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# Strategic Approaches to $CO_2$ Emissions The Case of the Cement Industry and of the Chemical Industry

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## Abstract

The ability of companies to turn an environmental constraint into a source of strategic opportunities is a controversial topic in published research. The article, which is based on a comparative study of the $CO_2$ emission reduction strategies implemented by the cement and chemical industries, shows that companies' freedom to adopt a proactive approach to sustainable development is severely constrained by the characteristic features of the sector, in terms of its dependence on natural resources, of flexibility in the composition of the business portfolio, and of the structure of the downstream sector.

JEL-Code: Q580.

Keywords: $CO_2$, sustainable development, corporate strategy, innovation.

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## 1. Introduction

The global warming debate has undergone significant changes over the past decade. One of the main causes of global warming is the increase in man-made greenhouse gas (GHG) emissions. Companies are involved in two ways: as GHG emitters and as participants in the development of new management models, where there will be no connection between economic growth and GHG emissions (McKinsey Global Institute 2008). Since the Rio Summit in 1992, many countries have committed to combat climate change, and a vast array of regulatory and incentive-based instruments has gradually been introduced. Within the Kyoto Protocol framework, the European Union has therefore chosen to spread its 8% GHG emission reduction target among its various Member States. To achieve this target, the European Union Emission Trading Scheme (EU-ETS), which covers the GHG emissions of industrial and electrical installations, was set up in 2005. The third phase of the EU-ETS, which covers the period between 2013 and 2020, has now set a 21% emission reduction target compared with 2005.

Some companies, which anticipated the development of these regulations, have unilaterally launched strategic initiatives aimed at reducing the environmental impact of their business activities. For instance, we have seen an expansion in branch agreements, such as those coordinated by the WBCSD[5] for steel and cement, or the agreements steered by professional organisations, like in the chemical industry. Economists often view these voluntary approaches as attempts to pre-empt the regulations (Morgensten and Pizer 2007). However, although most of the regulations are now in place, these voluntary approaches are still ongoing: aside from its regulatory aspect, climate change would therefore seem to have become a strategic issue for some companies. In fact, a number of companies are developing their own ambitions in this area, by seeking to make it a competitive differentiation point (Heal 2005). Based on this observation, this article proposes to examine this strategic dimension at a sector level.

Using on a two-stage model (Arjaliès and Ponssard 2010) that distinguishes between a so-called "compliance" approach (i.e. a compulsory exercise) and a second stage, which is described as "opportunistic" (i.e. a voluntary exercise), the article examines and compares two business sectors that emit particularly high levels of $CO_2$., i.e. the chemical industry and the cement industry. The article shows that companies' ability to innovate when dealing with $CO_2$ is constrained or encouraged by structural factors that are inherent to their business sector. Specifically, it identifies three key factors that help explain why some sectors are able to come up with proactive strategies for combating climate change (e.g. the chemical industry), while others adopt more reactive approaches (e.g. the cement industry). The factors in question are: 1) the dependency of the production process on natural resources, 2) the ability to leverage the business portfolio, and the resulting role for R&D, and 3) the structure of the downstream sector.

The article is structured as follows. After repositioning our approach in the context of published research in Section 2, Section 3 describes the two business sectors that we have selected and the assumptions put forward. An empirical analysis is carried out in Section 4, while Section 5 draws conclusions on the study's implications for the relationship between sustainable development and strategic innovation, based on a discussion of the main outcomes.

## 2. The relationship between CSR and strategy: a theoretical basis

Three kinds of arguments have traditionally been put forward in published research, in order to justify a company's strategic choices in terms of environmental issues, and more broadly in terms of CSR. The "business ethics" trend takes the view that a company must address these

[5] World Business Council for Sustainable Development

issues due to its moral obligation towards society rather than for economic reasons (Goodpaster 1983). The "business and society" trend (Wood 1991) asserts that a company is a social institution created by society, to which it answers, and that society can put an end to its business activities if they are inappropriate. This approach, which is nowadays regularly described as the CSR theory, has primarily relied on neo-institutional theory (DiMaggio and Powell 1983), and on stakeholder theory (Freeman 1984). According to these authors, a company incorporates CSR into its strategy primarily as a result of the institutional constraints that weigh on it and require it to meet its stakeholder expectations in order to preserve its legitimacy (i.e. licence to operate). Lastly, the "business case" approach (Vogel 2005) sees CSR as a source of strategic innovation that enables the company to improve its economic performance.

These three trends do not contradict, but complement one another. Indeed, it seems reasonable to believe that a company's strategic CSR choices are the result of considerations that are ethical, institutional, and business related at the same time. However, given the pre-eminence of business-related arguments where combating global warming is concerned (Stern 2006), we have chosen to focus on the arguments put forward by the "business case" approach. More specifically, we would like to gain a better understanding of why some companies see reducing $CO_2$ emissions as a source of strategic opportunities, while others essentially view this process as a constraint that they have to manage. In order to identify the possible explanations for such differences, we will explore the various arguments that have been developed in the "business case" approach. We are assuming that the strategic choices made where reducing $CO_2$ emissions is concerned are largely determined by sector-specific characteristics, a dimension that is often overlooked in the published research.

The "business case" trend has recently seen a renewal of interest from the academic and professional communities. This renewed interest has specifically resulted in the publication of several articles in the *Harvard Business Review*. For instance, Porter and Kramer (2006, 2011) make a distinction between "Responsive CSR", which aims to meet stakeholders' expectations and to mitigate the negative effects of regulatory constraints on the value chain (i.e. a risk-based approach) and "Strategic CSR", which aims to go beyond best practices, by making profound changes to the company's strategic positioning in relation to its competitors (i.e. an opportunistic approach). According to the authors, there are three ways for a company to create what they call "shared value" (i.e. value that combines economic and societal progress), namely re-thinking their products and markets, redefining the productivity drivers along the value chain, and enabling the development of new local business networks. In the same vein, Nidumolu *et al.* (2009) encourage companies to turn environmental compliance into a source of strategic opportunities, by redesigning their entire value chain, and by coming up with new products and services. Meanwhile, Aggeri *et al.* (2005) differentiate between "compulsory exercises" and "voluntary exercises" in the sustainable development field. The "compulsory exercise" sphere defines the standards with which a company must comply in order to reduce the risks relating to sustainable development issues. This reactive approach does not give the company a competitive advantage. Conversely, "voluntary exercises" refer to a series of innovative approaches and practices that call the company's core business and strategic orientations into question. It is these "voluntary exercises" which can lead to value creation by enabling the development of new business models relating to sustainable development.

In a previous article, Arjaliès and Ponssard (2010) put forward a strategy classification that is very much in keeping with this "business case" trend. In this model, they distinguish between two kinds of strategy, and the conditions for switching from one type to the other (see Table 1).

At the first stage, which is known as the "compliance[6]" stage (i.e. the "compulsory exercise"), change appears as a question of managing risk at the group level. The company seeks to limit the changes resulting from $CO_2$-related regulations, primarily through lobbying initiatives, and does not see the regulations as a strategic opportunity. The management systems are relatively unaffected by $CO_2$ emission reduction constraints, except for incremental initiatives, such as improving existing procedures aimed at encouraging greater energy efficiency in the production process. During the second stage, which is described as "opportunistic" (i.e. "voluntary exercises"), the company sees reducing $CO_2$ emissions as an opportunity to recalibrate its ambitions and culture based on a new strategy. The group performs a sector-based review in order to identify the company's strengths and weakness compared with those of its competitors, customers and suppliers. The aim of the new strategic direction is to rethink the company's business model in accordance with the challenge of climate change. Summary targets are set out and disseminated in the Sustainable Development report, and conveyed through internal action plans. These action plans are then explicitly incorporated into the management systems, with operating targets and matching incentives. This stage *two* is very close to the "voluntary exercise" concept developed by Aggeri *et al.* (2005), in terms of both its strategic aims and of its competitive positioning. However, it differs from that concept by its more "micro" nature, since it also focuses on the organisational structure and on the management tools introduced by the company in order to reach its new strategic targets.

The transition from stage *one*, which is based on risk management and compliance, to stage *two*, where the goal is to come up with new innovations and strategic opportunities, specifically requires 1) the company's senior management to acknowledge a strategic opportunity, 2) a cross-divisional R&D, Production and Sales approach in order to draw up targets, and 3) a consistent redesign of the management systems, which allows more room for interactive systems (i.e. systems that promote organisational learning; see, for instance, Simons (1995)).

| Component of the strategy | Strategy 1: Compliance | Strategy 2: Opportunity |
|---|---|---|
| **A. Ambition Value System** | – Seeing climate change as a risk and/or constraint.<br>– No significant change in the company's values. | – Seeing climate change as an opportunity.<br>– Overall change in the company's values. |
| **B. Nature of the industrial and market commitments where $CO_2$ is concerned** | – Carbon intensity of emissions.<br>– No commitments to new products or services (only to ongoing projects). | – Absolute value of emissions.<br>– New products and services that include partnerships, including with NGOs. |
| **C. Positioning in terms of the regulations on $CO_2$ emissions** | – Promoting sector-based agreements.<br>– If not, limiting the impact of unilateral cap and trade[7] systems (free allowances). | – Promoting cap and trade systems.<br>– Single carbon price at the global level. |
| **D. Business portfolio** | – No significant change in the business portfolio. | – Repositioning the business portfolio.<br>– A challenge throughout the value chain. |

[6] In this context, compliance should be understood in a broader sense than strictly complying with rules and standards.

[7] Tradable licence exchanges.

| Component of the strategy | Strategy 1: Compliance | Strategy 2: Opportunity |
|---|---|---|
| **E. The process for managing these commitments** | – Strengthening existing drivers (e.g. energy efficiency). | – New organisational structure that has implications for the strategic business unit reviews.<br>– Experience-sharing centres (cross-divisional component of product innovation).<br>– Impact on remuneration. |

**Table 1 – Strategic model proposal (according to Arjaliès and Ponssard, 2010)**

Although the sector-based aspect is a recurring factor in the research on competitive strategies performed by companies since Porter's (1980) textbook, we observe that this aspect has remained relatively unexplored in the various strategic approaches to CSR, which prefer to emphasise the company's potential to change (Aggeri *et al.*, 2005). This is all the more surprising given that the extra-financial research performed by asset management companies in order to achieve a better financial performance almost always relies on a sector-based approach. Based on this observation, this report will seek to gain a better understanding of the potential impact of the sector on the various strategic components identified in the previous model (see Table 1). Given the methodology constraints, we wanted to focus on the first five components (A to D), and to leave the assessment of management processes for subsequent studies.

The sector-based strategic analysis that we are proposing conventionally relies on identifying the main value-added stages, the importance and nature of the $CO_2$ at each of these stages, and the possible drivers for reducing $CO_2$. We will also consider a more specific approach, which combines sector-based business factors with societal issues (Hommel and Godard 2001). These authors addressed the following question: why are proactive CSR behaviours far from uniform? The authors' assumption is that the level of proactivity cannot simply be explained by the potential loss of legitimacy (licence to operate) following opposition by civil society. It is due to the existence of significant and non-recoverable investments (according to Baumol *et al.*'s (1982) theory of contestable markets, (1982)) e.g. building a plant with a long useful life that cannot be relocated, and which means making major CSR commitments.

## 3. Influence of the business sector on strategic choices in terms of $CO_2$

### 3.1. The role of $CO_2$ in a sector-based analysis: risk versus opportunity

A strategic analysis usually begins by positioning the sector in question in relation to five "competitive forces": upstream, downstream, new entrants, substitutes, and internal competition (Porter 1980). We are applying this matrix in order to identify the impact of $CO_2$ on margins for manoeuvre, and on the constraints that weigh on all the companies in both the sectors that we examined. Our analysis is based on Figures 1 and 2.

The cement sector is relatively simple to study. Its product is uniform, and not very expensive to produce compared with its land transport cost. Bulk sea transport costs are relatively low, and the corresponding flows can have a major impact on regional balances. The major companies in the sector are multi-nationals, which operate in a large number of countries and take advantage of their plant network in order to optimise their production. The production process as such is well identified, – the production of clinker – and also represents the main source of $CO_2$ (through the decarbonisation of limestone, and due to the power required for this high-temperature operation). The actual cement is obtained by crushing and adding various ingredients to the

clinker, primarily slag and fly ash. At the end stage, cement represents a major portion of the components in three markets: infrastructure, industrial and commercial buildings, and single homes. The $CO_2$ issue for the last two market segments is related not only to the carbon footprint of the components, but also to their energy efficiency throughout their life cycle (including the carbon footprint relating to the cement industry's upstream inputs). According to the EIA's statistics (2004), the cement sector accounted for around 18% of global Scope 1 $CO_2$ emissions in 2000 (Baumert *et al.* 2005)[8].

The main drivers for limiting emissions involve the clinker production process (greater energy efficiency and changing the fuel mix), increasing the clinker additives, and potential changes to products and procedures in order to improve energy efficiency at the actual construction level.

The options for a company to differentiate itself in terms of $CO_2$ at the cement production level appear limited, due to the strong uniformity of the clinker production process, mature technology, and the limited availability of additive sources. The sources of differentiation initially appear more significant downstream. Conversely, this level is highly fragmented, due to a large number of players from various business sectors, the importance of regional factors, and a wide array of regulations.

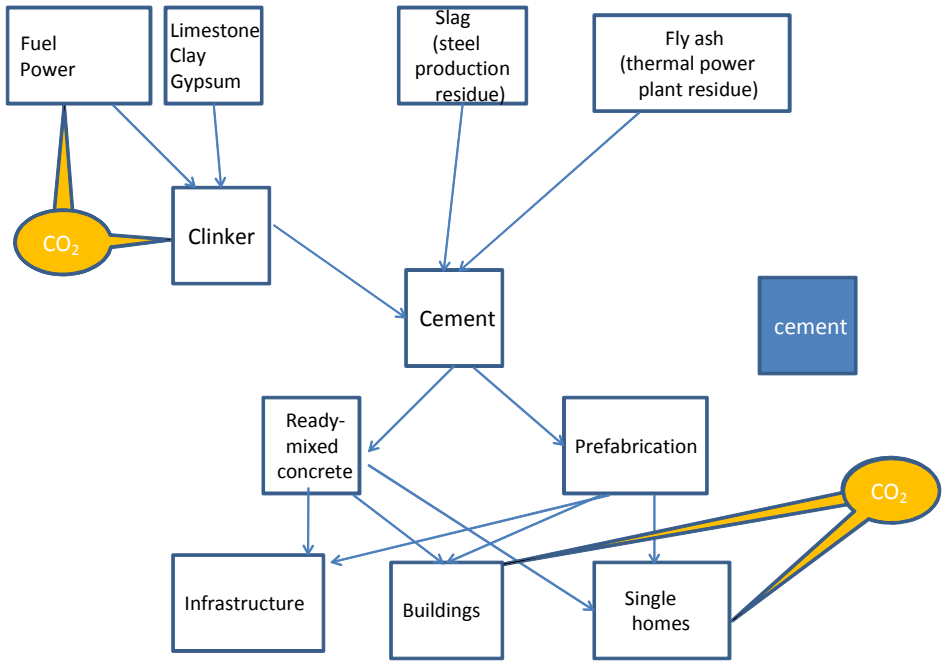


**Figure 1 – The cement sector value chain**

The chemical sector is much more complex. It includes a number of production processes, which range from base chemicals (ammonia, benzene, ethylene and propylene, etc.) to processes that vary depending on the type of application, such as speciality chemicals, so-called life science chemicals, and mass market chemicals. According to the CEFIC (European Chemical Industry Council), base chemicals accounted for 60% of sales in the European sector in 2009. The

[8] Scope 1 includes all direct GHG emissions, Scope 2 includes indirect emissions relating to energy consumption, while Scope 3 includes all other indirect emissions.

companies are very diverse in terms of their positioning in these various businesses and of their size.

It is worth noting that most large companies in the sector break down their businesses by market. In this context, we find application segments like the car manufacturing industry, farming, electronics and bagging, etc. alongside the segments shown here. The specific issues of these markets require rapid product renewal, which means that R&D plays a major role in the sector. R&D expenditure amounts to 4% of sales (Source: CEFIC), while this percentage is less than 1% for the cement industry (Source: annual reports).

The $CO_2$ issue and the corresponding drivers depend on the inputs (fossil fuels that can be partly substituted by low-carbon biomass products, in proportions that are much higher than those for the cement industry), and on the energy required at the various production stages (energy efficiency). In Scope 1 terms, again according to the EIA statistics, the chemical sector accounted for around 23% of global $CO_2$ emissions in 2000. Due to its upstream positioning, the chemical industry is also in a position where it can leverage its customers' carbon footprint. In cases where these customers are large companies, the industry is in a position to develop applications that are likely to have a rapid effect on major markets, where products and solutions often rely on joint ventures with powerful partners.

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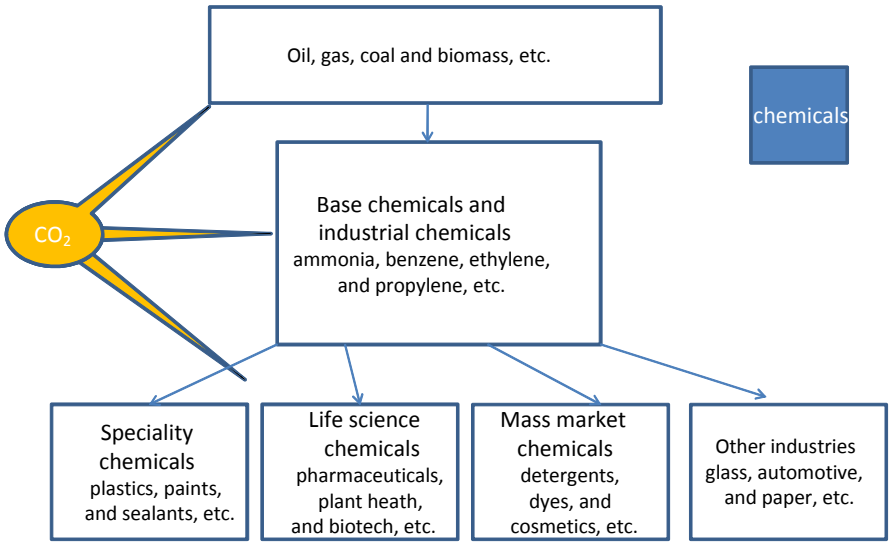


**Figure 2 – The chemical sector value chain**

This sector-based assessment leads us to put forward a first assumption.

**Assumption 1:** *The $CO_2$ issue is mainly focused on the production process for the cement industry. It is more disparate for the chemical industry, i.e. it relates to the production process, as well as to the potential impact on the company's entire business portfolio, both upstream and downstream.*

### 3.2. The role of $CO_2$ in a sector-based analysis: economic and social contestability

At this point, we refer to the approach developed by Godard and Hommel (2001). Where the issues relating to the economic and social contestability of $CO_2$ are concerned, we might initially think that there is no significant difference between the chemical and cement sectors. Indeed, companies in these sectors should initially commit to proactive CSR strategies, in order to safeguard the mostly irreversible nature of their industrial investments, which are highly capital intensive.

In reality, however, there are major differences between the two sectors, which mainly result from the place that $CO_2$ occupies among all the external effects generated by both businesses. On the one hand, the cement industry primarily emits $CO_2$ and few other greenhouse gases, while the chemical industry emits a whole series of GHGs, where the equivalent $CO_2$ multiples can go up to over 10,000, for HFCs for instance, but which, specifically, can also have extremely toxic effects, as demonstrated by the disasters ingrained in popular memory. On the other hand, the directly visible negative effects that are often associated with cement production primarily relate to the operation of giant quarries, which create a whole range of nuisances during their operation (vehicle traffic, and dynamiting of rocks, etc.), and which are likely to leave gaping holes in the landscape at the end of their operation. Proactive policy in the sector has therefore primarily focused on controlling these social opposition factors.

These considerations lead us to put forward our second assumption.

**Assumption 2:** *The issues surrounding $CO_2$ will naturally be incorporated into a broad proactive policy in the chemical sector, while remaining circumscribed in the cement industry.*

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**Methodology**

This article is based on studies of exploratory cases that aim to compare six or seven multi-national companies in each business sector (see Table 2). The companies are not statistically representative, and were selected on the basis of the role that they play in their sector (i.e. a leading role) and in their country of origin (i.e. geographical diversity). The analysis was carried out in three stages:

- First, we identified the main issues by carrying out an exploratory study on DuPont and Lafarge. This study was based on 1) interviews and meetings with several members of the senior management team who are responsible for strategy and/or for issues relating to $CO_2$, 2) on internal documents that were made available to us and 3) on secondary sources like institutional documents, the CDP (Carbon Disclosure Project[9]) and research by societal rating agencies. We built our theoretical model (see Table 1) on the basis of this information.
- We then carried out a comparative analysis of $CO_2$ strategies over a 20-year timeframe, which enabled us to observe genuine changes in the strategic behaviour of the groups that we examined. The limitations of the available data led us to draw up our study framework over a period ranging from 2000 to 2009 for annual report data and as from 1990 - or the benchmark year - for $CO_2$ emissions. To validate our assumptions, we processed the data according to the following methodology:
    1. We gathered financial data for the companies that we examined from the annual business reports that were available for the period between 2000 and 2009. Based on this data, we studied both the trend in overall revenues and their actual structure, i.e. core businesses and geographical regions. We also recorded annual R&D investments and annual $CO_2$ emissions on a net or carbon intensity basis for the goods produced.
    2. The 2nd stage consisted in observing these economic data by comparing them with published $CO_2$ emissions - on an overall basis, or according to their carbon intensity per product - over the same period, in view of the $CO_2$ emission reduction commitments made by these companies.

[9] The Carbon Disclosure Project is an NGO for institutional investors that gathers information from 2,500 multi-national companies on their ambitions, strategies, action plans and results in terms of $CO_2$ emissions. All the data gathered by the CDP are in the public domain.

3. The 3rd stage involved checking that the information found at Stages 1 and 2 matched the answers provided in the CDP.
4. Lastly, during the final stage, we analysed the change in management's comments thanks to the use of key words, in order to assess the way in which the company's ambitions had changed between the first sustainable development reports available and the last reports, for 2009.

| Cement industry | Total net emissions in 2009 (mt) | Chemical industry | Total net emissions in 2009 (mt) |
|---|---|---|---|
| Lafarge | 92.0 | DuPont | 16.2 |
| Holcim | 89.3 | Bayer | 8.1 |
| Cemex | 39.7 | Bayer Material Science | 4.8 |
| Italcementi | 36.3 | Bayer Health Care | 0.5 |
| Heidelberg | 52.8 | Bayer Crop Science | 1.1 |
| CRH | 9.8 | Rhodia | 5.3 |
| Titan | 8.7 | BASF | 29.3 |
| | | AkzoNobel | 4.6 |
| | | Dow Chemical | 41.3 |

**Table 2 – Companies analysed in each business sector**
(Sources: 2009 annual business reports, 2009 SD reports, websites and CDP)

## 4. Empirical analysis

The following approach consists in reviewing the four components of the strategy, as identified in Table 1, and in testing how close companies are based on these components. In summary, we will show that companies in the cement sector seem to follow a "compulsory" exercise, which is characteristic of Phase One, while companies in the chemical sector seem "freer" to engage in innovation strategies. We will return to the contribution made by these results in terms of validating Assumptions 1 and 2 in the following section.

### 4.1. Ambitions and value system (Component A)

In order to understand each company's ambition, we analysed the Chairman's Letter that introduced the Sustainable Development reports between 2000 and 2009. First, we carried out a quantitative analysis based on the presence of key words relating to three kinds of issues:

- The role of climate change and of issues relating to $CO_2$,
- The role of innovation,
- The role of issues relating to the market, and more generally to the value chain.

The corresponding results are shown in Tables 3a and 3b. Furthermore, a more qualitative analysis (our understanding of the strong messages featured in these letters) enabled us to give a more summary meaning to these quantified ambitions.

Our analysis tends to show that, in the cement sector, Holcim and CRH are the companies that emphasise climate change as a global societal issue, by insisting on the importance of sustainable construction in order to control $CO_2$ emissions by improving buildings' energy performance. Lafarge also addresses this topic, but it is not directly reflected in its ambitions, which remain characterised by the group's traditional values. In the chemical sector, BASG and DuPont associate $CO_2$ with global societal issues. This is also the case for Bayer, even if it is not demonstrated by the quantitative analysis. The Bayer Group's investments in initiatives to

improve the management of agricultural production in India or in the Ecobuilding programme, in partnership with players in the construction industry, provide some examples. These programmes are a response to the global issue of food in the context of climate change and increasing urbanisation in developing countries.

Generally speaking, we observe that the chemical sector's concerns focus almost exclusively on market issues (i.e. 8.57 for market issues compared with 1.38 for general issues relating to climate change) while the cement sector's concerns are spread equally (i.e. 2.55 compared with 2.28). Innovation as such clearly appears to be much more of an issue for the chemical sector than for the cement sector (1.08 compared with 0.37).

| | Holcim | Lafarge | Cemex | Italcementi | Heidelberg | CRH | Average |
|---|---|---|---|---|---|---|---|
| **Climate change & Protection** | 1.00[10] | 1.00 | 0.50 | 0.50 | 1.17 | 3.39 | 1.26 |
| **$CO_2$ or GHG** | 3.25 | 0.50 | 0.25 | – | 0.33 | 1.78 | 1.02 |
| **Total $CO_2$** | **4.25** | **1.5** | **0.75** | **0.50** | **1.50** | **5.17** | **2.28** |
| **Innovation** | **0.25** | **0.50** | **–** | **1.00** | **0.33** | **0.11** | **0.37** |
| **New products & Opportunities** | 0.50 | 0.50 | 0.75 | 0.75 | 0.92 | 1.31 | 0.79 |
| **Consumers & Customers** | 1.00 | 0.25 | 0.50 | 0.50 | 0.17 | 1.39 | 0.63 |
| **Suppliers** | 0.25 | – | 0.25 | 0.50 | 0.17 | 1.39 | 0.43 |
| **Market** | 0.25 | 0.50 | 0.25 | 1.00 | 0.67 | 1.56 | 0.70 |
| **Total market** | **2.00** | **1.25** | **1.75** | **2.75** | **1.92** | **5.64** | **2.55** |

**Table 3a – Analysis of cement company Chairmen's Letters**

| | BASF | Bayer | DuPont | Akzo | Rhodia | Average |
|---|---|---|---|---|---|---|
| **Climate change & Protection** | 0.75 | 3.00 | 1.00 | – | 0.25 | 1.00 |
| **$CO_2$ or GHG** | – | 0.33 | – | 0.33 | 1.25 | 0.38 |
| **Total $CO_2$** | **0.75** | **3.33** | **1.00** | **0.33** | **1.50** | **1.38** |
| **Innovation** | **2.50** | **0.67** | **0.50** | **1.00** | **0.75** | **1.08** |
| **New products & Opportunities** | 1.75 | 1.67 | 3.00 | 3.67 | 0.75 | 2.17 |
| **Consumers & Customers** | 4.75 | 0.33 | 2.50 | 3.00 | 2.50 | 2.62 |
| **Suppliers** | 0.75 | 1.00 | – | – | – | 0.35 |
| **Market** | 3.50 | – | 5.00 | 6.67 | 2.00 | 3.43 |
| **Total market** | **10.75** | **3.00** | **10.50** | **13.33** | **5.25** | **8.57** |

**Table 3b – Analysis of chemical company Chairmen's Letters**
(Sources: Chairmen's Letters in Annual or Sustainable Development reports between 2000 and 2009)

### 4.2. Nature of the commitments in terms of $CO_2$ (Component B)

We then identified the quantified targets that are mentioned in the Sustainable Development reports, to the extent that they directly concern issues relating to climate change and to $CO_2$. We looked for the presence of two kinds of targets:

[10] For Holcim, for instance, the term "climate change" or "climate protection" is mentioned once in each company document, on average.

- Industrial targets that were directly related to emissions;
- Targets relating to products or solutions aimed at the overall value chain.

Tables 4a and 4b summarise the first kind of targets. Each company sets out its targets within a multi-year framework: a target is announced on a given date (the commitment date) for a future date, in reference to a level achieved in the past (not necessarily the date when the commitment is made; for instance 1990 is often used when referring to the Kyoto Commitments), then the nature of the commitment is specified (on an carbon intensity basis or as an absolute value) with the corresponding quantitative target. The company discloses its progress compared with the target every year.

Where the cement sector is concerned, the targets are characterised by a carbon intensity target[11] and by a small difference in terms of the annualised level of the target goal (calculated as the percentage of reduction divided by the number of years between the benchmark and the target). The actual reductions in emissions by 2009 are fairly consistent, with the notable exception of Italcementi.

In the chemical sector, we first of all observe that the commitments shown in the 2009 reports are the result of more recent commitments than those made for the cement industry. This leads us to believe that they are, in fact, renewals of older commitments. We also observe greater diversity: the nature of the targets is split between absolute value and carbon intensity targets. The annualised targets involve broader ranges than for the cement industry, while the 2009 results are significantly more variable. We observe that some companies in the sector attribute their poor carbon intensity results to the 2009 financial crisis (by claiming fixed emissions relating to their operations, despite lower volumes). We can also observe the major problems experienced by companies when anticipating their results in absolute value terms. Such commitments therefore appear to be political commitments, which are intended to give a strong signal in terms of the company's desire to delink its growth and the level of its emissions.

Following our exploratory study (see Section 3), we were expecting to find commitments relating to products and/or markets among the chemical companies. We had noted that DuPont had already committed in 2005 to (i) doubling its R&D investments in projects that are directly related to environmental gains for its customers, (ii) increasing its revenues from products that reduce its customers' carbon footprint or boost their energy efficiency by US$2 billion, and (iii) doubling its revenues from products from renewable resources (green chemicals) by 2015. These targets were repeated and broken down into sub-targets in DuPont's 2010 report (there was no SD report in 2009).

We did not find the same visibility in terms of "market" ambitions among the other chemical companies. Only Akzo Nobel sets out market targets (30% of sales from "eco-premium" products). The other companies do communicate about some green products, or else point to partnerships aimed at developing new solutions, like the Eco-Efficiency Building (WBCSD) project, although they make few specific commitments in this area. Companies in the cement

[11] Except for Lafarge, which also has an absolute value target for its emissions in industrialised countries due to its partnership with the WWF; however, this commitment does not appear to have played an important role from an operating standpoint, as it is highly dependent on the trend in the European market (Source: Lafarge meeting).

sector also communicate on this issue, but none of them has pointed to quantified targets in this area[12].

| Company | Commitment date | Target year & Benchmark year | Type of target | Target goal & Benchmark | Annual carbon intensity target | 2009 result compared with 2009 target |
|---|---|---|---|---|---|---|
| Lafarge | 2000 | 2010/1990 | Carbon intensity | 20% | 1% | 112% |
| Holcim | 2002 | 2010/1990 | Carbon intensity | 20% | 1% | 111% |
| | 2010 | 2015/1990 | Carbon intensity | 25% | 1% | |
| Cemex | 2005 | 2015/1990 | Carbon intensity | 25% | 1% | 115% |
| Italcementi | 2002 | 2012/1990 | Carbon intensity | 2% | 0.1% | -49% |
| | 2007 | 2012/1990 | Carbon intensity | 5% | 0.2% | -20% |
| Heidelberg | 2003 | 2010/1990 | Carbon intensity | 15% | 0.8% | 137% |
| CRH | 2007 | 2015/1990 | Carbon intensity | 15% | 0.6% | 62% |
| Titan | 2005 | 2010/1990 | Carbon intensity | 15% | 0.6% | 141% |
| | 2009 | 2015/1990 | Carbon intensity | 22% | 0.9% | 96% |

**Table 4a – Analysis of cement companies' $CO_2$ emission reduction targets and results**

| Company | Commitment date | Target year & Benchmark year | Type of target | Target goal & Benchmark | Annual carbon intensity target | 2009 result compared with 2009 target | Annual target & Absolute value | 2009 result compared with 2009 target |
|---|---|---|---|---|---|---|---|---|
| BASF | 2008 | 2020/2002 | Carbon intensity | 25% | 1.4% | 0% | | |
| Dow Chemical | 2006 | 2015/2005 | Carbon intensity | 25% | 2.5% | 0% | | |
| Bayer Material Science | 2007 | 2020/2005 | Carbon intensity | 25% | 1.7% | 30% | | |
| Bayer Health Care | 2007 | 2020/2005 | Absolute value | 5% | | | 0.2% | 1125% |
| Bayer Crop Science | 2007 | 2020/2005 | Absolute value | 15% | | | 1% | 275% |
| DuPont | 2005 | 2015/2004 | Absolute value | 15% | | | 1.4% | 147% |
| Akzo Nobel | 2009 | 2015/2009 | Absolute value | 10% | | | 1.7% | |
| | 2009 | 2015/2009 | Carbon intensity 20 | 25% | 4.2% | | | |

[12] Please also note that the definition of green products is somewhat ambiguous in the cement industry. Can the adding of slag and fly ash be considered as "carbon free"? This issue is currently a subject of debate within the industry (private discussion with Cembureau).

| Company | Commitment date | Target year & Benchmark year | Type of target | Target goal & Benchmark | Annual carbon intensity target | 2009 result compared with 2009 target | Annual target & Absolute value | 2009 result compared with 2009 target |
|---|---|---|---|---|---|---|---|---|
| | | | to 25%) | | | | | |
| Rhodia | 2002 | 2010/1990 | Absolute value | 30% | | | 1.5% | 274% |

**Table 4a – Analysis of chemical companies' $CO_2$ emission reduction targets and results**
(Sources: 2000-2009 Annual and SD reports, & websites)

### 4.3. Positioning in terms of the regulations on $CO_2$ emissions (Component C)

All the cement companies that we examined are members of the CSI *(Cement Sustainability Initiative)*. The CSI includes 23 companies in the sector, which represents around 1/3 of total emissions. The CSI is one of the major WBCSD programmes. The aim of this programme, which was launched in 2000, is primarily to develop a Technology Road Map, in order to identify the drivers that will enable $CO_2$ emissions to be limited by 2030. In the regulation area, the CSI seeks to influence various national policies, by underlining the risks associated with implementing unequal carbon prices in different geographical regions (Europe, North America, and emerging countries, etc.). On the one hand, these risks involve competitiveness issues, given the impact of the carbon price on production costs (cement producers fear that international trade will be deeply affected), as well as carbon leakage issues relating to relocating production to areas where the regulations are the most lax.

The CSI recommends the introduction of sector-based agreements that combine carbon-intensity targets in emerging countries with a cap and trade system in industrial countries, alongside the award of free allowances to industrial companies in the cement sector that are based on appropriate benchmarks (these recommendations target Phase 3 of the EU-ETS directly).

All these recommendations are explicitly restated in Lafarge, Holcim and CRH's reports to the CDP, for instance. Cemex mentions the risk to competitiveness and refers to the CSI where recommendations are concerned. Heidelberger mentions the dangers of a long-term reduction in free allowances for the competitiveness of the European industry, and also refers to the CSI. We are therefore able to observe that there is a high degree of uniformity in the positions of cement companies, which is encouraged by the pre-eminence of the CSI.

The chemical industry's stance on climate & energy issues is relayed by the ICCA – International Council of Chemical Associations at the international level. This organisation includes most chemical industry organisations among its members, at the local, federal or European level. Senior members of the CEFIC are specifically responsible for the organisation's international communications. All the companies that we examined are included in the organisation's position-taking system via the presence of one or two representatives on the ICCA's committees or management bodies.

The ICCA positions itself as a defender of market mechanisms, as a business tool that promotes reductions in GHG emissions. Some avenues for improvement, biases and regulatory weaknesses are underlined. The regulation of GHG emissions must move towards a consistent international framework, in order to avoid the risk of a competiveness loss embodied by carbon

leakage. The uncertainty regarding the regulatory frameworks to which chemical companies will be subject must be minimised, in order to encourage investment decisions. The specific nature of the chemical industry, in the sense that it supplies a large number of sectors, must be taken into account, since it provides a major field for initiatives aimed at reducing greenhouse gas emissions. Particular emphasis is placed on the margins for improving energy efficiency offered by the chemical industry, both in terms of production processes and of the products supplied to other business sectors.

These positions are reflected in the answers provided to the CDP by the chemical companies that we examined. They all support a "global market" approach in order to reduce emissions, while underlining the importance of safeguarding the sector's competitiveness as long as regulations remain national. We observe a difference between DuPont and Rhodia's assessment of the CDM (Clean Development Mechanism). While Rhodia has benefited significantly from these mechanisms that enable transfers between emerging and industrialised countries, DuPont has adopted a fundamentally hostile position on the issue.

This sector-based comparison underlines that both sectors are equally concerned by the introduction of unilateral regulations resulting in $CO_2$ prices that vary from one region to the next. However, the cement industry appears more committed to the introduction of systems aimed at limiting the impact of this different pricing on competitiveness (by obtaining free allowances), while the chemical industry seems to prefer encouraging the harmonisation of unilateral policies.

### 4.4. The global trend in $CO_2$ emissions compared with changes in business portfolios (Component D)

In this section, we no longer focus on strategy, as expressed by the Chairmen in 2009 and via the published targets, but on implicit strategy, as demonstrated by the decisions taken over the past ten years. Due to data access reasons, this analysis was performed on a lower number of companies, i.e. three companies for each sector.

We calculated the trend in absolute $CO_2$ emissions between 1990 and 2009, and between 2000 (or 2003 by default) and 2009, and compared this trend with the revenue trend (see Tables 5a and 5b). We also calculated the revenue trend for each business activity (see Tables 6a and 6b). A review of major acquisitions and disposals over the period, as shown under the history tab on the companies' websites, enabled us to interpret the relationship between changes in the business portfolio and climate change issues.

| Companies | Increase in $tCO_2$ between 1990 & 2009 – as a % | Increase in $tCO_2$ between 2000 & 2009 or 2003 & 2009 as a % | Increase in revenues between 2000 & 2009 as a % |
|---|---|---|---|
| Lafarge | 22% | 30% | 30% |
| Holcim | 41% | 32% | 56% |
| Cemex | -3% | | 159% |

**Table 5a – Trend in $CO_2$ emissions compared with changes in cement companies' business portfolios**

| Companies | Increase in $tCO_2$ between 1990 & 2009 as a % | Increase in $tCO_2$ between 2000 & 2009 or 2003 & 2009 as a % | Increase in revenues between 2000 & 2009 as a % |
|---|---|---|---|
| DuPont | -78% | -6% | -7% |
| Bayer | -43% | 50% | 1% |
| Rhodia | -556% | -80% | -46% |

**Table 5b – trend in $CO_2$ emissions compared with changes in chemical companies' business portfolios**
(Sources: authors' calculations based on 2000-2009 Sustainable Development reports)

| | Lafarge | | Holcim | | Cemex | |
|---|---|---|---|---|---|---|
| Year | 2000 | 2009 | 2000 | 2009 | 2000 | 2009 |
| Cement | 36% | 60% | 65% | 65.34% | 76% | 46% |
| Aggregates and concrete | 31% | 32% | 23% | 28 | 23% | 51% |
| Plaster | 8% | 8% | 12% | 7% | 1% | 3% |
| Other | 25% | | | | | |

| | | | |
|---|---|---|---|
| Major acquisitions | ▪1994: expansion in China<br>▪1998: Redland (roofing business)<br>▪2007: Orascom (Middle-East), Heracles Greece) | ▪2005: expansion in India<br>▪2008: expansion in China<br>▪2009: disposal of Rinker (Australia) | ▪1992: two largest Spanish cement producers<br>▪2000: Southdown (US)<br>▪2005: RMC (Europe and US)<br>▪2007: Rinker (Australia) |
| Major disposals | ▪2008: resale of the Redland business | | ▪2009: Rinker (Australia) |

**Table 6b – Changes in cement companies' business portfolios**
(Sources: authors' calculations based on annual reports)

The three companies in the cement sector experienced very strong growth in terms of revenues. This growth corresponds to the globalisation of their business activities, which included significant expansion in emerging countries (India and China for Holcim, China and the Middle East for Lafarge, and a contrasting rebalancing of the portfolio focused on developing countries for Cemex, via the acquisition of Southdown in the US). The companies remain focused on their core business, i.e. cement, ready-mixed concrete and aggregates, with cement playing the dominant role. Over the period, Lafarge, which had diversified downstream via the acquisition of Redland (roofing business) in 1998, took a step backwards (although it kept the plaster business). Since the nature of production is relatively consistent between one country and the next, this focus on the core business explains the increase in Lafarge and Holcim's emissions, in absolute value terms. The decrease observed for Cemex corresponds to the increase in the importance of the concrete aggregates business, which is highly complementary to the cement business (acquisition of RMC in 2005 and of Rinker in 2007, although the latter was resold in 2009 against the backdrop of the financial downturn). The fall in emissions on a carbon intensity basis ($tCO_2$ per tonne of cement) recorded in Table 4a is the result of ongoing improvements in the production process (fuel mix, energy efficiency, and introduction of additives to the clinker); however, it was not sufficient to change the $tCO_2$/revenues ratio substantially, and certainly not to reduce total emissions. It is easier to understand why companies in the cement sector did not

publish emission reduction targets in absolute value terms, as such targets would have been in contradiction with their development strategy.

| | Rhodia | | | Bayer | | | DuPont | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year | 2005 | 2009 | | 2000 | 2009 | | 2000 | 2009 |
| Breakdown of revenues by business | Agriculture | 20% | _ | Agriculture | 11% | 22% | Agriculture | 14% | 32% |
| | Polyamide | 38% | 37% | Healthcare | 32.30% | 51% | Healthcare | 5% | _ |
| | Novecare | 21% | 20% | Chemical materials & products | 46% | 23% | Chemicals | | 19% |
| | Silcea | 9% | 16% | Other | 10% | 4% | Materials | 17% | 18% |
| | Acetow | 9% | 14% | | _ | _ | Coatings | 17% | 13% |
| | Energy Services | 0% | 5% | | _ | _ | Safety & Protection | 12% | 11% |
| | Eco Services | 4% | 5% | | _ | _ | Electronics | 11% | 7 % |
| | Other | -1% | 3% | | _ | _ | Textiles | 24% | _ |
| | | _ | _ | | | | Other | 0.40% | _ |
| Major acquisitions | ▪ Conglomerate-type portfolio (Rhône Poulenc) that was refocused on speciality chemicals, and on the automotive, electronics and electrical, and energy industries, etc. | | | ▪ Focus on Healthcare, Food & Seeds, and Material Sciences<br>▪ 2006: Icongenetics (seeds)<br>▪ 2006: Schering (contraception)<br>▪2007: Stoneville Pedigreed Seed<br>2008: Direvo biotech (seeds)<br>▪ 2009: Athenix (pesticides) | | | ▪ Switch from fossil fuel chemicals to green chemicals<br>▪ 1997: Pioneer (biotech) | | |
| Major disposals | ▪2004: phosphates, and food ingredients<br>▪2005: sale of CFCs to DuPont<br>▪2007: disposal of Nylstar (synthetic textile fibres)<br>▪2008: disposal of Rhodia Organics | | | ▪ 2000: Bayer Solar<br>▪ 2005: medical imaging<br>▪ 2006: cellulose, silicone, and polymers | | | ▪1998: Conoco (oil)<br>▪2001: disposal of the pharmaceutical business | | |

**Table 6b – Changes in chemical companies' business portfolios**
(Sources: authors' calculations based on annual reports)

The situation of companies in the chemical sector is quite different from that of companies in the cement sector. Generally speaking, these companies have redefined their business portfolios. Over the period between 2000 and 2009, the three companies saw more of a decline in their revenues (a very marked one for Rhodia). The fall in DuPont's emissions in absolute value terms is in line with this decline in business volumes. For Bayer, the $tCO_2$/revenues ratio increased at first, and then began to fall in 2007. Rhodia is the only company that significantly reduced its $tCO_2$/revenues ratio, due to its $N_2O$ burner, and the sale of high carbon-intensity businesses like phosphate production. Although the three companies have stated their ambition to delink their growth from their absolute emission levels, only Rhodia seems to be achieving results that go in that direction. For DuPont and Bayer, the switch from fossil fuel chemicals to green chemicals remains a bet on the future. If we now return to the fall in emissions in absolute value terms over the entire period between 1990 and 2009, aside from the changes in the portfolio, the size of

these reductions is also explained by the introduction of major innovations, including, for instance, the elimination of CFCs at DuPont at the beginning of the 1990s or the elimination of $N_2O$ at Rhodia as from 1998. Other innovations have also been announced, primarily in Bayer's chlorine production processes.

The chemical industry benefits from two leverage points, in order to reduce its emissions. First, it has the ability to make significant changes to its production process, and to benefit from these changes in the form of patents and technology transfers. Second, the industry can also restructure its business portfolio to a substantial extent.

The interpretation of the portfolio changes is not immediately obvious for chemical companies, unlike for the cement industry. We will examine the various companies' cases in detail. The restructuring process is particularly clear in the case of Bayer and DuPont. It should be noted that the approaches below demonstrate the companies' capacity to identify high growth potential sectors that touch on climate change issues in advance, including agriculture, energy, and healthcare. In fact, both companies have adopted strong positions in the agricultural field, which represents a relatively substantial portion (26.6%) of the reduction in potential emissions relating to applications for chemical industry products (ICCA-2009). Bayer's Crop Science business increased its share of revenues by almost 11 points between 2000 and 2009, rising from 11 to 22%. This expansion went hand in hand with an approach involving a large number of significant acquisitions involving companies specialising in seeds and pesticides. Over the same period DuPont saw the share of its agriculture and nutrition business rise from 14 to 32%.

However, the groups' approaches are very different where the second growth driver is concerned. Although Bayer is making massive investments in its healthcare business, which now accounts for over 50% of its revenues, DuPont is going down the route of high-performance chemicals that are mostly used in the energy efficiency and renewable power generation fields (solar panels). Bayer's choice is primarily explained by the anticipated emergence of diseases relating to climate change, like malaria, etc.

Rhodia has taken a completely different path. Having restructured its businesses a number of times between 2000 and 2005, two points should be noted. First of all, the pharmaceutical and agrochemical businesses that are included in Rhodia Organics (20% of revenues) were sold in 2008. Rhodia's disposal of this segment is particularly interesting, given that this decision goes in the opposite direction to that adopted by the other two companies that we examined. The second particularly significant component of Rhodia's strategy is the emergence of businesses that are directly related to $CO_2$ emissions, and that target its customers and regulations. Rhodia was able to take advantage of the flexibility mechanisms linked to the Kyoto Protocol very early on. It was able to develop emission reduction projects that grant rights to offset credits known as CERs, on the back of its technological innovation relating to $N_2O$ emissions. These credits are an authorised compliance tool for companies under constraint within the European Union Emission Trading Scheme. To maximise the financial benefits, Rhodia set up a joint venture with Société Générale (Orbeo). At the same time, Rhodia offered its customers energy supply management services through setting up its Rhodia Energy Services business. This new division already accounts for 5% of the group's revenues[13]. **The cement industry would need to succeed in inventing a clinker-free cement to secure comparable results.** These decisions show the company's desire to reposition its business on a high-growth sector relating to environmental concerns, namely, generating power from renewable biological materials.

[13] DuPont is also pursuing a similar strategy via its Security and Protection business.

## 5. Discussion and conclusions

We will begin by drawing up a summary overview for each sector based on our empirical analysis of the four components in Table 1. The companies in the cement sector that we examined offer a fairly consistent picture. They recognise the issues associated with climate change in their strategic ambitions (Component A). At this stage, these issues are reflected in commitments on the intensity of emissions (Component B) while underlining the dangers of unilateral regulations (like the EU ETS) for firms' competitiveness (Component C). These initiatives rank alongside more traditional initiatives aimed at safeguarding the environment (in the case of quarry operations) without creating any new strong momentum for the time being. The changes in their business portfolios are largely explained by the globalisation issues that are specific to the cement sector, and not by a desire to take advantage of opportunities relating to climate change (Component D). At this stage, issues relating to climate change do not seem to offer any differentiation points between companies in the sector; emission reduction targets focus on emissions relating to the cement production process, while the results obtained are similar. However, we note the introduction of internal programmes aimed at moving towards "market" targets (solution products) relating to the sustainable construction field. However, even if companies communicate about these programmes (one-off achievements and partnerships), they have not published any quantified external target relating to them.

In our view, this summary picture justifies the validation of Assumptions 1 and 2 for this sector. The $CO_2$ issue for cement companies is mainly focused on the production process. The issues remain circumscribed, and have not resulted in the company's global strategy being called into question for the time being. Given the uniformity observed in the sector, we may conclude that the economic factors in the sector are deterministic, and assert that these factors lead to "compulsory exercises".

We will now examine the situation in the chemical industry. Generally speaking, the companies that we examined have taken advantage of issues relating to climate change in order to redesign their strategic ambitions (Component A). Aside from $CO_2$, some of them have identified global societal issues that are linked to the impact of climate change on agriculture and health. The issues relating to actual emissions are part of a long tradition associated with the discharge of toxic substances, which are now substances characterised by long-term harmful effects. Industrial measures to limit the corresponding emissions rely not only on conventional drivers (energy efficiency) but also on changes in procedures as a result of major innovations ($N_2O$ burner at Rhodia, and chlorine production process at Bayer). The related commitments appear diverse from the outset, and are often in value terms that correspond to various commitment dates, and specifically often result in very different outcomes between one firm and the next. A few companies make "market" commitments, but they remain a minority in our sample (Component B). Competitiveness issues also influence positions towards unilateral regulations, while the issue of free allowances is less of a focal point; some companies see the CDM as an opportunity, while others are hostile towards it (Component C). The difference with the cement industry is obvious where the impact of climate change on the business portfolio is concerned. It is still too early to talk of a switch from fossil fuel chemicals to green chemicals; however, our analysis (Component D) suggests that the switch is underway, and that it is reflected in different choices depending on the firm.

Under these conditions, we believe that it is legitimate to consider that Assumptions 1 and 2 are validated where the chemical sector is concerned. The $CO_2$ issue is harder to grasp, as it is not limited to strictly industrial issues, but to issues that affect the entire value chain. The redesign of their strategic ambitions is leading these companies to review their business portfolio in a

proactive way, in order to take advantage of new opportunities. The diversity of the strategies observed is perfectly in line with the idea of "voluntary" exercises.

Even if our results confirm the importance of structural economic factors in companies' CSR approaches, our analysis nonetheless remains limited. The motive for our analysis was a case study on DuPont and Lafarge, which led us to offer two kinds of CSR strategies relating to $CO_2$ issues. At this stage, we may consider that the differences observed between DuPont and Lafarge can also be found at a sector level to a large extent. We would need to validate this observation in a more systematic manner by starting from variables that can be verified and have been gathered from a sample that is representative of the sectors concerned. We would also need to study the influence of other more institutional factors (DiMaggio and Powell 1983) such as the charisma of some senior executives, the mimetic effect, or the pressure exercised on strategic choices by stakeholders. Such an analysis would undoubtedly enable us to identify the more organisational reasons that may have been behind the differences between companies in the same sector, like, for example, the frequently mentioned leadership at Lafarge in the early 2000s, or the leadership at DuPont during the same period.

Despite its limits, this study encourages us to believe that companies' ability to innovate when dealing with climate change does not only depend on a company's ability to manage its "voluntary" and "compulsory" exercises (Aggeri *et al.* 2005), but is also heavily influenced by structural factors that affect all the companies in the same sector. These results qualify the comments made in the research on "CSR Strategy" (Porter and Kramer 2006, and 2011), which assigns significant importance to the measures taken by companies in order to turn their environmental constraints into sources of strategic opportunities. Specifically, this comparative study shows that heavy structural constraints can slow the rate at which companies transform their competitive and social space, which is an essential feature of "voluntary exercises". Conversely, the article also shows that some sectors are more favourable to proactive and innovative approaches by nature. Companies in the chemical sector, which benefit from more favourable structural factors, are therefore further along in the transition from "compulsory exercises" to "voluntary exercises", and are turning $CO_2$ constraints into a source of strategic innovation. The structural factors identified in this article, namely 1) the dependence of the production process on natural resources, 2) the ability to leverage the business portfolio and the resulting role for R&D, and 3) the structure of the downstream sector, could also provide food for thought on incentive policies aimed at encouraging green growth (Crifo et al. 2009), by providing keys to factoring in the sector-specific component in the regulations.

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