 2008; Hoffman, 2006; Grant Thornton, 2007). Such savings depend largely on the cost of fossil fuels, how much energy the company uses, and the ease of reducing that consumption or of finding competitively priced alternative energy. The energy efficiency measures may also lead to technological innovations and the development of capabilities that enhance productivity and competitiveness (Dunn, 2002; Nitin et al., 2009; Hoffman, 2006; Hoffmann et al., 2009; Pinkse and Kolk, 2010). The existence of a market for tradable emissions permits may also influence corporate strategies (Martin and Rice, 2010; Hoffmann et al., 2009).

Companies that do not address climate change in their corporate strategies are exposed to risks in terms of their competitive position (Nitin et al., 2009; Hoffman, 2006; Kearney, 2010). For example, the lack of substantial corporate commitments or clear strategies in this area may limit the economic opportunities that these issues present (sale of tradable emission permits, technological innovations to reduce GHG emissions, new products, etc.). Consequently, some governments, such as that of France, plan to introduce carbon taxes penalizing companies or countries that have not introduced substantive measures to reduce their GHG emissions. In general, the introduction of new regulations or new policies represents a risk for companies that have failed to anticipate these developments (Deloitte and Touche, 2006; KPMG, 2008a, 2008b).

This win-win reasoning, which predominates in the literature on the possible economic impacts of environmental actions, suggests the following hypothesis:

H6: GHG performance positively influences the financial performance of the company.

Control Variables

The corporate response to these pressures is difficult to assess and depends on many factors, such as customer demands, the development of new technologies, or the potential savings that could result from reducing the use of fossil fuels (Enkvist and Vanthournout, 2008; Jones and Levy, 2007; Grant Thornton, 2007; Pinkse and Kolk, 2010). Similarly, the impact of commitments to reduce GHG emissions on financial performance may depend on the company's efforts and contextual factors including the size of the firm, the implementation of standards such as ISO 14001, or the sector of activity. Moreover, the actual commitment of companies may be superficial or even contradictory, resulting in less predictable effects on financial performance and reduction of GHG emissions.

As shown in Figure 1, the model also takes into account various contextual variables whose impacts are seemingly difficult to assess. Thus, the environmental risks specific to different sectors of business activity (environmental exposure) may influence the main variables of the model: different motivations depending on the sector, varying levels of external pressure depending on the amount of pollution emitted, widely variable economic impacts depending on the industry, etc. (Pinkse, 2007; Brouhle and Harrington, 2009; Jeswani et al., 2008; Al-Tuwaijri et al., 2004). That said, the relationships among the model variables are not necessarily affected by the sector of activity. The same applies to other variables such as the size of the firm. Some managerial variables, such as ISO 14001 certification and the overall environmental actions of the company, may also affect some variables in the model, in particular the commitment to reduce GHG emissions and GHG performance. However, the impact of these variables remains controversial. The real efficacy of ISO 14001 certification in improving environmental performance and, more specifically, in reducing GHG emissions has not been clearly demonstrated (Jiang and Bansal, 2003; Boiral, 2007).

Methods

Survey Design

The data were collected from a survey administered to a random sample of 1556 Canadian manufacturing firms obtained from Scott's database. This database comprises fully autonomous entities or subunits of larger firms. In all cases, the firms were listed as separate entities in the database. We selected organizations with 20 or more employees, for which the contact names of the top management team were available. The final sample comprised 1514 organizations (after exclusion of erroneous addresses, organizations that had moved, etc.). The questionnaire was first validated using a pre-test administered to four academics and 20 managers. Data were then collected using a structured questionnaire sent to the CEO or the highest member of the 'corporate' top management team (for autonomous entity) or 'local' top management team (for business subunits) listed in the database. The questionnaire was sent to the respondents along with a letter explaining the purpose of the study and a self-addressed stamped envelope. Four weeks after the initial mailing, the non-respondents received a replacement questionnaire.

A total of 319 usable questionnaires were received, for a response rate of 21.1%. A sample size of 100 to 200 is generally considered adequate for small-to-medium structural equation models, yielding 5 to 10 observations per estimated parameter (Bentler and Chou, 1987; Anderson and Gerbing, 1988). In the current study, the sample size is adequate to test the proposed model (n = 319) as well as the number of observations per parameter (7.09). Furthermore, based on the guidelines of MacCallum et al. (1996), this study has adequate statistical power at 0.99, well above the recommended threshold of 0.80.

The average size of the firms was 342 employees and the respondents had an average of 14.1 years of experience working for their organization. Appendix 1 presents a description of the sample in terms of the respondents' position, experience and level of education, and the number of employees in the organization. To check for potential non-response bias, a two-step analysis was conducted. First, respondents were compared with non-respondents in terms of sample characteristics (firm size, industry, and geographical region). Then, early respondents (i.e. those providing answers before the follow-up questionnaire was sent) and late respondents (i.e. those providing answers after follow-up and used as proxies for non-respondents) were compared in terms of the parameters of the main construct. Using chi-square statistics, no significant differences ($P > 0.05$) were found between respondent firms and non-respondent firms in terms of their size, geographical region, or industry. Similarly, no significant differences were found between the means of the measures for the main constructs for early and late respondents. Hence, it appears that non-response bias is not a major concern for this sample.

Measurement of Constructs

The instruments used to measure the main constructs are presented in Appendix 2. The descriptive statistics of the main constructs and correlation matrix are presented in Table 1.

The GHG pressure construct consists of a list of key stakeholders identified as such in the literature (Delmas, 2002; Henriques and Sadorsky, 1999). The extent to which the respondent's facility was under pressure from those stakeholders to reduce GHG emissions was assessed on a five-point scale, with higher scores indicating higher perceived pressure.

To identify the underlying dimensions of the 'motivation' construct, an exploratory factorial analysis (EFA) with varimax rotation was carried out on the list of 12 motivation elements presented to the respondents (Table 2). This list was drawn from two specific instruments

(Delmas, 2002; Henriques and Sadorsky, 1999). Respondents were asked to indicate the extent to which the 12 elements influence the environmental commitment of their facility (scale: 1 = no influence at all to 5 = very strong influence). The final factorial analysis revealed that two dimensions – business motivations and environmental/social motivations – explained a total of 50.06% of the variance.

Four items adapted from an instrument developed by Melnyk et al. (20 03) were used to measure GHG commitment. The respondents were asked to assess the extent of implementation of various initiatives on a five-point Likert-type scale (1 = not at all, 5 = to a great extent). A higher score thus indicates a greater GHG commitment.

The measures for both the GHG and financial performance variables were adapted from subjective instruments developed by Judge and Douglas (1998). In the view of many authors (e.g. Venkatraman and Ramanujam, 1987; Dess and Robinson, 1984), neither objective nor subjective measures are superior in terms of consistently providing valid and reliable performance assessments. For GHG emissions performance, respondents were asked to rate the GHG performance of their facility over the past 3 years relative to others in their industry. The questionnaire contains three items assessed on a five-point Likert-type scale (1 = much worse, 5 = much better), with higher scores thus indicating better GHG performance. Financial performance was measured using four items on which the respondents were asked to rate the overall performance of their facility over the past 3 years relative to others in their industry, based on a five-point Likert-type scale (1 = much worse, 5 = much better). A higher score thus indicates better financial performance.

	GHG pressure	Business motivations	Environmental and social motivations	GHG commitment	GHG performance	Financial performance
Descriptive statistics						
No. of items	8	4	5	4	3	4
Theoretical range	1–5	1–5	1–5	1–5	1–5	1–5
Minimum	1	1	1.29	1	2	1
Maximum	5	5	5	5	5	5
Mean	2.37	3.21	3.59	3.34	3.96	3.54
Standard deviation	1.30	0.86	0.77	1.15	0.84	1.07
Median	2.0	3.20	3.57	3.33	3.67	3.25
Correlation matrix (Pearson)						
GHG pressure	1.0					
Business motivations	0.153**	1.0				
Environ. and social motivations	0.233**	0.495**	1.0			
GHG commitment	0.662**	0.028	0.320**	1.0		
GHG performance	0.338**	−0.036	0.032	0.469**	1.0	
Financial performance	0.333**	−0.074	0.026	0.306**	0.481**	1.0

Table 1. Descriptive statistics and correlation matrix of the main constructs
GHG, greenhouse gas.
**Significant at the 0.01 level.

To establish the reliability of each construct, we examined the Cronbach alpha and composite reliability coefficients. The recommended threshold of 0.70 was used to determine acceptable reliability (Nunnally, 1967; Fornell and Larcker, 1981). Moreover, to verify convergent validity, the variance extracted and first-order confirmatory factor analyses (CFA) were performed. Acceptable validity was determined by variance extracted values above the benchmark level of 0.50 (Hair et al., 1998). Three main elements were examined for the CFA: (i) the significance of the standardized factor loading and the R^2 for each item, (ii) the overall acceptability of the measurement model using chi-square statistics, and (iii) three indices of fit. These latter indices – the non-normed fit index (NNFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA) – represent complementary index types (absolute fit and incremental fit measures) and are among the most frequently reported.[1] Lastly, discriminant validity was assessed by comparing the variance extracted from each individual construct with the squared correlation between latent constructs (Fornell and Larcker, 1981). To support discriminant validity, the variance extracted for each construct must exceed the squared correlations.

Items	Business motivations	Environmental and social motivations
Marketing/advertising opportunity	0.482	0.430
Reducing production costs	0.629	−0.051
Increasing shareholder value	0.691	0.306
Customer demands	0.731	0.102
Greater access to capital	0.762	0.191
Public demonstration of environmental stewardship	0.059	0.732
Reducing environmental impacts and pollution	0.033	0.788
Improving regulatory compliance	0.251	0.505
Top managers' social responsibility and ethical concerns	0.032	0.724
Employee mobilization	0.430	0.539
Corporate headquarters requirement	0.251	0.526
Demonstrating environmental leadership in our industry	0.195	0.774
Eigenvalues	1.596	4.411
% total of variance	13.298	36.760

Table 2. Exploratory factor analysis for the motivation constructs

Appendix 2 presents the statistics of the measurement analysis for the initial and re-specified models. Re-specification was necessary for only two constructs, namely business motivations (one item was deleted due to an inadequate R^2 value) and environmental and social motivations (two items were deleted due to inadequate R^2 values). Once those re-specifications were made, all constructs exceeded the recommended thresholds for the Cronbach alpha, composite reliability, and variance extracted; exhibited acceptable model fit; had adequate R^2 values; and all factor loadings were statistically significant ($P < 0.01$). The only exceptions were the variance extracted values for the two motivation constructs, which were slightly below the threshold. All comparisons between the variances extracted and the squared correlations supported the discriminant validity of the constructs.

Data Analysis

SEM was used to test the theoretical model. SEM consists of a set of linear equations that simultaneously test two or more relationships among directly observable and/or unmeasured

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[1] The recommended threshold values are: (i) NNFI > 0.90 (Tabachnick and Fidell, 2001), (ii) CFI > 0.95 (Hu and Bentler, 1995), and (iii) RMSEA < 0.10 (Browne and Cudeck, 1993).

latent variables (Bollen, 1989; Bollen and Long, 1993). We analyzed the data collected from the survey using LISREL 8.72 and used a covariance matrix as the input matrix. As has been suggested for models using multivariate non-normal data (Bentler and Chou, 1987), we used maximum likelihood estimates (robust to this type of violation) and multiple indices to assess the model's overall goodness-of-fit. Furthermore, composite indices and a partial disaggregation approach were used to represent latent constructs (Bagozzi and Heatherton, 1994).

Results

Structural Model and Hypotheses

Table 3 presents the results for the structural model in terms of path coefficients, Z statistics, number of iterations, proportion of variance (R^2), and goodness-of-fit indices. The model exceeded the recommended threshold values (see footnote 1) for the three fit indices: NNFI = 0.97, CFI = 0.97, RMSEA = 0.06. This indicates a good overall fit of the data to the model. No re-specification of the initial models was made and no starting values were used. Figure 2 illustrates and summarizes these results.

When each hypothesis was examined separately, support was found for four of the six hypotheses. The first three hypotheses all dealt with the determinants of GHG commitment. A significant and positive link was observed between GHG pressure and GHG commitment (0.762; P < 0.01). This result provides strong support for H3 by suggesting that increased stakeholder pressure positively influences companies' commitment to reduce GHG emissions. The results also provide support for H2, showing a significant and positive association between environmental and social motivations and GHG commitment (0.330; P < 0.01). However in the case of H1, the results indicate a significant but negative link (−0.269; P < 0.01), suggesting that, contrary to our expectations, increased business motivations were associated with a reduced GHG commitment. Given the overall support for the win–win thesis, one possible explanation of this surprising result lies in the possibility that benefits such as marketing opportunities, reduced production costs, or increased shareholder value were not expected at the outset by these Canadian companies. Still, our results show that 64.4% of the variance of GHG commitment is explained by the three variables we examined, particularly by GHG pressure and environmental and social motivations.

Hypothesis	Description of path	Path coefficient	Z statistic	R^2
H3	GHG pressure → GHG commitment	0.762	12.709**	0.644
H1	Business motivations → GHG commitment	−0.269	3.358**	
H2	Environmental and social motivations → GHG commitment	0.330	4.087**	
H5	GHG pressure → GHG performance	−0.107	1.092	0.271
H4	GHG commitment → GHG performance	0.598	5.298**	
H6	GHG performance → Financial performance	0.498	7.834**	0.248

Table 3. Standardized results of the structural equation model (see text for hypotheses H1–H6)
GHG, greenhouse gas.
Goodness-of-fit indices: $\chi 2$ (145) = 327.07, P < 0.01; NNFI = 0.97; CFI = 0.97; RMSEA = 0.06.
Number of iterations = 12; sample size n = 319.
**P < 0.01

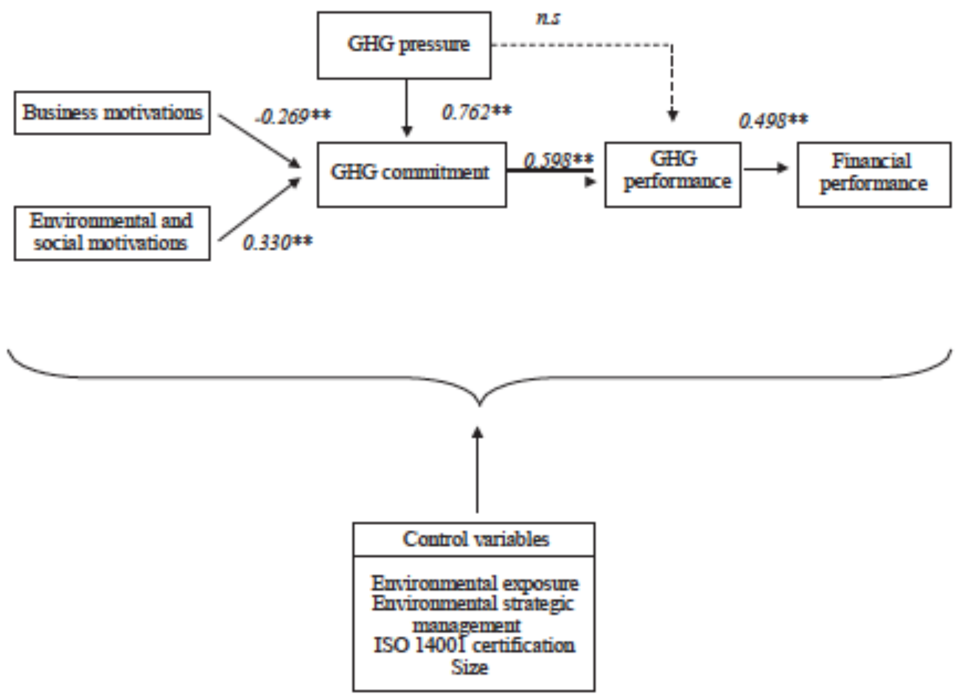

Figure 2. Results of the structural model (**Significant at the 0.01 level)

Of the two hypotheses addressing the specific determinants of GHG performance (H4 and H5), the results indicated support only for H4. While 27.1% of the variance in GHG performance could be explained, only GHG commitment could be linked significantly and positively to GHG performance (0.598; $P < 0.01$); the relation between GHG pressure and GHG performance was not found to be significant. This unexpected result suggests that although increased GHG pressure may increase GHG commitment, it does not, in itself, lead to improved GHG performance; however, greater GHG commitment does.

Finally, the positive and significant link between GHG performance and financial performance lends strong support to H6 (0.498; $P < 0.01$) and the overall win-win thesis put forward in this study. Furthermore, the results indicate that 24.8% of the variance in financial performance is explained by GHG performance.

Sensitivity Analyses

Considering the potential influence of other factors on the relationships presented in the conceptual model, four control variables were examined, namely (i) environmental exposure, (ii) strategic environmental management, (iii) ISO 14001 certification, and (iv) size. Environmental exposure refers to the firm's exposure to future environmental costs (Al-Tuwaijri et al., 2004). Strategic environmental management is defined as the importance the firm gives to integrating environmental issues into organizational practices. These factors were chosen for two purposes. First, their influence has been documented in several studies of environmental management (e.g. Sharma and Vredenburg, 1998; Judge and Douglas, 1998; Wagner and Schaltegger, 2004; Henriques and Sadorsky, 1999; Al-Tuwaijri et al., 2004). Second, these factors encompass internal and external perspectives as well as general organizational factors and specific environmental factors.

In order to validate the robustness of the theoretical model, subgroup analyses are used to assess cross-sample validation and to reinforce the findings on individual hypothesis tests. Two subgroups were created by dividing the sample at the median value for each contextual variable, and those subgroups were then compared. Table 4 presents the results of four subgroup analyses using environmental exposure, strategic environmental management, ISO 14001 certification and size as splitting variables. Each model met the recommended thresholds mentioned above. As seen in Table 4, most of the results remain qualitatively unchanged: results that were previously significant are still significant and those that were not remain unchanged. However, we found slight statistical differences between subgroups for the link between business motivations and GHG commitment for two contextual variables, environmental exposure and ISO 14001 certification. In both cases, the association was no longer significant for one subgroup.

Discussion and Conclusions

The aim of this study was to propose an integrated model of the determinants of corporate strategies to reduce GHG emissions and their impacts on environmental and economic performance. The development and validation of a SEM made it possible to examine several important relationships. First, the results confirm, in broad terms, the hypothesis of a win-win relationship between the commitment to reduce GHG emissions and financial performance. Although this relationship is often emphasized in the literature on environmental management in general (Porter and van der Linde, 1995; Russo and Fouts, 1997; Roy et al., 2001; Halkos and Evangelinos, 2002; Plaza-Úbeda et al., 2009), it remains very controversial, especially in debates on the efforts to tackle climate change. This study contributes to these debates by demonstrating that, in Canada, the industrial firms most committed to tackling climate change tend to have better financial performance than other firms. Although the economic impacts of environmental actions have been widely studied in the literature, the positive relationship between GHG commitment and financial performance had not previously been clearly demonstrated.

In general, this win-win rationale has often been explained by the economic benefits of some environmental policies (energy efficiency, reduced consumption of resources, etc.) and by new capabilities developed by the most proactive companies (Nitin et al., 2009; Hoffman, 2006; Hoffmann et al., 2009). Another plausible hypothesis is that those companies that are best managed and best performing from an economic point of view are more likely to incorporate environmental concerns than others (Roy et al., 2001). This hypothesis was explored in this study, by examining alternative models in which financial performance influenced the commitment of the company or the motivation behind this commitment. However, the SEM results showed that the validity of these alternative models was lower than that of the proposed model. In light of this, we can assume that efforts to reduce GHG emissions actually have a positive effect on financial performance. This study thus responds to Weinhofer and Hoffmann's (2010) appeal to deepen our understanding of this relationship.

Description of path and expected sign	Path coefficients							
	Environmental exposure[1]		Environmental strategic management		ISO 14001		Size	
	Low	High	Low	High	No	Yes	Small	Large
GHG pressure → GHG performance	−0.165	−0.131	−0.266*	0.056	−0.124	−0.237	−0.229	0.002
GHG commitment → GHG performance	0.708**	0.479**	0.536**	0.659**	0.637**	0.599**	0.642**	0.590**
GHG pressure → GHG commitment	0.843**	0.607**	0.742**	0.772**	0.796**	0.636**	0.820**	0.703**
Business motivations → GHG commitment	−0.319*	−0.176	−0.245*	−0.295**	−0.205*	−0.210	−0.252*	−0.275*
Environ. and social motivations → GHG commitment	0.388**	0.260*	0.418**	0.268*	0.215*	0.446**	0.322**	0.334**
GHG performance → Financial performance	0.479**	0.477**	0.446**	0.552**	0.538**	0.327**	0.547**	0.453**
R^2 for GHG commitment	0.786	0.417	0.661	0.647	0.662	0.538	0.745	0.554
R^2 for GHG performance	0.332	0.171	0.146	0.494	0.296	0.235	0.223	0.350
R^2 for financial performance	0.230	0.227	0.199	0.305	0.289	0.107	0.300	0.205
Fit indices of the model:								
chi square	240.68	242.47	238.09	234.62	289.62	206.74	238.19	252.70
d.f.	145	145	145	145	145	145	145	145
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NNFI	0.96	0.94	0.96	0.96	0.96	0.94	0.96	0.96
CFI	0.97	0.95	0.97	0.97	0.97	0.95	0.97	0.97
RMSEA	0.07	0.07	0.06	0.07	0.07	0.06	0.07	0.07
Number of cases (n)	144	132	173	146	208	111	143	176

Table 4. Standardized results of subgroup analyses
*P < 0.05; **P < 0.01.
[1]This information was not available for all the organizations included in our sample.

Paradoxically, the results of the study also show that economic motivations do not positively influence corporate commitment to reduce GHG emissions. Our findings indicate that this commitment is primarily motivated by environmental and social concerns (e.g. public demonstration of the company's commitment, ethical issues, pollution reduction) and by pressure from various stakeholders (e.g. the head office, general public, environmental groups).

The possible reduction in production costs, better response to consumer demands, or improved access to capital that could result from efforts to tackle climate change are negatively correlated with the commitment to reduce GHG emissions. This result runs counter to studies that emphasize this type of motivation as a driving force (Kearney, 2010; Okereke, 2007; Hoffman, 2006; Okereke and Russel, 2010; Ernst & Young, 2010; Deloitte & Touche, 2006). Moreover, this result seems to be contrary to the win-win reasoning that this study supports overall. This apparent paradox may be explained in several ways. On the one hand, for many in senior management, efforts to reduce GHG emissions represent not only possible benefits but also potential costs, thus the economic arguments may not prevail in the decision to move ahead, or not, on such commitments. On the other hand, efforts to reduce GHG emissions can result in benefits that executives have not foreseen. For example, the willingness of leaders to reduce pollution and improve corporate social responsibility can lead to profitable innovations or a reduction in the firm's consumption of costly fossil fuels. Finally, the results of the sensitivity analysis showing the influence of certain contextual factors should not be underestimated. The negative relationship between economic motivations and GHG commitment was not significant for companies with high exposure to environmental risks or for those that have adopted ISO 14001 certification. Thus, for companies that have already incorporated environmental management into their organizational practices, economic motivations would play less of a role in their decision to commit to reducing GHG emissions.

Interestingly, although institutional pressures can influence the corporate commitment to reduce GHG emissions, they do not have a direct impact on actual GHG performance, contrary to our expectations. This result can be explained by the nature of such pressure. In Canada, in the absence of mandatory regulations with specific targets for reduced GHG emissions, pressure from stakeholders can be quite weak and ineffective, resulting in superficial responses from firms or implementation of measures that do not really improve performance. This type of disconnect between institutional pressures and the real efficacy of the measures put in place in response to those pressures has been highlighted by various schools of thought, particularly the neo-institutional theory (DiMaggio and Powell, 1983; Boiral, 2006; Delmas and Montes-Sancho, 2010). According to this view, in response to external pressures, companies adopt measures that are intended primarily to improve their social legitimacy without necessarily re-examining their internal practices. This theory does not necessarily call into question the necessity of considering the expectations of stakeholders who are concerned with climate change (Kolk and Pinkse, 2007a; Esty, 2007; Sprengel and Busch, in press); however, it shows that such consideration may be largely symbolic and does not necessarily lead to measurable improvements.

The same applies for the adoption of environmental management systems such as ISO 14001. This system had been adopted by 29.8% of the firms in the study sample. An examination of alternative models in which ISO 14001 certification influenced GHG performance did not yield conclusive results, thus implementation of this standard does not appear to improve the efficacy of strategies to reduce GHG emissions. This result may seem paradoxical given the environmental purpose of this standard. However, it is possible that companies have not yet had time to truly integrate climate change concerns into their environmental management system or, alternatively, that the system is geared to improving the company's image more than their real performance, as some studies suggest (Jiang and Bansal, 2003; Boiral, 2007).

Our findings have several implications for corporate executives and for public policy on the environment. Firstly, they suggest that businesses would generally benefit from being more proactive in dealing with climate change issues and by reconsidering their ingrained resistance stemming from financial concerns. Although such resistance can be quite legitimate, according to our findings it does not constitute an argument justifying the status quo that prevails in many industrial sectors in Canada. The process of seeking ways to reduce GHG emissions can represent, in itself, a source of increased competitiveness, in addition to the environmental and social benefits that may result.

Secondly, the results of this study suggest that policymakers should push companies harder to commit to tackling climate change. The paradox between the overall win-win logic demonstrated in this study and the negative role of economic motivations may be partly explained by the dominant political discourse in Canada on the supposed economic risks of efforts to reduce GHG emissions, particularly in terms of international competitiveness. While this study was not designed to explore those risks, the findings do tend to undermine their legitimacy. Our results also suggest that institutional pressures should be more effective and positively influence GHG performance. Although this link was not validated in our study, it appears logical and its implementation would be likely to involve the establishment of clearer rules and regulations. It would also require better stakeholder surveillance of the actual GHG performance of companies.

Although this study enhances our knowledge of the challenges and consequences associated with corporate responses to climate change, the results should be interpreted in the context of its limitations. The unique characteristics of Canadian policies on these matters are likely to influence some of the relationships in the proposed model (Jeswani et al., 2008; Pinkse, 2007; Kolk and Pinkse, 2007a). Although the Kyoto Protocol has been ratified by the Canadian government, no binding regulations had been put in place in Canada when this study was conducted in 2008. Thus, a priori for Canada, regulations have only a slight bearing on the constructs of GHG pressures and environmental motivations used in the model. The various action plans announced by the federal government never really resulted in substantive measures, apart from the signing of several voluntary agreements with some companies, particularly as part of the Canadian Climate Change Voluntary Challenge and Registry Program (Brouhle and Harrington, 2009). However, the efficacy of this type of voluntary agreement in terms of the commitment of firms and their environmental performance remains very unclear (Baranzini and Thalmann, 2004; Glachant, 2007; Delmas and Montes-Sancho, 2010). It is difficult to analyze the possible role of the specific geographical location of companies, due to the complexity of how jurisdiction in environmental matters is distributed between the federal government and the provinces (Brouhle and Harrington, 2009). However, when the study was conducted, none of the Canadian provinces had established binding measures or clear targets for reduction of GHG emissions by industrial companies. The very recent announcement of GHG reduction targets by some provinces, in particular Quebec (20%), Ontario (15%), and British Columbia (11%), has not yet resulted in mandatory measures for industry. In addition, the federal government has criticized the targets announced by some provinces. This was especially the case for Quebec, where the federal Minister of the Environment declared that the GHG reduction targets announced by the province in 2010 were too ambitious and put business competitiveness at risk, particularly in the automotive sector. In general, the Canadian system of governance with respect to reducing GHG emissions allows companies considerable leeway (Eberlein and Matten, 2009) and can be likened to market governance (Griffiths et al., 2007). This system of governance is characterized by a very weak real commitment from the government and a lack of clearly established institutional coordination mechanisms. In this context, the corporate commitment to reduce GHG emissions is largely voluntary and filled with uncertainty about possible implementation of new public policies.

In general, further research on the factors that influence the GHG performance of companies would be very useful. For example, future research could explore the roles of technological innovations, competitive positioning of businesses, or the environmental values held by senior management. Having an established policy and specific targets for reducing GHG emissions could also influence performance in this area. It would also be of interest to measure the influence of a company's vulnerability to the physical impacts of climate change on its corporate commitment. To date, very few management studies have attempted such a comparison (Hoffman, 2006; Winn et al., 2011). However, geographical location and the potential biophysical impacts of climate change may help explain why certain companies are more proactive than others.

The role of the regulatory and public policy context could also be studied using an approach based on a comparative analysis of the GHG emission performance of companies within the same industry but located in different regions of the world. Regulatory pressures and governmental policies to reduce GHG emissions may indeed vary significantly from one country or region to another (Helm, 2008, Falkner et al., 2010). Moreover, such differences in the goals set by each country and in the regulatory constraints imposed on firms are the source of many criticisms of the Kyoto Protocol (Pinkse and Kolk, 2009; Boiral, 2006). Further research on the relationship between the GHG pressures, GHG performance, and financial performance of companies could help determine to what extent these criticisms are justified. The model proposed in this paper could be used to explore the relationships between these variables in research conducted in different regions of the world.

Another useful avenue of research would be the role played by the relative unpredictability of the economic impacts of corporate commitments to reduce GHG emissions. Indeed, our findings suggest that, in contrast to environmental and image-oriented motivations, business-oriented motivations do not positively influence corporate GHG commitment. This negative relationship may be partly explained by senior management's uncertainty concerning the real economic impacts of efforts to reduce GHG emissions. If corporate leaders were more convinced that such efforts can actually have a positive influence on financial performance, it could reasonably be assumed that they would have stronger business-oriented motivations for making a commitment to reduce GHG emissions. It can also be assumed that increased uncertainty concerning the economic impacts of efforts to reduce GHG emissions does not encourage proactive efforts in this area. The degree of uncertainty concerning the potential positive or negative economic impacts of efforts to reduce GHG emissions could thus be an important variable affecting corporate commitment. Unlike the influence of regulatory uncertainty, which has been examined in many studies (Jones and Levy, 2007; Luo, 2004; Boiral, 2006; Hoffmann et al., 2009; Engau and Hoffmann, 2011b), uncertainty about the economic impacts of efforts to reduce GHG emissions does not seem to have been studied in great depth. Presumably, this prevailing uncertainty is driven in part by political debates on the economic impacts of the Kyoto Protocol. The lack of empirical studies on these impacts also tends to increase uncertainty. The degree of uncertainty about economic impacts may also vary by geographical region, depending on the public policies adopted to reduce GHG emissions, such as tax incentives and subsidies, and on whether a carbon emissions allowance market has been established, as well as the prevalence of a win-win or win-lose discourse among political leaders. It might also depend on the type of practices implemented by businesses to reduce GHG emissions.

Although this study cannot determine what the best practices to improve performance would be, it is clear that the processes implemented to reduce GHG emissions will depend on the sectors involved and cannot rely on universal solutions. More in-depth case studies would certainly help analyze how solutions adapted to each industry can emerge within organizations and contribute to improving their financial performance. Such case studies would also improve our understanding of the resistance of business leaders to adopting measures to reduce GHG emissions and its apparent contradiction of the prevailing win-win reasoning in the literature.

This resistance is probably not only due to the economic or strategic concerns of business leaders, but also, to some extent, due to their core values and their ability to manage complex problems such as the integration of economic, social, and environmental issues in the process of tackling climate change. In this view, the climate change strategies that companies adopt reflect the complex management challenges posed by introducing the concept of sustainable development into the corporate world. It is likely that these challenges will only be truly addressed by companies when the rules of the game and the institutional system of governance that underpins monitoring of GHG emissions become clearer in Canada, as elsewhere in the world.

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Appendix A: Description of the Sample

Position of respondent

		Experience within the firm (average in years)
CEO/general manager	21%	19.3
Senior executive/other manager	43.3%	11.9
Production manager	6.6%	12.4
Director of environmental affairs	14.7%	13.1
Other manager of environmental affairs	11.3%	15.1
Information not available	3.1%	14.0
Average		14.1

Level of education of respondent

Secondary	3.4%
Post-secondary (other than university)	25.1%
University – undergraduate level	45.5%
University – graduate level	23.8%
Information not available	2.2%

Company size

Number of employees	% of companies
<100	10.7
Between 100 and 149	23.8
Between 150 and 299	29.8
Between 300 and 499	25.0
>500	10.7
Average	342

Appendix B: Questionnaire Items and Statistics of Measurement Analysis

Pressure to reduce GHG emissions pressure

To what extent is your facility under pressures to reduce its GHG emissions from the following actors?

Scale: 1 = No pressure, to 5 = High pressure.

Items (mean score; standard deviation)	Initial model: Standardized loadings	Initial model: R^2	Re-specified model: Standardized loadings	Re-specified model: R^2
Headquarters (2.6; 1.6)	0.751**	0.564	-	-
Public, citizens (2.2; 1.5)	0.922**	0.851	-	-
Environmental groups (2.3; 1.5)	0.894**	0.799	-	-
Customers (2.2; 1.4)	0.879**	0.773	-	-
Government (regulations, public policies, etc.) (2.7; 1.5)	0.811**	0.657	-	-
Financial institutions and insurance companies (2.1; 1.4)	0.895**	0.802	-	-
Stockholders (2.4; 1.6)	0.821**	0.674	-	-
Employees (2.4; 1.4)	0.851**	0.725	-	-
Goodness-of-fit of the model:	x^2 (19) = 115.44, P < 0.001; NNFI = 0.97; CFI = 0.98; RMSEA = 0.12		-	
Cronbach alpha:	0.96		-	
Composite reliability:	0.96		-	
Variances extracted:	0.73		-	

**Significant at the 0.01 level.

Business Motivations

Please indicate the extent to which the following elements influence the environmental commitment of your facility.

Scale: 1 = No influence at all, to 5 = Very strong influence.

Items (mean score; standard deviation)	Initial model: Standardized loadings	Initial model: R^2	Re-specified model: Standardized loadings	Re-specified model: R^2
Marketing/advertising opportunity (3.1; 1.2)	0.486**	0.236	-	-
Reducing production costs (3.9; 1.1)	0.583**	0.340	0.570**	0.325
Increasing shareholder value (3.1; 1.3)	0.717**	0.514	0.644**	0.415
Customer requirement (3.3; 1.3)	0.671**	0.450	0.679**	0.461
Greater access to capital (2.7; 1.2)	0.738**	0.544	0.707**	0.500
Goodness-of-fit of the model:	x^2 (5) = 28.24, P < 0.001; NNFI = 0.91; CFI = 0.96; RMSEA = 0.12		x^2 (2) = 1.28 P = 0.53; NNFI = 0.99; CFI = 1.0; RMSEA = 0.0	
Cronbach alpha:	0.74		0.75	
Composite reliability:	0.78		0.75	
Variances extracted:	0.42		0.43	

**Significant at the 0.01 level.

Environmental and Social Motivations

Please indicate the extent to which the following elements influence the environmental commitment of your facility.

Scale: 1 = No influence at all, to 5 = Very strong influence.

Items (mean score; standard deviation)	Initial model: Standardized loadings	Initial model: R^2	Re-specified model: Standardized loadings	Re-specified model: R^2
Public demonstration of environmental stewardship (3.3; 1.2)	0.638**	0.407	0.638**	0.407
Reducing environmental impacts and pollution (4.1; .92)	0.734**	0.538	0.732**	0.535
Improving regulatory compliance (4.0; .97)	0.474**	0.225	–	–
Top managers' social responsibility and ethical concerns (3.8; 1.0)	0.628**	0.394	0.627**	0.393
Employee involvement (3.1; 1.1)	0.587**	0.344	0.576**	0.332
Corporate headquarters requirement (3.2; 1.4)	0.514**	0.264	–	–
Demonstrating environmental leadership in our industry (3.6; 1.2)	0.767**	0.589	0.784**	0.614
Goodness-of-fit of the model:	x^2 (14) = 40.51, P < 0.001; NNFI = 0.95; CFI = 0.97; RMSEA = 0.08		x^2 (5) = 19.45, P < 0.001; NNFI = 0.96; CFI = 0.98; RMSEA = 0.09	
Cronbach alpha:	0.81		0.80	
Composite reliability:	0.82		0.81	
Variances extracted:	0.39		0.46	

**Significant at the 0.01 level.

Greenhouse Gas (GHG) Emissions Commitment

To what extent do the following statements describe your facility's commitment to reduce GHG emissions?

Scale: 1 = Totally disagree, to 5 = Totally agree.

Items (mean score; standard deviation)	Initial model: Standardized loadings	Initial model: R^2	Re-specified model: Standardized loadings	Re-specified model: R^2
Our top managers are concerned about global warming (3.7; 1.2)	0.638**	0.407	-	-
Our facility supports the Kyoto protocol (3.3; 1,3)	0.577**	0.333	-	-
Our facility has a proactive strategy to cut GHG emissions (3.1; 1.5)	0.964**	0.930	-	-
We disclose to the public information about our facility's GHG emissions (2.8; 1.7)	0.673**	0.452	-	-
Goodness-of-fit of the model:	x^2 (1) = 0.361, P = 0.548; NNFI = 1.0; CFI = 1.0; RMSEA = 0.0			
Cronbach alpha:	0.82			
Composite reliability:	0.81			
Variances extracted:	0.53			

**Significant at the 0.01 level.

Greenhouse Gas (GHG) Emissions Performance

Please rate the environmental performance of your facility over the past three years relative to others in your industry on each of the following items.

Scale: 1 = Much worse, to 5 = Much better.

Items (mean score; standard deviation)	Initial model		Re-specified model	
	Standardized loadings	R^2	Standardized loadings	R^2
Regulatory compliance (4.1; 0.9)	0.677**	0.458	-	-
Air emission levels (3.9; 1.0)	0.922**	0.849	-	-
GHG emissions (3.8; 1.1)	0.863**	0.745	-	-
Goodness-of-fit of the model:	x^2 (0) = 0, P = 0.0; NNFI = 1.0; CFI = 1.0; RMSEA = 0.0			
Cronbach alpha:	0.86			
Composite reliability:	0.86			
Variances extracted:	0.68			

**Significant at the 0.01 level.

Financial Performance

Please rate the overall performance of your facility over the past three years relative to others in your industry on each of the following items.

Scale: 1 = Much worse, to 5 = Much better.

Items (mean score; standard deviation)	Initial model		Re-specified model	
	Standardized loadings	R^2	Standardized loadings	R^2
Sales growth (3.6; 1.1)	0.853	0.727	-	-
Profits (3.5; 1.2)	0.954	0.910	-	-
Return on sales (3.5; 1.1)	0.943	0.889	-	-
Return on investments (3.5; 1.2)	0.909	0.826	-	-
Goodness-of-fit of the model:	x^2 (2) = 2.34,		-	
	P = 0.311;			
	NNFI = 0.99;		-	
	CFI = 1.0;			
	RMSEA = 0.02		-	
Cronbach alpha:	0.95		-	
Composite reliability:	0.95		-	
Variances extracted:	0.84		-	