Carbon management accounting and reporting in practice

A case study on converging emergent approaches

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Abstract

Purpose – The purpose of this paper is to focus on carbon accounting as one aspect of accounting for impacts on the environmental capital and to detail the "convergence" process between two emergent corporate carbon management accounting approaches within a multinational company. In contrast to the reporting stakeholder and regulatory focus, company-internal issues of carbon accounting have so far rarely been investigated in depth. Based on a qualitative analysis of this in-depth case study, questions about what could be considered an effective carbon management accounting system are raised.

Design/methodology/approach – The research has been conducted with an in-depth case study, using participant observation (Spradley, 1980). The authors follow a pragmatic research approach, and the proposal of Malmi and Granlund (2009) "to create theories useful for practice is to solve practical problems with practitioners and synthesize the novel solutions to a more general form".

Findings – This case study demonstrates that it is possible to connect two corporate carbon management accounting approaches focusing on products and the organization into a combined carbon management accounting system. This has potential impact in making carbon management accounting in organizations leaner, and more efficient in terms of performance measurement and external communication.

Research limitations/implications – This research is based on a single case study, and more case studies in different industries could highlight further practical implementation difficulties and approaches to overcome.

Practical implications – This paper unveils that different carbon management accounting approaches can emerge in parallel in the same corporation. The paper discusses possibilities and challenges to converge them in terms of methodology (emission factors for example) and/or in terms of information systems, on which the calculations are based.

Originality/value – This is, to our knowledge, the first case study of an organization explicitly acknowledging the existence of multiple emerged carbon management accounting approaches and

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trying to make sense of them in a convergence process to create an overarching carbon accounting system.

Keywords Convergence, Carbon accounting, Management accounting, GHG protocol, PAS 2050

Paper type Case study

1. Introduction

Corporate carbon accounting is a relatively new research area dealing with impacts on environmental capital and has received particular attention through the development of carbon emission trading markets raising issues such as the recognition of carbon trading permits in the balance sheet (MacKenzie, 2009), carbon price development (Nelson *et al.*, 2011) or the establishment of carbon registers (Kolk *et al.*, 2008). Corporate carbon accounting, addressing the environmental dimension of sustainability, has also been studied for different regulatory, professional and societal conditions and applications (Ascui and Lovell, 2011; Bowen and Wittneben, 2011; Schaltegger and Csutora, 2012) by highlighting priorities of different stakeholders involved in carbon accounting and standardization processes.

Because corporate carbon reporting is important for external stakeholders to receive a true and fair representation of an organization's carbon footprint and efforts in emissions reduction, it requires comparable and accurate accounting of carbon emissions, similar to financial reporting rules (Mizuguchi, 2008; Cotter *et al.*, 2011; Haigh and Shapiro, 2012; Schaltegger and Csutora, 2012). On the other side, organizational management issues of carbon accounting are highly relevant with regard to decision-making, performance management and what is reported (Burritt *et al.*, 2011). In contrast to reporting (Mizuguchi, 2008; Andrew and Cortese, 2011; Cotter *et al.*, 2011; Haigh and Shapiro, 2012; Hrasky, 2012), company-internal issues of carbon management accounting have so far rarely been empirically investigated in depth. An exception is the paper of Burritt *et al.* (2011) who examine internal carbon management accounting practices in German companies.

The design of carbon management accounting can be of strategic importance for organizations trying to measure and manage their carbon performance (Hendrichs and Busch, 2012; Schaltegger and Csutora, 2012). Managers may expect that carbon management accounting helps them identify and assess the potentials of different activities to reduce the company's emissions and related economic impacts. The management of carbon performance requires a sound accounting management system which links carbon management with the business, its competitive strategy and that integrates carbon information with economic business information and carbon reporting (Schaltegger and Wagner, 2006). This is why this paper examines how different corporate approaches dealing with carbon management accounting influence the measures of the total carbon footprint of a corporation and the carbon performance representation. The in-depth case study also looks at how carbon management accounting can be connected to external reporting of carbon emissions to link internal performance management to external performance reporting (Burritt, 2012).

This paper aims at contributing to the further development of corporate carbon accounting by examining the carbon management accounting of a multinational company (Danone). Taking a pragmatic research approach to investigate carbon accounting development (Baker and Schaltegger, 2015), this paper is based on the

examination of corporate practices which emerged in the same company over time and the company's attempt to link these emerged approaches to ex-post create a joint carbon management accounting system. This multinational company has attempted to improve both environmental and financial carbon performance by setting up its own carbon management accounting system and by linking it to its external carbon reporting based on the Greenhouse Gas (GHG) Protocol Corporate Standard. The notion "carbon management accounting system" is used in this paper when the ex-post developed overarching accounting system of carbon information management is meant, whereas "carbon management accounting *approach*" is used as a term to describe the different approaches which were previously independently developed by Danone and the Greenhouse Gas Protocol. The existence of two approaches required a convergence which lead to the development of the now existing "carbon management accounting system" of Danone.

We raise questions about the design of an effective carbon management accounting system and how it can both serve the internal performance measurement and the external reporting. Although the most used carbon accounting and reporting framework, the GHG Protocol Corporate Standard, is said to serve both the purpose of performance measurement and reporting, we observe in this case study that a different carbon management accounting approach has been first developed internally. This other identified performance-oriented carbon management accounting approach has then been re-connected to the GHG Protocol Corporate Standard for carbon management accounting.

Whereas various standards have been developed to support the accounting of an organization's carbon footprint (European Commission Joint Research Centre, 2011), the GHG Protocol Corporate Standard is currently dominant and most widely used (Ranganathan, 2011; Schaltegger and Csutora, 2012). We therefore discuss, on the basis of a case study, how the application of this carbon accounting standard can complement the existing carbon management accounting to increase its role in supporting internal management decisions for carbon emission reductions.

The paper firstly reviews the literature on carbon accounting for organizations and the different current corporate carbon accounting standards. Secondly, it describes the research design of the case study. Thirdly, we explain Danone's carbon management accounting approach, which has been designed to drive organizational change and engage the organization in carbon emission reduction activities. With the example of one business unit (Stonyfield) of the company, we discuss how this accounting approach is being re-combined with the GHG Protocol Corporate Standard for carbon management accounting to deliver annual GHG emission figures for decision support and reporting purposes at the same time. The process and possibilities of linking both accounting approaches are analysed. With this case study, we aim at contributing to the further development of carbon management accounting to help organizations in achieving carbon reduction goals and informing stakeholders with transparent and comparable carbon reports.

2. Carbon performance and carbon management accounting

2.1 Multiple facets of carbon performance

Corporate carbon performance has been discussed since the beginning of the 2000s, and even more so since Al Gore's film "An inconvenient truth". Corporations have started to

tackle their carbon performance in the late 1990s and developed accounting approaches to measure it. How to measure carbon performance is challenging because of its novelty as a topic, its complexity and the link between climate change sciences and professional accounting practices.

Although some companies have already claimed to be green or environmentally successful for a long time, there is still a lack of a clear definition of what environmental performance (Henri and Journeault, 2010) or carbon performance is, let alone what being a sustainable company encompasses (Gray, 2010).

Carbon performance has been described as both, reduction of the absolute amount of discharges into the environment (absolute reduction of GHG emissions), as well as improving intensities or efficiencies, such through the reduction of emissions per kilogram of product or functional unit (Busch, 2010; Hoffmann and Busch, 2008; Schaltegger and Csutora, 2012). Carbon performance also has a stakeholder dimension, which varies depending on whether it is calculated for internal purposes and stakeholders (e.g. employees, different departments and managers) or for external reporting purposes and stakeholders. External stakeholders have different needs and expectations, whether they are investors, governmental bodies, NGOs, consumers or the general public (Schaltegger and Burritt, 2000).

Table I summarizes key expectations of stakeholders when accounting for carbon. It shows that they are often different, resulting in the need to design different carbon management accounting approaches. In particular, the requirements of comparability (often required by external stakeholders) and of connectivity with financial management accounting structures (required by internal management and employees) do not match. For example, managers are often responsible for sales within a geographical area (country/region), but the GHG Protocol Corporate Standard accounts for carbon responsibility of where the products are produced and not where they are sold. However, the GHG Protocol Corporate Standard mimics the financial boundaries used within financial accounting, which speaks to investors and rating agencies. Different stakeholder needs influence the design and use of particular emission factors from an industry-wide database, or allow companies to use, for example, emission factors provided by suppliers if they are audited and certified. Using emission factors from an industry-wide database allows for comparability (only the activity of the firm is then considered); however, using supplier-based factors is more accurate, for example, when the company has chosen to work with a specific supplier to achieve a reduction target on a material (Schaltegger, 1997). Designing carbon management accounting simple enough that it can be implemented successfully for an entire corporation can even contradict with the strive for accuracy and the scientific complexity of the topic. Simplifications may not be regarded well by, for example, NGOs or media suspicious of potential greenwashing. Satisfying both external stakeholders and internal stakeholders with contradicting needs can be challenging for companies developing nascent carbon management accounting systems. External stakeholders such as investors require comparability and would advocate the use of, for example, database emission factors, whereas internal stakeholders, whose performance management (emissions reduction) appraisal depend on accuracy, will look, for example, for supplier specific emission factors which will translate the supplier chain's efforts in carbon emission reduction. External stakeholders such as investors require GHG Protocol Corporate Standard accounting and reporting with equity share, financial control or

Table I.
Stakeholder requirements (examples)

Stakeholders	Requested accounting method	Main requested characteristics for accounting	Auditability
Investors	GHG Protocol Corporate Standard	Comparability of results (between companies)	Yes
Rating agencies	GHG Protocol Corporate Standard or equivalent	Comparability of results (between companies)	Yes
Governmental labelling programs	Life cycle based (PAS 2050, BPX 30-323-0)	Comparability of results (between products)	Yes
Distributors	Life cycle based, sometimes private scheme	Readability	Private auditing approaches exist
Consumers	Life cycle based	Readability	Certifiable (based on a labelling system)
NGOs	Life cycle based or GHG Protocol corporate standard (disclosure)	Must translate action of emissions reduction into accounting numbers (accuracy)	No specific auditability required
Managers	Flexible "management accounting" method that can reflect their own work structure and that is based on a legitimate accounting standard	Readability and connectivity with financial management accounting structure. Must translate action of emissions reduction into accounting numbers (accuracy)	Certifiable (based on standard)
Employees	Flexible "management accounting" method that can reflect their own work structure	Readability and connectivity with financial management accounting structure. Must translate action of emissions reduction into accounting numbers (accuracy)	No specific auditability required

operational control boundaries, whereas internal stakeholders sometime work outside those boundaries along the supply chain to reduce their products' carbon impact.

Additionally, many external rating agencies, which have developed in the past decade, assess carbon performance of corporations in different ways (Table II). They define performance in terms of disclosure, compliance or actions to reduce carbon emissions. Some also rate engagement with public policy and societal stakeholders as part of carbon performance.

In between the many carbon performance ratings, the "Rate the Raters" study of SustainAbility in 2010 unveils very clearly that the Carbon Disclosure Project (CDP) is the most influential rating (SustainAbility, 2010). The CDP advocates the use of the GHG Protocol Corporate Standard and has had an influential role in globalizing the use of this standard. Their primary focus is on rating the amount and quality of disclosure of a company. In 2010, they started rating carbon "performance" with a disclosure score. Performance is determined on the basis of actions considered to contribute to climate change mitigation, adaptation and transparency of carbon disclosure. In 2012, they launched an initiative called "Carbon Action" [1], demonstrating that compliance and transparency are not enough, but there is a need for companies to put systems in place to reduce emissions. This is a clear signal towards a more comprehensive and integrated carbon management accounting systems, with performance being more closely linked to reductions in emissions, not only targeting "reporting". Additionally to different views of what carbon performance could encompass, organizations face various carbon accounting standards with different boundaries and different objects of reference (site, product, company, project, etc.), resulting in very different performance results.

As a conclusion, depending on the stakeholder, the understanding of performance and the information requirements can vary substantially. This multitude of information expectations and uses has led to the emergence of different carbon accounting approaches.

External ratings	What it rates	Advocated carbon accounting method
Carbon Disclosure Project (CDP)	Rates disclosure	GHG Protocol accounting
Climate counts	Reduction (56 points out of 100)	An industry accepted accounting protocol
Global 800 carbon ranking (Environmental Investment Organization)	Compliance to GHG protocol accounting	GHG Protocol accounting
New Economy Magazine	Disclosure, stakeholder engagement and reduction	None
Gigaton Awards	Reduction	None
Dow Jones Sustainability Index (DJSI)	Reduction through targets (intensity) and strategy	GHG Protocol accounting
Green Rankings	Environmental impact and environmental management	None
FTSE/CDP Carbon Strategy Index	Carbon management quality, carbon efficiency performance and disclosure quality	None

Table II.
External ratings of carbon performance

2.2 Bridging carbon management accounting approaches

2.2.1 The emergence of multiple carbon management accounting approaches. Measures of carbon performance are influenced by the scope and quality of the accounting approach used, the input data and the accounting standard applied. Currently, a multiplicity of carbon management accounting approaches exists for organizations that are confronted with the complexity of developing carbon measurement and accounting systems.

Carbon management accounting comprises:

> […] the recognition, the non-monetary and monetary evaluation and the monitoring of greenhouse gas emissions on all levels of the value chain and the recognition, evaluation and monitoring of the effects of these emissions on the carbon cycle of ecosystems.

(Stechemesser and Guenther, 2012; Burritt *et al.*, 2011). More particularly, we identify three major different types of carbon management accounting used for different purposes: organization carbon accounting, product carbon accounting and project carbon accounting (for a discussion of scopes of carbon accounting also see Schaltegger and Csutora, 2012; Ascui and Lovell, 2011).

Organization carbon accounting has been developed to measure and analyse carbon emissions of a company as a legal entity and to help setting targets for the reduction of carbon emissions (Burritt *et al.*, 2011). The first organizational carbon accounting standard was issued in 2001 by the GHG Protocol, revised in 2004 and complemented in 2011 (GHG Protocol, 2001; GHG Protocol, 2004; GHG Protocol, 2011a). It is the most widely used to date. In parallel to the dominant standard, various other organizational carbon accounting approaches have emerged: the European Union's (2010) report found 30 "major" GHG accounting approaches being in use globally (ERM, 2010). Within those 30 other major methods, you can find ISO 14064 the French "Bilan Carbone" or more recently a "corporate LCA" used for the Puma "environmental profit and loss account" and the Accor company carbon footprint. These methods are based either on site-focused accounting, or on streams of carbon emissions such as mobile combustion emissions. All those organizational carbon accounting approaches try to capture the direct and indirect emissions from Scope 1 to 3 (as defined by the GHG Protocol Corporate Standard [2]). The numerous attempts at carbon accounting clearly show that, although the GHG Protocol Corporate Standard is at present the dominant carbon accounting standard for external carbon reporting (Ranganathan, 2011), a variety of different organizational carbon accounting standards and approaches co-exist currently. There is no one and only way to arrive at one globally comparable result measuring and reporting in carbon performance. Even within the GHG Protocol Standard, different options in terms of organizational boundaries allow for major differences in performance results, for example, between equity share and financial or operational control (GHG Protocol, 2004). For example, an affiliated company can have its GHG emissions reported by its parent company at 40 per cent (equity share), 0 per cent (if no financial control) and at 100 per cent (if they estimate to have operational control over this affiliated company).

A second type of carbon management accounting used is *product carbon accounting*. This accounting approach measures carbon emissions (or emissions in carbon equivalents) based on the life cycle assessment (LCA) approach for one product only and is internally used for product optimizations and design and externally for eco-labelling

purposes and communication to consumers. The two methods most widely used are described in the Publicly Available Specification (PAS) 2050 from the British Standards Institute (BSI) and the Product Life Cycle Standard of the GHG Protocol Initiative. Although product carbon accounting is limited to accounting for one product at a time, several companies, such as Akzo Nobel[3], Casino[4] or Tesco[5], have communicated efforts to "amplify" and apply product accounting to several hundred different products. The ambition to apply product carbon accounting for each and every product is also linked to the development of environmental footprinting initiatives, such as the French "affichage environnemental" or the European Green Products initiative.

Another type of carbon management accounting is *project accounting*, for example, to create CO_2-compensation offsets with Joint Implementation or Clean Development Mechanism projects. Other project carbon accounting approaches focus on the calculation of the expected carbon impacts or carbon reduction effects of real investments. Project accounting is usually disconnected from the initial base calculation of an organization's emissions and practised separately in a second step. In the case study company Danone, project accounting was practiced on compensation projects for the Evian brand only through the Livelihoods Fund. The project accounting is performed externally to Danone and concerns one brand only. Therefore, it was not included in the initial convergence project performed in 2012. However, further studies could analyse the further convergence of carbon accounting for emission reductions and for emissions compensation.

2.2.2 Convergence as a corporate carbon management accounting challenge. As a consequence of the different goals and requirements for carbon performance measurement, management and reporting, various consumer market-oriented companies are today internally dealing with two different carbon management accounting approaches, namely, organization carbon accounting and product carbon accounting. Moreover, whereas in the 1990s and early 2000s, companies could limit product accounting to one or two LCAs, they are now aiming to account for the carbon impact of their whole product range (i.e. each and every different product) which challenges management to conduct hundreds to thousands of different product carbon footprints. Finally, organization carbon accounting has become a "must" for multinationals responding to sustainability and carbon ratings, such as the Dow Jones Sustainability Indices (DJSI) or the CDP. More recently, various national regulations, such as the Article 75 of Grenelle 2 law in France, which force companies to establish organization carbon accounting, or the Companies Act 2006 and Regulations 2013 in the United Kingdom, which requires all quoted companies to report on their greenhouse gas emissions as part of their annual Directors' Report, are emerging. In France, this is complemented by the "experiment" on environmental product labelling (Article 225 of Grenelle 2 law).

With the increasing requirements, large internationally oriented companies are increasingly challenged to link the different emerging carbon management accounting approaches by developing a carbon management accounting system which combines both external and internal requirements, by serving different purposes and stakeholders and at the same time securing high data quality and information consistency. To explore the potential, difficulties and possibilities of convergence of organization and product carbon accounting has therefore become a relevant management task. Linking the two carbon management accounting approaches, one more internal management and

product oriented and the other more for external reporting purposes but with substantial company internal management accounting consequences, would reduce the cost of accounting (information system cost, external consultancy and human resources cost). Enabling linking carbon reduction calculations at the product and corporate level would eliminate inconsistencies that could arise from accounting for the same externality, carbon, with two different approaches. Linking the two carbon management accounting approaches may furthermore help to crosscheck the quality of data created by the two carbon management accounting systems. Convergence into one software supported carbon information management system may furthermore increase the efficiency and thus also the information availability for internal managers and staff to support internal decision-making and to responding to external requirements.

Additionally, standard setters say that reconciliation between the addition of product footprints of one corporation and the total footprint of this same corporation is possible. The GHG Protocol in its 2011 Product Standard (GHG Protocol, 2011b) shows a graphical representation of the link between the two accounting approaches (Figure 1).

The European Union in its efforts to develop an "organisation environmental footprint guide" and a "product environmental footprint general guide" from 2010 to 2012 have always had the convergence of results in mind (European Commission Joint Research Centre, 2011).

To our knowledge, only one attempt to link both corporate and product carbon accounting has been made with only two products of Tetra Pack Italy, on a one-way mode, from corporate to product accounting (Scipioni *et al.*, 2012). Their approach tests how organization-scale decisions affect a product's carbon footprint. They designed a model that integrates:

> […] the life cycle approach of the ISO 14,040 standards with ISO 14,064 to model the management and monitoring of emissions and to develop an inventory of GHG emissions for products (Scipioni *et al.*, 2012).

2.2.3 Potential and challenge of convergence. Given that it makes sense to explore whether different carbon management accounting approaches can be linked and

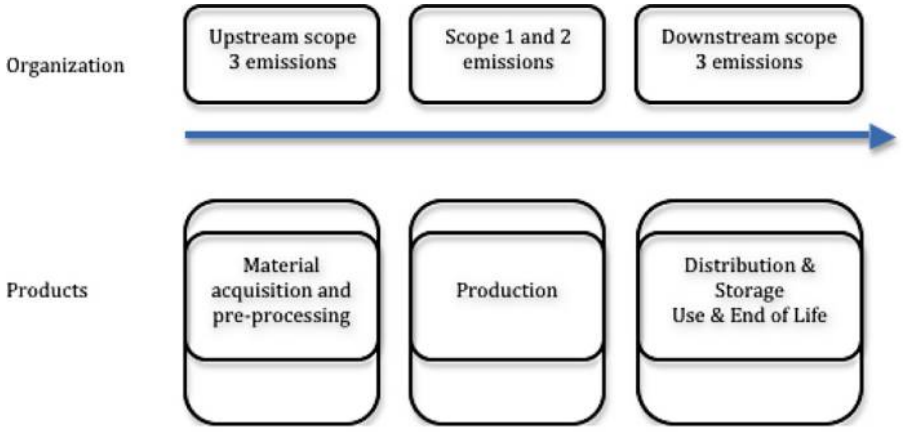

Figure 1.
The link between corporate and product carbon accounting

Source: GHG Protocol (2011a, 2011b, p. 8)

possibly converged into an integrated carbon management accounting system, the first question is whether organization and product carbon accounting bear the potential to be linked.

One way to explore the linking potential is to compare the main standards representing the two carbon management accounting approaches. Table III lists the goals of each standard in the same order as each standard is listed in their introductory sections. Therefore, the table emphasizes how the GHG Protocol underlines reporting and PAS 2050 internal assessment. However, both contain, in different orders, the similar goals. Examining the goals of both PAS 2050 and the GHG Protocol Standard shows that these standards match on a general level and, in principle, allow linking the two approaches. The first emphasizes "internal assessment", "benchmarking" different internal programmes and eco-design, whereas the latter emphasises "a true and fair account" of emissions and "consistency and transparency" in reporting. However, both have in their goal list the external reporting and the internal management foci, although they are classified in a different order of importance.

Building an organizational carbon performance measurement system:

- *Carbon accounting standards*: Widely accepted, implementable, etc.
- *Carbon accounting methods*: For estimating emissions that accurately represent the sources for carbon emissions.
- *Calculation tools*: Enterprise resource planning (ERP) system, excel and other information-gathering tools.

Goals of PAS 2050	Goals of GHG Protocol
Allows for a comparison of goods or services using a common, recognized and standardized approach to life cycle GHG emissions assessment (4) Supports reporting on corporate responsibility. (5)	To help companies prepare a GHG inventory that represents a true and fair account of their emissions, through the use of standardized approaches and principles (1) To increase consistency *and* transparency in GHG accounting and reporting among various companies and GHG programs. (5) To simplify and reduce the costs of compiling a GHG inventory (2)
Allows internal assessment of the existing life cycle GHG emissions of goods and services (1) Facilitates the evaluation of alternative product configurations, sourcing and manufacturing methods, raw material choices and supplier selection on the basis of the life cycle GHG emissions associated with goods and services (2) Provides a benchmark for ongoing programmes aimed at reducing GHG emissions (3)	To provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions (3)

Sources: PAS 2050 (2008) and GHG Protocol (2004)

Table III.
Comparing PAS 2050 and the GHG protocol goals as part of carbon accounting standards

- *Organisation*: Carbon accountants and/or cross-functional GHG inventory team.
- External assurance available.
- *Collecting data*: Emission factors and activity data (Source: adapted from GHG Protocol, 2004) lists different requirements to be considered when developing a converged carbon management accounting system.

This list of requirements indicates that several implementation issues can quickly develop as bottle necks, for example, when considering that in most organisations very little knowledge and training in carbon management accounting has been conducted so far (Epicor, 2012), there is a shortage in trained carbon accounting professionals (GHGMI, 2009) and that only few carbon management accounting systems have been tested on a broad scale to manage Scope 1, 2 and 3 for an entire corporation[6], or which support an efficient and reliable conducting of LCAs for the whole product range of a large company (for a discussion of different carbon accounting scopes, see Schaltegger and Csutora, 2012). Data availability may also be an issue, for example, in logistics when information on vehicles is required for management control. For supply chains, the availability of carbon information, for example, on the origin of processed fruit or on the transformation process used, may cause further challenges.

In the following, we analyse different challenges and convergence of carbon management accounting with the case study of Danone. Emphasis is placed on the tensions between different performance appraisals and accountings and the development of a converged carbon management accounting system. The "convergence project" of this company examined in this research tries to reconcile different performance views and different carbon management accounting approaches into one carbon management accounting system.

3. Research design

The research aims to investigate the design of company carbon management accounting system, including the link to carbon reporting. To explore and understand the internal challenges and how they are addressed, we applied a pragmatic research approach (Baker and Schaltegger, 2015) and conducted an in-depth case study using participant observation (Spradley, 1980). We follow the approach of Malmi and Granlund (2009, p. 613) "to create theories useful for practice is to solve practical problems with practitioners and synthesize the novel solutions to a more general form". Providing an insight in both a corporate-wide carbon management accounting system based on product responsibility, and the reconnection with the externally recognised carbon "reporting" standard – the GHG Protocol Corporate Standard is, according to Malmi and Granlund (2009), a practice theory that addresses "what systems or techniques to use, how and in which circumstances". In the case of carbon accounting research, the question of developing accounting relevant for different stakeholder needs, including carbon performance and carbon reporting, has not been addressed until now.

One of the authors was part of the Danone's nature finance team for 12 months and, therefore, had full access to all data and information needed for this project. The author was responsible for the audit of the newly implemented SAP Carbon system, helping with the GHG Protocol implementation within Danone, implementing business intelligence reports for carbon performance and the convergence project. The position of the author allowed for access to the full dataset of carbon accounting data, procedures

and information systems. The author was part of meetings related to carbon accounting management and interacted daily with carbon masters, external consultants and the nature finance team, of which she was part.

The case study company, Danone, is a French multinational in the fast-moving consumer goods sector. Fast-moving consumer goods are goods which are consumed on a daily or nearly a daily basis (like food, beverages, etc.). Since 2007, the company has developed a unique carbon management accounting system, based on PAS 2050, and its own carbon information systems to measure the footprints of a large range of individual products. In November 2010, Danone decided to test the reconciliation of their accounting with the most commonly used carbon management accounting standard, the GHG Protocol Corporate Standard. The project was prolonged to 2012 to create a full year dataset. In February 2012, the data of 237 products over a one-year period (2011) were collected for the business unit Stonyfield (USA). In addition, carbon information conforming to the GHG Protocol Corporate Standard Scopes 1, 2 and 3 were computed for 2011. Over a period of five months, data were analysed and broken down to exactly match the carbon data of both accounting approaches, the first covering the carbon footprints for the full product range and the second pertaining to the GHG Protocol Corporate Accounting Standard. The project included workshops with the ERP partner of Danone, SAP, on the feasibility to converge a carbon information system collecting the GHG Protocol carbon data with the carbon ERP system used by Danone, and co-built by SAP in 2009 and 2010.

The authors were able to collect all data necessary from the convergence project. Data include 36 excel documents and four Power Point presentations from two-day workshops organized in April, May and June 2012 with SAP on the project. Other data collected include email exchanges.

4. Danone's carbon management accounting system

Danone's carbon management accounting system is composed of the two different accounting approaches: product carbon accounting and the organization, site-based carbon accounting. One system collects product-related data and consolidates carbon emissions for each country business unit based on sales (e.g. the emissions of all yoghourts, bottles of water and baby and medical nutrition products sold in one country equals this country's total emissions). The other system collects site-specific data and consolidates carbon emissions by country business unit (e.g. the emissions of all production units, administrative sites and commercial sites of that country equals the total emissions of that country).

These two carbon management accounting systems are complemented with an information system to calculate environmental key performance indicators for annual sustainability reporting, of which the energy consumption indicator is used in organizational carbon management accounting. The information collected for energy data on each manufacturing site is raw data and is not transformed into carbon emissions before it is used in the organization's carbon management accounting system.

The goal of the company is to link the two carbon management accounting approaches and also the environmental performance indicators management system in a way that they share common data for all activities related to carbon emissions, and to converge the carbon management accounting approaches through the development of a coherent carbon management accounting system.

The core goal of the converged carbon management accounting system was to support the measurement and achievement of the 30 per cent target of carbon emissions reduction between 2008 and 2012 (goal was achieved). Linked to this overarching goal, Danone's carbon management accounting also supports management control for investments (the "green capex initiative") and provides data for a performance incentive system which influences the bonuses of managers.

On the organisational level, carbon is managed through a network of "carbon masters" in every country business unit of the company, a "nature finance" team based at the headquarters, and a carbon data committee dealing with all technical questions of carbon management accounting (e.g. changes in emission factors and calculation methodologies).

Danone's carbon management accounting was originally primarily based on the LCA methodology (ISO 14044) and then on PAS 2050 (2008). The tool used since 2007 to collect data for individual product footprints is an Excel tool called "danprint" which is used by the "carbon masters" (the employees responsible for the data collection) in each country business unit to calculate carbon footprints once a year. The Excel tool provides tables with emission factors and calculation formulas so that the carbon masters only need to fill in activity data (ingredients, kilometres, energy consumption, etc.) for the specific year. For the first year when the carbon accounting system was developed, the carbon masters filled in data for at least ten products, sometimes more depending on the representativeness of the products in terms of turnover in their country. Danone calculated the business unit's footprint for each country but allocated the responsibility on a consumption basis and not on a production basis. For example, a product unit of Actimel made in Belgium and sold in France has a footprint partially calculated in Belgium, and the rest of the footprint is complemented with carbon accounting data by the French carbon master for logistics, consumption and end-of-life based on French market data. Based on the consumer responsibility principle, the total carbon product footprint is then allocated to the French business unit, as it has ordered the manufactured product (in Belgium) and as the product has been sold to the final customer in France. Since 2010, Danone has developed an ERP system that is gradually replacing the Excel tool. This ERP system allows consolidating the data of all products of a country business unit (and not only a representation of it by a selection of a small amount of products). It also allows consolidating the data for the entire company. Currently Danone's corporate footprint is calculated with the support of Excel; but in the very near future, the ERP system should allow to calculate the corporate footprint in a much faster and easier manner and in a format comparable to the GHG Protocol corporate standard footprint. The boundary for Danone's accounting is the reported turnover. This means that the company also includes "co-made" products produced by others but sold under the Danone brand.

The decision to construct their carbon management accounting according to the LCA/PAS 2050 approach was based on several key criteria. Danone believes in the "extended responsibility" concept, meaning that their responsibility as a corporation does not end at the gates of their factories. This is why they designed their accounting to consider the life cycle of their products from cradle to grave. They also want to drive carbon emission reductions and, thus, embed the accounting in "the Danone way of doing business". As Danone has an internal responsibility structure based on brand and country business units, it makes sense to develop a carbon accounting system which

reflects product footprints and then country business unit footprints based on sales for each country. This allows the company to render each manager accountable for their product, brand and country's carbon footprint and to make them responsible for the reduction of the emissions in their particular area of responsibility.

This way Danone's accounting approach tries to respond to calls for a more "engaged" approach (Trexler, 2011) that would translate into more emission reduction. With its performance orientation, Danone places more emphasis on reducing carbon emissions than on disclosures of carbon footprints.

In spite of the focus on performance improvements, Danone also recognizes that external stakeholders base their analysis of corporate carbon performance on reported information and, thus, require the application of a common and widely recognized carbon accounting standard, i.e. the GHG Protocol Corporate Standard. This is why, since 2012, the company has additionally been measuring company-wide carbon emissions for all its sites (not limited to manufacturing sites) using the GHG Protocol (2004). The GHG Protocol Corporate Standard is currently managed through an external web system, unconnected to "danprint" or the current SAP Carbon version of carbon management accounting. It was tested for four country business units in 2011 and extended to all business units in 2012. It encompasses a comprehensive calculation of Scope 1 and 2 carbon emissions of the company once a year. The calculation of carbon emissions according to the GHG Protocol is linked to the environmental key performance indicator (KPI) information system feeding energy and refrigerant data from the KPI information system into the GHG Protocol web system.

This challenges the company to reconcile different accounting requirements and goals. Figure 2 displays these different carbon management accounting approaches at Danone, as they are currently practised and how their convergence into an overarching carbon management accounting system is managed. The next sections discuss the specific challenges and approaches to achieve this convergence.

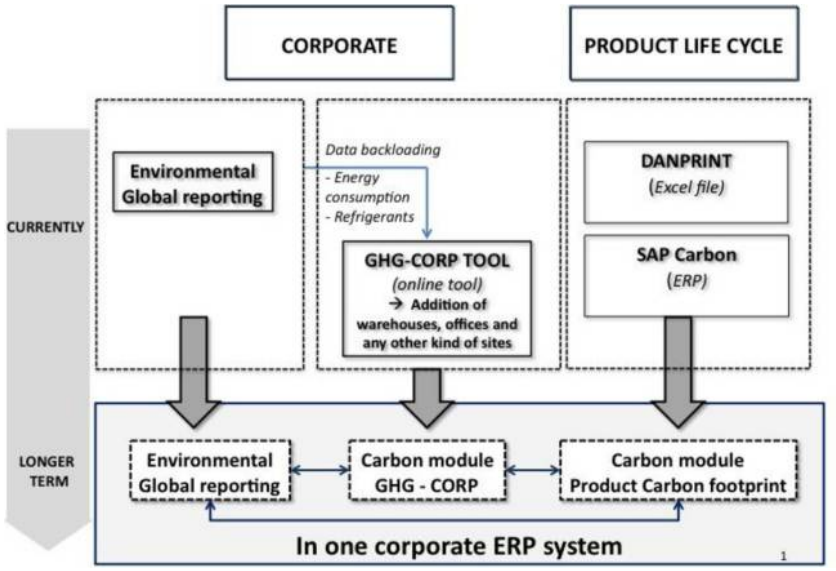

Figure 2.
Carbon accounting system at Danone

5. Testing the convergence project for a business unit

Based on the need to bring together different stakeholder views of carbon performance, Danone decided in 2010 to launch the "convergence" project. Having to comply with two different accounting approaches could be cumbersome and lead to one winning over the other. However, Danone recognized it needed both, one that served their internal management purposes, other that served their reporting purposes. The nature finance team had identified potential issues that would have emerged either from carbon masters (double data entry, for example), from external stakeholders (are your numbers from your two systems different and why? Are they both auditable? Mistrust could have arisen if Danone would not be able to explain the reconciliation), and the convergence project was lead into the direction of building a common and converged carbon management accounting system that would comply with internal and external stakeholders' needs.

The different listed goals of the project were: to account for all emissions that Danone is responsible for as Danone believes in the extended responsibility concept (their carbon management accounting is based on that principle), to be compliant with current worldwide standards in carbon accounting: GHG Protocol/PAS 2050, to build a verifiable carbon measure, and finally, to allow for maximum carbon reduction potential and to optimize reporting for legal requirements (Grenelle 2). Additionally, the project had to keep in mind the following goals linked to carbon accounting management: minimize and optimize data entry, use direct data whenever possible (e.g. production jobs from manufacturing), keep granularity to allow for action plans to take place and allow for reporting towards monitoring reduction targets. The convergence was made on the basis that both global results – calculated with Danone's own carbon management accounting and with the GHG Protocol Corporate Standard – (Scope 1, 2 and 3) would match. The convergence was to help reconcile the different categories within each accounting approach, and build a verifiable carbon measure based on both standards.

First, the project team analysed and identified several potential differences that could appear from the standards literature and that would need to be tackled if the reconciliation was to succeed. Secondly, the team performed a real-life convergence of the two carbon management accounting approaches with the year 2011 data of the US business unit Stonyfield to examine the reconciliation issues that would emerge. To our knowledge, the convergence of different carbon management accounting approaches has never been tested to this magnitude before.

5.1 Methodological reconciliation differences

During the workshops organized for the convergence project, the project team (the carbon accounting team of Danone, the carbon specialist at SAP and the Stonyfield carbon master) identified three types of differences prior to the convergence actually being performed: the non-attributable processes, the differences linked to the specifics of the carbon management accounting developed by Danone and the differences linked to the existing carbon standards.

At the time the convergence was performed, Danone's carbon management accounting did not take into account what is called "non-attributable processes" in the PAS 2050 standard or in the new GHG Protocol product life cycle accounting and

reporting standard (p. 36 of the standard) Methodological differences identified in carbon accounting standards (including Danone's own accounting):

(1) Non-attributable processes:
- Administrative sites (Headquarters and sales offices).
- Capital goods.
- Sales teams' fleet.
- Corporate activities and services: R&D, marketing, finance and operating expenses.
- Transport of consumer to the retail location.
- Employee travel.

(2) Differences linked to Danone's carbon management accounting approach:
- Co-maker products (products made by others on behalf of Danone).
- Inter-company products (consumption-based approach).
- Inventory issues (stock) (consumption-based approach).

(3) Differences linked to carbon reporting standards:
- Transport of employees to and from their normal place of work is excluded in PAS 2050 but is included in Scope 3 (GHG Protocol Value Chain Standard).
- Investments in other companies is considered in Scope 3 of the GHG Protocol Standard, but not in LCA approaches (PAS 2050) and not in Danone's current accounting approach.

Non-attributable processes are:

> […] some service, material, and energy flows (that) are not directly connected to the studied product during its lifecycle because they do not become the product, make the product, or directly carry the product through its life cycle (GHG Protocol, 2011b).

GHG Protocol (2011b) advises to report capital goods and infrastructure in the cases when they have a large impact relative to the rest of the inventory.

In the Stonyfield case, non-attributable processes that were not included in Danone's accounting included capital goods, employee commuting, business travel and the headquarter emissions. This accounts for 3.3 per cent of total emissions for Stonyfield in 2011.

Other differences are related to the specifics of Danone's carbon management accounting system such as the consumption-based perspective. Their accounting requires accounting for products at the place of sales to end consumers even if produced elsewhere. This causes timing issues because the GHG Protocol Corporate Standard considers production-based emissions at the time of production, whereas Danone's consumption-based accounting considers emissions when the product is consumed. One consequence of this perspective is to have to account for inter-company products (products made in one business unit but sold to the end consumer in another business unit). For example, products made in Belgium but sold in France, would have their emissions accounted in France. The second consequence is that using the consumption-based perspective, carbon emissions are stocked and accounted for later at

the time of consumption. This is important for dry baby products that are kept longer in warehouses than products such as yoghurts.

Another difference is a "boundary" issue. Danone considers its responsibility beyond the factory gates, and this includes products that are "co-manufactured" by other companies but sold under the Danone label. These products do not enter any form of "control" in the GHG Protocol Corporate Standard, and would only be considered as purchase of raw materials in Scope 3.

Further identified differences are standard based. The transport of employees, which is a non-attributable process for LCA standards but is included in Scope 3 of the corporate GHG Protocol standard, has to be included in the final convergence of a carbon management accounting system as a non-attributable process. Investments could also be seen as non-attributable but have not been calculated for the current case study because of a lack of data (the footprint of the companies where the investments were made would have to be collected).

Further differences have been noted and must be taken into consideration when considering convergence. Firstly, emission factors can be taken from different literature sources and can be based on full life cycles or only on Scope 1 and 2. For this project, emission factors have been analysed systematically so that data sources are the same for both accounting approaches. Emission factors (especially for energy) have been broken down into scopes for the reconciliation purpose. Secondly, for the cases where Danone has produced products for other companies (business-to-business [B2B]), the GHG Protocol Corporate Standard requires the accounting for energy consumption at the production site even though these products are not Danone products and thus, not considered by Danone's current accounting. This is not discussed further in the current case study and remains an open topic for further research on B2B sales.

5.2 The stonyfield case study

The following figures are simplified and real numbers based on 2011 emissions data collected. However, the order of magnitude of the numbers has been changed to respect the confidentiality of the data that Stonyfield allowed us to publish. The case study illustrates that reconciliation is possible, although this particular study does not resolve all issues that may arise on a wider scale and in other industries. With this study, we would like to initiate the discussion for additional in-depth analysis of the convergence process, and also call for further case studies to deepen our analysis of this process.

The case study was conducted with 2011 data (Tables IV-VII). The GHG Protocol (2004) was used to calculate the carbon emissions for Scope 1, 2 and 3.

The corporate footprint of the business unit Stonyfield was calculated on the basis of the 237 different products creating the turnover of Stonyfield for 2011 (Table VI) and using Danone's own carbon management accounting.

Based on the two accounts shown in Tables IV-VI, it is hard to see whether matching is possible. It is necessary to break the items down to a lower level with more details to enable information convergence. Table VII shows how the convergence was rendered possible.

For example, the manufacturing process within Danone's carbon management accounting had to be broken down into four GHG Protocol categories: energy for manufacturing plants (under operational control) Scope 1, 2 and 3 emissions, and Scope 3 end-of-life site category (packaging). It has to be noted that although this particular case

study does not include inter-company products (Stonyfield produces and sells all of its products in the USA), inter-company products sold to another country business units would have been considered as sold to an end consumer. Purchased inter-company products are considered like "co-made" products and accounted for like a purchased good.

Site	Scope 1 and 2 (tonnes of CO_2)
Plant 2 factory	2,620
Plant 2 warehouse	461
Plant 2 dry good warehouse	60
Plant 1 factory and warehouse	14,342
Headquarters	1,326
Other site miscellaneous	443
Café 1	14
Café 2	227
Total	19,493

Table IV. GHG protocol corporate standard results Scope 1 and 2

Category	Scope 3 (tonnes of CO_2)
Purchased goods and services	113,709
Capital goods	5,052
Fuel- and energy-related activities (not in Scope 1 and 2)	1,519
Upstream transportation and distribution	66,947
Waste generated in operations	4,848
Business travel	704
Employee commuting	1,162
Upstream leased assets	n/a
Downstream transportation and distribution	18,477
Processing of sold products	n/a
Use of sold products	3,458
End-of-life treatment of sold products	223
Downstream leased assets	n/a
Franchises	n/a
Investments	n/a
Total	216,099

Table V. GHG protocol corporate standard results for Scope 3

Emission process	Tonnes of CO_2
Raw and pack production	113,709
Upstream logistics	12,647
Manufacturing	20,178
Downstream logistics	59,070
Retail	18,477
Use phase	3,458
End-of-life	223
Non-attributable processes	7,810
Total	235,572

Table VI. Carbon emissions according to Danone's carbon management accounting[7]

Table VII.
Reconciliation table between the GHG protocol accounting and Danone's so far developed accounting approach

Danone's accounting			GHG Protocol Corporate Standard		
Product life cycle phase	Phase: detailed	Tonnes of CO_2	Scope	Scope 3 No.	Category
Raw and pack production	Raw and pack (without upstream transportation)	113,709	3	1	Purchased goods and services raw and packs (Danone products)
Upstream logistics	Upstream transportation (not under operational control)	12,647	3	4	Upstream transportation and distribution
Manufacturing	Manufacturing plants (under operational control)	6,698	1	–	Scope 1 energy-related emissions
Manufacturing	Manufacturing plants (under operational control)	12,092	2	–	Scope 2 energy emissions
Manufacturing	Manufacturing plants (under operational control)	1,311	3	3	Scope 3 energy-related emissions
Manufacturing	End-of-life site (packaging) Danone products	77	3	5	Waste generated in operations
Downstream logistics	Downstream transportation (not under operational control)	43,332	3	4	Upstream transportation and distribution
Downstream logistics	Energy and fugitive emissions of warehouses not under operational control	10,968	3	4	Upstream transportation and distribution
Downstream logistics	Transportation losses	4,770	3	5	Waste generated in operations (logistic)
Retail	Fugitive emissions from fridges at retail not under operational control	18,477	3	9	Downstream transportation and distribution (energy and fugitive emissions of retail not under operational control)
Use phase	Emissions at home	3,458	3	11	Use of sold products
End-of-life	End-of-life at retail and at home	223	3	12	End-of-life treatment of sold products
Non-attributable process	Headquarters and other sites	226	1	–	Scope 1 energy-related emissions (Headquarters and other sites)
Non-attributable process	Mobile combustions from sales cars and company cars	99	1	–	Scope 1 mobile combustions from sales cars and company cars

(*continued*)

Danone's accounting			GHG Protocol Corporate Standard		
Product life cycle phase	Phase: detailed	Tonnes of CO_2	Scope	Scope 3 No.	Category
Non-attributable process	Energy emissions from headquarters and other sites (electricity)	359	2	–	Scope 2 energy-related emissions from headquarters and other sites
Non-attributable process	Capital goods	5,052	3	2	Capital goods
Non-attributable process	Energy-related emissions from headquarters and other sites	208	3	3	Scope 3 energy-related emissions (headquarters/others)
Non-attributable process	Business travel	704	3	6	Business travel
Non-attributable process	Employee commuting	1,162	3	7	Employee commuting
Total		235,572			

Table VII.

Practical issues that arose from this case study include:

- it is necessary to have a common definition of what a "site" is (especially when the warehouse is part of a factory building or when new sites are built or bought which had not been in the ERP system before);
- logistics data (which are often related to problems of availability of information) do not always allow distinguishing Scope 1 from Scope 3 information; and
- Scope 3 data from operating expenses, such as marketing or finance, are mainly available in a format that requires an input-output type of LCA rather than the one currently used (PAS 2050).

Of course not all issues arising from such an investigation can be solved with the analysis of one case study. However, Table VII allows mapping all processes by breaking them down to a common denominator. This approach can potentially be repeated in further case studies of other business units.

6. Discussion and conclusion

This paper highlights a core challenge that many consumer goods companies are facing when developing carbon management accounting: how to link and converge the various carbon management accounting approaches which have emerged for the past couple of years? Although the overarching goal of different accounting approaches, namely, to reduce the carbon footprint of the company and its products, is the same, they focus on different aspects providing different kinds of information to different stakeholders. The emergence of multiple organization and product carbon accounting approaches created multiple carbon performance definitions and various stakeholder expectations for comparable and standardized carbon reporting.

The divergence and convergence of organizational accounting processes may not be an exception but rather quite common in the practical development and emergence of carbon and other environmental management accounting approaches. In LCA research, attributional and consequential approaches are distinguished and both have fundamentally different purposes. Referring to the distinction between attributional and consequential LCA by Finnveden *et al.* (2009, p. 3), attributional carbon management accounting can be defined by its focus on describing the climate relevant physical flows to and from a company and its subsystems, whereas consequential carbon management accounting aims to describe how flows carbon and carbon equivalent emissions will change in response to possible decisions. Transferring this to carbon accounting, the GHG Protocol can be considered (mainly) attributional and PAS 2050 (mainly) consequential. When developing a carbon management accounting system, only the latter is likely to be truly useful for decision-making in companies, as it does not constrain management to arbitrary scopes of responsibility which do not match management responsibilities assigned in the company organization.

This case study provides a rare insight into a company's carbon management accounting system and the convergence challenges, shedding light into the black box of company internal carbon management accounting. The case identifies concrete practical challenges of convergence common to other consumer goods companies, including matching to the lowest level denominator the scope categories

(GHG Protocol) and the life cycle-detailed phases (Danone accounting) for convergence (Table VII), defining common data source and emission factors, getting carbon accountants to be experts in both standards and gearing the information system to allow common data collection (e.g. site "tagging" was considered for Scope 1, 2 and 3 emissions). To overcome them may not only reduce costs of carbon management accounting but also increase data quality and support different actors in their strive to reduce the carbon footprint of the company and its products.

Multiple stakeholders ask for carbon management accounting with different characteristics that sometimes contradict each other. As a consumer goods company, Danone was involved in the testing of governmental labelling programmes (France, European Union). As a publicly listed multinational, the company is requested to respond to investors, the French state and rating agencies using an organization carbon accounting standard, such as the GHG Protocol corporate standard or ISO 14064. Other stakeholders, such as NGOs, production and product managers, and more recently investors through the CDP's carbon project initiative, are asking for a reduction of carbon emissions. This has challenged the company to design different carbon management accounting approaches with different characteristics and scopes to respond to multiple requests and support decision-making at various levels and for different purposes.

The ongoing project is to further reconcile those carbon management accounting approaches both methodologically and computationally. In 2012, the company tested the methodological "convergence" with their US-based unit Stonyfield's "real life" data and initiated a project with SAP on testing the possibility to converge the different accounting approaches to one common carbon management accounting system.

The convergence project was only made possible through the current organization and ERP system that Danone has in place to collect the carbon footprint information of all products. Although many indications exist that a convergence of the two types of carbon management accounting is possible, various challenges remain to bridge organizational and product information measuring carbon performance on a larger scale. Further technical accounting issues may arise (e.g. on untested Scope 3 categories such as investments).

Currently the main difference left is the consideration of inventories. For Danone, this is especially the case for the water and baby food businesses where products can be manufactured a long time in advance. Those carbon emissions are then "stocked" in warehouses and, when applying the consumption-based accounting approach, only accounted for much later when consumed.

Further research is necessary to better understand the technical issues related to the convergence of different carbon accounting approaches. More case studies in different industries and comparisons of experiences could highlight further practical implementation difficulties and approaches on how to overcome these challenges. New corporate LCA-based accounting, such as developed by Accor and Puma, could also be considered and potentially help companies to bridge different carbon accounting approaches. Although at first hand, it may seem like a simple accounting exercise to introduce carbon management accounting, this project highlights that to establish a comprehensive carbon management accounting system, which effectively addresses the different performance management and

reporting needs of various stakeholders, includes different challenges for the accounting organization and the development of carbon management accounting approaches. First, it is necessary to develop a carbon performance measurement system that responds to various stakeholders needs, and second, to create transparency for stakeholders who express legitimate information requests aiming at comparing corporate performance between companies and over time. Sectors in B2B markets may not have the same incentives to develop such integrative carbon management accounting systems or to converge different accounting approaches but are linked with their supply chains to companies operating in the consumer market. This raises further challenges on how to establish carbon management accounting in industry networks.

Finally, it is recognized that converging different carbon management accounting approaches requires specific knowledge and information systems that are not always readily available in the organizations today.

Notes

1. The Carbon Action Initiative started in 2013 is defined as "an investor-led initiative to accelerate company action on carbon reduction and energy-efficiency activities which deliver a satisfactory return on investment" (CDP, 2013).
2. Scope 1 emissions are direct GHG emissions that occur from sources that are owned or controlled by the company, Scope 2 emissions are GHG emissions from the generation of purchased or acquired electricity, steam, heat or cooling consumed by the company, and Scope 3 emissions are all other indirect GHG emissions (GHG Protocol, 2004).
3. "We have now assessed 366 key value chains" said Akzo Nobel in 2012. (http://report.akzonobel.com/2012/ar/sustainability/valuechain/note11climatechange.html?cat=m)
4. 600 products have been analysed as of 2008 (www.developpement-durable.gouv.fr/IMG/pdf/COMMUNIQUE_DE_PRESSE.pdf)
5. Tesco has calculated the footprints of 1100 products and labelled 500 of them but since 2012, has dropped out of carbon labelling.
6. In 2012, only 14 of the global 500 companies reported on all 15 categories included in Scope 3 to the CDP questionnaire according to Quantis. Quantis issued in December 2014 a new tool named "scope 3 evaluator", which allows companies to make an initial rough approximation of Scope 3 emissions, acknowledging the complexity of collecting emissions towards accounting for Scope 3 (www.quantis-intl.com/files/9714/1865/7181/Scope_3_Evaluator_Press_Release_FINAL.pdf)
7. There is a slight difference in totals (20 tons between 235,572 tons for Tables VI and VII and 235,592 for Tables IV and V) linked to rounding in energy consumptions used in different files.

References

Andrew, J. and Cortese, C. (2011), "Accounting for climate change and the self-regulation of carbon disclosures", *Accounting Forum*, Vol. 35 No. 3, pp. 130-138.

Ascui, F. and Lovell, H. (2011), "As frames collide: making sense of carbon accounting", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. 978-999.

Baker, M. and Schaltegger, S. (2015), "Pragmatism and new directions in social and environmental accountability research", *Accounting, Auditing and Accountability Journal*, Vol. 28 No. 2, pp. 263-294.

Bowen, F. and Wittneben, B. (2011), "Carbon accounting: negotiating accuracy, consistency and certainty across organisational fields", *Accounting, Auditing & Accountability Journal*, Vol. 24 No. 8, pp. 1022-1036.

Burritt, R.L. (2012), "Environmental performance accountability: planet, people, profits", *Accounting, Auditing and Accountability Journal*, Vol. 25 No. 2, pp. 370-405.

Burritt, R.L., Schaltegger, S. and Zvezdov, D. (2011), "Carbon management accounting: explaining practice in leading German companies", *Australian Accounting Review*, Vol. 21 No. 1, pp. 80-98.

Busch, T. (2010), "Corporate carbon performance indicators revisited", *Journal of Industrial Ecology*, Vol. 14 No. 3, pp. 374-377.

CDP (2013), "Carbon action", available at: www.cdp.net/en-US/Programmes/Pages/Initiatives-CDP-Carbon-Action.aspx (accessed 1 June 2015).

Cotter, J., Najah, M. and Wang, S.S. (2011), "Standardized reporting of climate change information in Australia", *Sustainability Accounting, Management and Policy Journal*, Vol. 2 No. 2, pp. 294-321.

Epicor (2012), "Global survey reveals most companies naïve when it comes to energy management".

ERM (2010), "Company GHG emissions reporting – a study on methods and initiatives".

European Commission Joint Research Centre (2011), "Organisation environmental footprint guide".

Finnveden, G., Hauschild, M., Ekvall, T., Guineé, J., Heijungs, R., Hellweg, S., Koehler, A., Pennington, D. and Suh, S. (2009), "Recent developments in LCA", *Journal of Environmental Management*, Vol. 91 No. 1, pp. 1-21.

GHG Protocol (2001), "GHG Protocol Corporate Standard".

GHG Protocol (2004), "GHG Protocol Corporate Standard", (revised edition).

GHG Protocol (2011a), "Corporate value chain accounting and reporting standard".

GHG Protocol (2011b), "Product life cycle accounting and reporting standard".

GHGMI (Management Institute) (2009), "The 2009 greenhouse gas & climate change workforce needs assessment survey report", available at: http://ghginstitute.org/wp-content/uploads/2009/11/2009_green_jobs_survey.pdf (accessed 15 May 2015).

Gray, R. (2010), "Is accounting for sustainability actually accounting for sustainability … and how would we know? An exploration of narratives of organisations and the planet", *Accounting, Organizations and Society*, Vol. 35 No. 1, pp. 47-62.

Haigh, M. and Shapiro, M.A. (2012), "Carbon reporting: does it matter?", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 1, pp. 105-125.

Hendrichs, H. and Busch, T. (2012), "Carbon management as a strategic challenge for SMEs", *Greenhouse Gas Measurement and Management*, Vol. 2 No. 1, pp. 61-72.

Henri, J.F. and Journeault, M. (2010), "Eco-control: the influence of management control systems on environmental and economic performance", *Accounting, Organizations and Society*, Vol. 35 No. 1, pp. 63-80.

Hoffmann, V.H. and Busch, T. (2008), "Corporate carbon performance indicators", *Journal of Industrial Ecology*, Vol. 12 No. 4, pp. 505-520.

Hrasky, S. (2012), "Carbon footprints and legitimation strategies: symbolism or action?", *Accounting, Auditing & Accountability Journal*, Vol. 25 No. 1, pp. 174-198.

Kolk, A., Levy, D. and Pinkse, J. (2008), "Corporate responses in an emerging climate regime: the institutionalization and commensuration of carbon disclosure", *European Accounting Review*, Vol. 17 No. 4, pp. 719-745.

MacKenzie, D. (2009), "Making things the same: gases, emission rights and the politics of carbon markets", *Accounting, Organizations and Society*, Vol. 34 Nos 3/4, pp. 440-455.

Malmi, T. and Granlund, M. (2009), "In search of management accounting theory", *European Accounting Review*, Vol. 18 No. 3, pp. 597-620.

Mizuguchi, T. (2008), "The need for standardised disclosure on climate-risk in financial reports: implications of the JICPA reports", in Schaltegger, S. (Ed.), *Environmental Accounting for Cleaner Production, Eco-Efficiency in Industry and Science*, Springer, Dordrecht, pp. 353-364.

Nelson, T., Wood, E., Hunt, J. and Thurbon, C. (2011), "Improving Australian greenhouse gas reporting and financial analysis of carbon risk associated with investments", *Sustainability Accounting, Management and Policy Journal*, Vol. 2 No. 1, pp. 147-157.

Ranganathan, J. (2011), "GHG protocol: the gold standard for accounting for greenhouse gas emissions", *WRI Insights*, 4 October, available at: www.wri.org/blog/2011/10/ghg-protocol-gold-standard-accounting-greenhouse-gas-emissions (accessed 15 February 2015).

Schaltegger, S. (1997), "Economics of life cycle assessment (LCA): inefficiency of the present approach", *Business Strategy and the Environment*, Vol. 6 No. 1, pp. 1-8.

Schaltegger, S. and Burritt, R. (2000), *Contemporary Environmental Accounting: Issues, Concepts and Practice*, Greenleaf Publishing, Sheffield.

Schaltegger, S. and Csutora, M. (2012), "Carbon accounting for sustainability and management: status quo and challenges", *Journal of Cleaner Production*, Vol. 36 No. 1, pp. 1-16.

Schaltegger, S. and Wagner, M. (2006), "Integrative management of sustainability performance, measurement and reporting", *International Journal of Accounting, Auditing and Performance Evaluation*, Vol. 3 No. 1, pp. 1-18.

Scipioni, A., Manzardo, A., Mazzi, A. and Mastrobuono, M. (2012), "Monitoring the carbon footprint of products: a methodological proposal", *Journal of Cleaner Production*, Vol. 36 No. 1, pp. 94-101.

Spradley, J.P. (1980), *Participant Observation*, Holt, Rinehart and Winston, New York, NY.

Stechemesser, K. and Guenther, E. (2012), "Carbon accounting: a systematic literature review", *Journal of Cleaner Production*, Vol. 36 No. 1, pp. 17-38.

SustainAbility (2010), "Rate the raters phase two: taking inventory of the ratings universe".

Trexler, M.C. (2011), "GHG measurement and management are vital, but always be looking to advance the end game of mitigating climate change", *Greenhouse Gas Measurement and Management*, Vol. 1 No. 2, pp. 77-79.

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