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Four stages of carbon accounting: a small country perspective

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***Extended abstract*: The study provides a systematic overview of the evolution, stages and challenges of corporate carbon accounting, with particular reference to the carbon balance of supply chains and the entire life cycle of products. It examines and assesses the evolution and development of the conceptual background of carbon accounting in four stages (environmental accounting focus, direct carbon dioxide focus, direct and indirect greenhouse gas emission focus, climate impact focus). Based on these, it appears that the monitoring of indirect emissions is playing an increasingly important role in corporate carbon accounting, supported by the methodological toolkit presented in the study, especially as the accounting of indirect emissions has become more widespread.**

Still, accounting of indirect emissions still seems to be the 'game' of focal company in multinational companies located in industrialised counties. The development hardly spills over to far end suppliers or to smaller countries.

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I. INTRODUCTION

In the age of the network economy, carbon accounting for global supply chains goes far beyond environmental protection and is of major economic and social importance. Concerns about global climate change and related international policies have led to the development of enterprise-level carbon accounting. [

During the last twenty years, organizational-level carbon accounting has undergone a major transformation, from being merely a well-defined example of a broad functional issue to becoming a special focus area of environmental management accounting. This development and transformation of carbon accounting can be divided into four stages, which will be described in this paper in order to provide added value compared to earlier reviews (for example, Schaltegger and Csutora 2012) [1] offer a conceptual perspective but do not address climate change accounting, and Stechemesser and Günther (2012) [2] mainly discuss definitional issues). Moreover, this paper sheds light on the complexity of the issue and the difficulties we face when trying to provide a good estimate of total carbon or climate costs related to business activity.

For the last twenty years, carbon accounting issues have been on the agendas of businesses as well as academics in the academic field of environmental management accounting. However, the focal points and questions of carbon accounting have shifted significantly during this period. Therefore, we have classified the development of carbon accounting into four stages, which are surveyed in the following subsections.

STAGE 1: CARBON ACCOUNTING AS AN EXAMPLE FOR ENVIRONMENTAL MANAGEMENT ACCOUNTING

Originally, environmental management accounting developed its functional rather than its topical areas. These functional areas included physical environmental accounting, material flow cost accounting, financial accounting, reporting, capital budgeting, and others. etc. (see, for example, Schaltegger and Burritt 2000) [3].

Carbon-related costs, although seldom mentioned in these terms, have found their place in each of these functional areas, but they have been used more as an example than as a topical issue.

While physical accounting has embraced carbon dioxide and other greenhouse gas emissions (Bennett – James 1998), [4] financial accounting has focused on related financial costs such as carbon taxes and costs of tradable emission permits. Management accounting has gone even further by recording energy costs as environmental resource costs and energy savings as environmentally induced benefits (Jasch 2003) [5]. This approach – considering energy costs as environmental costs – was a brave and innovative step in moving away from the short-sighted approach that treated environmental costs mainly as treatment costs and penalties. Considering all wasted material and energy as environmental costs was a revolutionary suggestion that many accountants found surprising and challenging. It is no surprise that at this stage, when even these simple concepts were controversial, there was little coverage of carbon accounting and no mention of
it as a special focus area..

II. CARBON ACCOUNTING AS A SEPARATE FOCUS TOPICS

During the second decade of environmental management accounting, increasing attention was paid to the climate and, therefore, to carbon emission issues, which developed into a special focus area of both sustainability research and business practices. Greenhouse gas emissions were no longer treated as one type of airborne emissions but rather as a standalone topical issue within environmental accounting. Thus, we can speak of carbon management accounting – as a specific field of study – starting in the early 2000s.

In the early 2000s, climate change was still not fully accepted as a threat, as the public – especially in the developed world – could not directly feel it, or at least could not directly connect carbon emissions to their environmental consequences. However, increased media coverage resulted in growing public interest in the topic. Europe-wide citizen surveys (Eurobarometer 2007; 2011)

[6;7]indicate that climate change was perceived as a top sustainability concern, even if it lost some ground after the financial crisis. Regulatory and political pressures, such as the Kyoto protocol, emissions trading in the EU and carbon taxes like those in Australia (Pellegrino – Lodhia 2012), [8] were accompanied by societal and market pressures to control climate change. Thus, whether or not they believe in climate change, businesses were forced, as a consequence of climate policy and public perception, to measure and manage their carbon emissions and related costs.

Voluntary corporate initiatives have also played an important role in creating change. The measurement and management of GHG emissions are now on the agendas of the top management of leading companies and advanced business associations. Voluntary corporate initiatives have gained attention, carbon management and accounting divisions have been set up in major consulting companies, and professional accounting organizations are defining their approaches to carbon accounting (Ascui – Lovell 2012; [9] Ratnatunga – Balachandran 2009 [10]). The growing interest in carbon accounting and reporting has also raised the demand for standardization in the field.

III. CARBON ACCOUNTING COVERING SUPPLY CHAIN AND PRODUCT ISSUES

Although there have been developments in the field of policy regulation and in company-level carbon accounting and management, there is a clear – and even growing – discrepancy between the national efforts taken to combat carbon releases and still-increasing global carbon missions. A large and increasing share of European and US GHG emissions has been embedded in imported goods as a 'carbon rucksack' (von Weizsäcker et al. 1997; [11] von Weizsäcker 2009 [12]). Moreover, the CO2-intensity of products has often increased, partially as a result of more stages of transport and longer transportation distances. National carbon accounts, in both developed and developing countries, are therefore distorted with regard to who actually causes the carbon emissions and their related responsibilities (e.g., Bastianoni et al. 2004) [13] The large and increasing share of GHG emissions 'hidden' in imported goods underlines the importance of calculating carbon emissions and impacts beyond those directly related to the organizations responsible for production. There has been a growing need to include whole supply chains and product life cycles in carbon accounting, including the emissions caused by semi-manufactured products imported by manufacturing industries. The growing complexity and flexibility of supply chains, however, posed substantial challenges to this type of carbon accounting (Schaltegger – Csutora 2012). [1]

Efforts to effectively combat climate change will fail if companies are not engaged in substantially reducing their carbon emissions. International and political institutions have introduced different measures with varying rigidity and scope (Garnaut 2010). [14] The carbon impacts of delocalized production were not captured and measured until the last decade. At the moment, the dominant and most widely used framework and international standard for carbon accounting is the Greenhouse Gas (GHG) Protocol, developed by the World Business Council for Sustainable Development and the World Resources Institute (WBCSD – WRI 2004; 2011). [15,16] This protocol goes to great lengths to help organizations include their indirect carbon emissions. According to the GHG Protocol, carbon emissions are usually grouped into different 'scopes'. The three scopes suggested by the GHG Protocol are the following:

• Scope 1: Direct GHG emissions, including sources that are owned or controlled

by the company (e.g., emissions from own boilers, vehicles, etc.)

• Scope 2: Electricity indirect GHG emissions from the generation of purchased electricity consumed by the company (the protocol considers solely electricity, but other purchased energy – heat or steam – should also be considered here).

• Scope 3: Other indirect GHG emissions based on activities such as external transportation or the use of sold products. Scope 3 is an optional accounting category that allows for the inclusion of all other indirect emissions. The Scope 3 standard of the GHG Protocol (WBCSD – WRI 2011) [16] provides detailed guidance for organizations on how to include their carbon impacts embedded along the value chain. Beyond upstream emissions, Lenzen and Murray (2010) [17] stress the importance of including downstream impacts in organizational carbon footprint accounts as well. To comprehensively account for these carbon emissions is a much bigger challenge compared to Scopes 1 and 2, as will be highlighted in Section 3. Although Scope 3 emissions account for a significant portion of organizational emissions (Stein – Khare 2009; [18]), indirect CF elements (other than Scopes 1 or 2) are usually underestimated by companies. Matthews et al. (2008) [19] claim that only 14% of a company's total carbon footprint is covered by Scope 1, and only 26% is covered by Scopes 1 and 2 among US companies. However, Matthews et al. consider Scope 3 as too vaguely defined and instead suggest Scope 3 (indirect emissions for production) and Scope 4 (indirect emissions for the total life cycle including delivery, use, and end-of-life). Huang et al. (2009 [20]) found that indirect GHG emissions along supply chains can account for as much as 75% of the total GHG emissions of a company. The most costeffective carbon mitigation strategies cannot be revealed if Scope 3 emissions are neglected (Matthews et al. 2008). [19] Indeed, accounting for and reporting indirect carbon emissions can lead to better management, as corporations are motivated to choose more environmentally friendly options in their production

activities and to incorporate reduction aims into their corporate strategies (Ascui – Lovell 2012). The GHG protocol sets the minimum requirement that companies should separately account for and report on scopes 1 and 2 (WBCSD – WRI 2004).

IV. From Carbon Accounting to Climate Accounting

Carbon accounting, in a broader sense, can also refer to a larger set of greenhouse gas groups, which are covered by the Kyoto Protocol: nitrous oxide (N2O), methane (CH4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6). If the scope of carbon accounting is extended to a broader set of GHGs, the term carbon accounting is somewhat misleading, as other non-carbon-based GHGs (such as N2O and SF6) are covered as well. In this sense, the terms GHG accounting – or even global warming accounting – may be considered even more appropriate (compare with Northey et al. 2013). [21]

Additionally, the concept of 'climate change accounting' broadens the horizon even further, as it addresses not only emission costs but also climate change mitigation and adaptation costs. Stechemesser et al. (2015) [22] tried to conceptualize and empirically test 'carbon vulnerability accounting', which delineates how climate adaptation impacts corporate accounts (through increased insurance costs or energy consumption as a consequence of climate change). Focus has already been placed on GHG-accounting in a broader sense, but climate change accounting (including adaptation issues) may also come into the spotlight in the future, as climate change becomes an essential element of organizational cost accounting.

From a temporal perspective, the stages overlap somewhat, as academic discussion began to address the different issues before they became widespread elements of practice. With this consideration, Stage 1 covers the first decade (late 1990s to early 2000s), while Stage 2 is the dominant approach of the early and mid-2000s. Although indirect carbon emissions (Stage 3) have been the focus of the academic agenda since the mid-2000s, some methodological issues remain unresolved even in the academic discussion (see next chapter),) thus, we can argue that this is still an ongoing stage. Last but not least, organizational climate adaptation issues only began to be addressed in the 2010s and will probably become a focus in the future.

V. Future of Carbon Accounting

Although much has been achieved in carbon accounting during this period (from the field's earliest beginnings to its status as a well-established field both in academic discussion and corporate practices), there is still much to do in the future. From a methodological perspective – even if top-down and hybrid approaches to carbon accounting have been worked out – there are still uncertainties regarding how to set system boundaries and avoid double counting while also systematically including supply chain and product-related carbon emissions. So, academic research needs to further focus on refining these issues related to Scope 3 carbon emissions. Another challenge that has emerged recently in the scope of academic discussion and that definitely requires deeper insights from future research is the development of a structural approach to climate change accounting (addressing – beyond merely carbon emissions – the climate adaptation-related impacts of organizations). Regarding business-related challenges in the field of carbon accounting, the relationship of voluntary and mandatory reporting remains an issue, even though there are good practices in voluntary accounting and reporting (the Greenhouse Gas Protocol or the Carbon Disclosure Project). This type of reporting, however, will not involve the majority of companies in the near future, and those with poorer performance in the field are especially likely to stay away, even if their participation would be valuable in moving towards an economy and society that seek not only competitiveness but also welfare in a broader sense Mandatory reporting might fill this gap to some extent, but it remains to be seen how accurate methodologies can be developed and how comprehensively carbon emissions can be assessed by this type of regulation. Another challenge is related to the resource need of companies to account for their carbon emissions comprehensively. Larger companies may have the financial and human resources to do this; SMEs, however, are very likely to suffer shortages in this context. There are also simpler, freely available carbon calculators on the market, but these are not yet sufficient to provide valid and reliable coverage in the field (Szigeti – Harangozo 2016). [23]

Based on an analysis of Hungarian companies' accounting practices, the largest companies are already paying close attention to carbon accounting, quantifying their direct (Scope 1) and purchased energy (Scope 2) emissions, while the accounting of their emissions related to the other parts of the supply chain (Scope 3), however, are still in their infancy. Accounting of indirect emissions still seems to be the 'game' of focal company in multinational companies located in industrialised counties. The development hardly spills over to far end suppliers or to smaller countries.

VI. Relevance for practice

So far, we have summarized the conceptual background of carbon accounting and reporting; these practices have also gained relevance for businesses (underpinned by the number of companies voluntarily releasing data or participating in related initiatives such as the CDP). Furthermore, carbon accounting can be relevant and useful to corporate professionals with very

different backgrounds. Indeed, it can be applied to almost all corporate functions, as Table 3 summarizes. The table highlights (with examples) that goals, challenges, methods and unanswered questions are quite diverse in the various fields, making it a complex task for companies to include them properly. On the one hand, top management may need aggregated information on the total carbon impact of the company and how carbon reduction could support its competitive strategy. On the other hand, marketing, for example, may be interested in carbon labels, certifications and product optimization designs, which create carbon reduction effects for customers through product innovations.

A key challenge for corporate-level carbon accounting is, therefore, to develop a carbon accounting system that can meet the different needs of all functions in the most efficient manner. Links to strategy and existing management information system(s) are thus to be explored, as they may have the potential to integrate carbon-related accounting with conventional financial accounting information.

There are best practices (international standards, e.g., the GHG Protocol discussed earlier, or consultancy from numerous professional organizations, including NGOs) that can lead and guide companies (and even multiple members of value chains) to integrate carbon issues into their various functional fields in order to properly address this challenge. A key issue regarding the integration of carbon management into the different functional areas is, however, the motivation of organizations. If proper motivation is missing, the chances are high that carbon accounting – even if present – will remain only an isolated field that is not integrated with other functional areas. The motivations behind organizational-level carbon management can be grouped into three levels:

• Regulatory-driven: stricter regulation in the field forces companies to integrate carbon accounting into some areas (such as production and product management, and even supply chain management in those industries that have legal expectations at the product level for carbon emissions that are influenced by earlier steps of the supply chain – as in the automotive industry).

• Efficiency-driven: if the potential for cost-savings due to reduced energy use or carbon emissions (related to carbon quotas) is considered important, a more comprehensive carbon accounting approach is expected to develop at the organizational level, with integration into further functions such as finance and accounting, logistics and (at least internal) communication. In this case, mainly

Scope 1 and 2 emissions are likely to be covered (where direct costs apply to the organization).

• Market-driven: if market stakeholders along the value chain (final consumers, any B2B customers along the supply chain, or even competitors or suppliers) show interest in carbon issues related to the final products or the supply chain, this is a sufficient motivation to address carbon accounting at the level of strategic management and to integrate it into fields such as marketing (carbon footprint of products), human resources management (how can the organizational

footprint be further managed by including the daily practices of all employees) or even PR. When including supply chain impacts (with a strong focus on

Scope 3 emissions), the possibility of double accounting is an issue; so, total

numbers of different companies along the same supply chain shall not be added

mechanically. However, this information can be used for management and responsibility purposes (also based on the principle of shared responsibility).

VII. Conclusions

So far academics has focused on extending the scope and depth of analysis of corporate-level carbon emissions. Parallel to these efforts, academics and practitioners may come up with simpler, but still valid, frameworks designed for the needs of SMEs as well.

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