



UNIVERSIDAD  
DE BURGOS

Programa de Doctorado en Ciencias Jurídicas, Económicas y Sociales

Elena Carrión Moneo

DOCTORAL DISSERTATION

*Accounting for net-zero emissions*

Supervised by:  
Prof. Carlos Larrinaga González

May 2024

Elena Carrión Moneo

*Accounting for net-zero emissions*

## **Abstract (English)**

Climate change is a collective action problem that requires urgent and profound transformations to decarbonize the economy and ensure a safe and just operating space for humanity. Transnational companies, which have a key role in ensuring planetary sustainability, have galvanized net-zero commitments in an attempt to recognize the need and opportunity that a low-carbon future brings. In this regard, carbon accounting arises as a common label motivating research on how corporate climate action, regulation, and governance can drive the transition to a low-carbon society.

This thesis explores the role of accounting in translating the global goal of net-zero emissions at the corporate level. This objective is structured across three articles that unfold distinct yet interdependent issues that constitute new approaches to address the grand challenge of climate change. The first article draws on the Institutional Analysis and Development framework to identify and problematize the accounting technologies that participate in decarbonization. For this purpose, the paper reviews the technicalities surrounding the Science-based Target initiative, a voluntary initiative that provides the private sector with science-based guidance to reach net-zero emissions. The findings of this first study suggest that the present conceptualization of temporal and spatial boundaries, methods, and monitoring mechanisms are insufficient to mediate between climate urgency and corporate decision-making. With these insights, the second article investigates how science-based targets connect the global temperature limit with business operations through the specific lenses of evaluative infrastructures and the Institutional Analysis and Development framework. Continuing with the case of the Science-based Target initiative for the empirical setting, data collection relies on semi-structured interviews and archival documentation from ten large multinational companies that participate in the Science-based Target initiative. The analysis suggests that the interviewed companies, which operate within an infrastructure of collective action challenges that emerge in decarbonization, are not on track to fulfill their committed targets, among other reasons, due to accounting tensions arising in temporal and spatial boundaries, methods, and monitoring mechanisms. The third article explores the construction of the greenhouse gas emissions inventory and corporate net-zero target and their translation into an action plan for decarbonization with tangible consequences for the organization. This article mobilizes the notion of commensuration, or the translation of

different qualities into a common metric, with corporate transition plans, which emerge as a tool to ensure a credible and consistent corporate strategy to implement net zero pledges beyond disclosure. The empirical work relies on a qualitative case study research strategy, entailing interviews, archival data, and participant observation, with two companies that have committed to achieving net-zero emissions by 2050 and play a significant role in decarbonization due to their size, influence and long-standing trajectory on sustainability policies and actions. The analysis shows that the construction of the greenhouse gas emissions inventory and net-zero target and its translation to the action plan entails controversies, uncertainty, and the emergence of different viewpoints or interpretations. Likewise, the strategy for decarbonization is loosely coupled with measurements of net-zero targets, suggesting that the pathway towards achieving net-zero emissions becomes subject to varying interpretations, which shows that commensuration is not only a technical exercise but also a social and political process.

This thesis contributes to the field of environmental accounting by advancing the understanding of technical accounting details that companies face in the transition to a low-carbon future. The articles theorize how accounting mediates between the global goal of net-zero emissions and the corporate level within an infrastructure of collective action challenges. In the context of climate change as a complex societal problem, it offers practical implications that can guide business managers and policymakers in their decision-making processes.

**Keywords:** Carbon accounting; Net-zero emissions; Science-based Target initiative; Transition plans; Collective action, Qualitative research.

## Abstract (Spanish)

El cambio climático es un problema de acción colectiva que requiere transformaciones urgentes y profundas para descarbonizar la economía y garantizar un espacio operativo seguro y justo para la humanidad. Las empresas transnacionales, que desempeñan un papel clave a la hora de garantizar la sostenibilidad planetaria, han impulsado compromisos de descarbonización en un intento de reconocer la necesidad y la oportunidad que trae un futuro con bajas emisiones de carbono. En este sentido, la contabilidad del carbono surge como una respuesta sobre cómo la acción climática, la regulación y la gobernanza corporativas pueden impulsar la transición hacia una sociedad baja en carbono.

Esta tesis explora el papel de la contabilidad en la traducción del objetivo global de descarbonización al nivel corporativo. Este objetivo se estructura en tres artículos que desarrollan cuestiones distintas pero interdependientes que constituyen nuevos enfoques para abordar el gran desafío del cambio climático. El primer artículo utiliza el marco de Análisis y Desarrollo Institucional para identificar y problematizar las tecnologías contables que participan en la descarbonización. Para ello, en el documento se revisan los aspectos técnicos que rodean la *Science-based Target initiative*, una iniciativa voluntaria que proporciona al sector privado guías para alcanzar la descarbonización a través de objetivos de reducción de emisiones basados en ciencia. Los hallazgos de este primer estudio sugieren que la conceptualización actual de los límites temporales y espaciales, métodos de reducción de emisiones y mecanismos de monitoreo son insuficientes para mediar entre la urgencia climática y la toma de decisiones corporativas. Con estos resultados, el segundo artículo investiga cómo los objetivos basados en la ciencia conectan el límite de temperatura global con las actividades empresariales, utilizando una perspectiva basada en infraestructuras de evaluación y en el marco de Análisis y Desarrollo Institucional. Continuando con el caso de *Science-based Target initiative* para el análisis empírico, la recopilación de datos se basa en entrevistas semiestructuradas y documentación de archivo de diez grandes empresas multinacionales que participan en la *Science-based Target initiative*. El análisis sugiere que las empresas entrevistadas, que operan dentro de una infraestructura de desafíos de acción colectiva que surgen del compromiso de descarbonización, no están en camino de cumplir sus objetivos comprometidos, entre otras razones, debido a tensiones contables que surgen en los límites temporales y espaciales, métodos de reducción de emisiones y mecanismos

de monitoreo. El tercer artículo explora la construcción del inventario corporativo de gases de efecto invernadero y el objetivo corporativo de descarbonización y su traducción en un plan de acción para la descarbonización con consecuencias tangibles para la organización. Este artículo desarrolla el concepto de conmensuración, o la traducción de diferentes cualidades en una métrica común, a través de los planes de transición corporativa, que surgen como una herramienta para garantizar una estrategia corporativa creíble y consistente para implementar compromisos de descarbonización. El trabajo empírico se basa en una estrategia de investigación de estudio de caso cualitativo, incluyendo entrevistas, datos de archivo y observación participante, con dos empresas con objetivos de descarbonización y que desempeñan un papel importante debido a su tamaño, influencia y larga trayectoria en políticas y acciones de sostenibilidad. El análisis muestra que la construcción del inventario de emisiones y el objetivo de descarbonización y su traducción al plan de acción implica controversias, incertidumbre y el surgimiento de diferentes puntos de vista o interpretaciones. Del mismo modo, la toma de decisiones para la descarbonización está vagamente conectada con el objetivo de descarbonización, lo que lleva a las empresas a establecer su estrategia en base a un criterio de factibilidad.

Esta tesis contribuye al campo de la contabilidad ambiental al avanzar en el conocimiento de los detalles técnicos contables que las empresas afrontan en la transición hacia un futuro con bajas emisiones de carbono. Los artículos teorizan cómo la contabilidad media entre el objetivo global de descarbonización y el nivel corporativo dentro de una infraestructura de desafíos de acción colectiva. En el contexto del cambio climático como un problema social complejo, esta tesis ofrece implicaciones prácticas que pueden guiar a los administradores de empresas y a los reguladores en sus procesos de toma de decisiones.

**Palabras clave:** Contabilidad del carbono; Descarbonización; *Science-based Target initiative*; Planes de transición; Acción colectiva, Investigación cualitativa.

# INTRODUCTION

---

## Background and general objective of the thesis

We live in the Anthropocene (Crutzen, 2002), a geological epoch that evidences the intensification of human drivers, such as the use of land or resource exploitation, on nature (Folke et al., 2011; Steffen et al., 2007, 2015). Human activity, which is inescapably connected with Biosphere systems (Young et al., 2006), is generating unsustainable regime shifts (Hughes et al., 2013) and irreversible environmental changes that endanger human prosperity (Griggs et al., 2013). In this scenario, scientists have identified nine Earth-system processes<sup>1</sup> that govern the stability and resilience of the planet (Rockström et al., 2009). Each of these processes comprises a *planetary boundary*, a control variable value that determines “a safe operating space for humanity” (Rockström et al., 2009, p.472). Therefore, exceeding any of the planetary boundaries leads to leaving the conditions for a Holocene-like state (Rockström et al., 2009). Moreover, overshooting any of them triggers changes in others, as they are interdependent (Steffen et al., 2015). For instance, an increase in deforestation due to the land-system change for agriculture provokes higher greenhouse gas (GHG) emissions accumulated in the atmosphere, increasing ocean acidification and intensifying climate change. Nevertheless, climate change and change in biosphere integrity are identified as core Earth-system processes due to their particular and dangerous regime shift if their planetary boundary is exceeded (Steffen et al., 2015).

The planetary boundary of climate change comprises a *global carbon budget*, which refers to the maximum amount of carbon emissions released in the atmosphere before warming exceeds specific temperature thresholds. According to the Intergovernmental Panel on Climate Change (IPCC, 2021), the remaining carbon budget for a 67% likelihood of limiting warming to 1.5°C is 400 Gt CO<sub>2</sub>e. This temperature limit emerges from the internationally agreed 1.5°C science-based target at the United Nations Paris Climate Agreement.

---

<sup>1</sup> The nine Earth system processes are climate change, change in biosphere integrity, stratospheric ozone depletion, ocean acidification, biogeochemical flows, land system change, freshwater change, atmospheric aerosol loading, and novel entities (Richardson et al., 2023).

Limiting warming to 1.5°C requires achieving *net-zero emissions* by 2050 through urgent and profound emissions reductions (i.e., decarbonization). Transnational companies, which have a key role in ensuring planetary sustainability (Österblom et al., 2022), have galvanized net-zero commitments in an attempt to recognize the need and opportunity that a low-carbon future brings. Still, there is a global lack of rigor in accounting for corporate impacts on ecosystems (Lamont et al., 2023).

Carbon accounting arises as a common label motivating research on how climate action, regulation, and governance (Charnock et al., 2021) can drive the transition to a low-carbon society (He et al., 2022). In a broad sense, *carbon accounting* refers to the recognition, measurement, and monitoring of GHG emissions (Ascui & Lovell, 2011). As we move forward in the Anthropocene, the approach to carbon accounting needs to shift (Bebbington et al., 2020) to contribute to sustainable development (Bebbington & Larrinaga, 2014).

The overall aim of this thesis is to explore the role of accounting in translating the global goal of net-zero emissions into the corporate level. As presented below, the research design is structured in three articles that seek to contribute to understanding the challenges of the corporate transition towards a low-carbon future. This proposition positions this study with an interpretive approach (Alvesson & Sköldbberg, 2018) to qualitative research. By engaging in problematization (Alvesson & Sandberg, 2011) and interrogating the taken-for-granted assumptions, empirical material does not emerge as proof of an objective reality (Alvesson & Sköldbberg, 2018) but as a way of challenging and inviting reflection upon both practice and the extant literature. This thesis seeks to open the black box of carbon accounting to question the “matters of apparent detail that in fact play critical roles” (Mackenzie, 2009, p. 453). Building on theoretical insights from political economy (the Institutional Analysis and Development framework designed by Elinor Ostrom) and sociology (the notion of commensuration mobilized by Wendy Espeland, the concept of infrastructures as explained by Martin Kornberger, or the idea of framing and overflowing proposed by Michael Callon), the theoretical framework has helped explain the specific accounting complexities for achieving net-zero emissions.

### **Structure of the thesis**

Chapter I draws on the constitutive role of accounting (Burchell et al., 1985; Hopwood, 1987; Miller & Power, 2013) to explore the translation of the global decarbonization goal into net-zero organizational targets. Building on the notion of common pool resources (CPR) (Ostrom & Ostrom, 1977) and the conceptual map developed by Ostrom (2005) to



understand how institutions operate in collective action problems., i.e., the Institutional Analysis and Development (IAD) framework, the first research article explains the mediation of carbon accounting between the different interests at play in governing the net-zero arena. To address this objective, the empirical case is framed around the Science-based Target Initiative (SBTi), a voluntary framework launched in 2015 to guide corporate efforts in mitigating emissions through science-based targets (SBTi, 2019). Through an in-depth review of SBTi's publicly available resources, this chapter mobilizes four accounting devices that mediate the role of carbon accounting in the net-zero arena: timeframe, target boundary, methods, and monitoring mechanisms. Together with previous accounting contributions, this chapter displays how net-zero targets are operationalized at the corporate level. First, SBTi requires companies to set their science-based targets around a timeframe, meaning that companies must establish a base year and target year to build the roadmap for decarbonization. Yet, the urgent need to reduce emissions (Tregidga & Laine, 2022) contrasts with the different choices in setting a timeline for net-zero emissions. Second, SBTi sets the target boundary, determining the threshold under which emissions are accounted for in the corporate inventory, but difficulties emerge in accounting for emissions occurring within the supply chain (He et al., 2022). Third, SBTi criteria determine the pathway to reduce emissions through absolute and intensity targets, methods which need to be problematized in terms of effectiveness (Golubeva, 2022). The fourth issue is monitoring mechanisms, which, according to Ostrom (2005), are critical in ensuring the success of CPR and whose absence in voluntary initiatives may increase the risk of greenwashing (Bjørn et al., 2022). The findings of the analysis suggest that the accounting implications underlying the SBTi are insufficient to mediate between climate urgency and corporate decision-making. The implications of this case spill over into recent sustainability standards, which provide a lower level of granularity in defining the technical accounting aspects of net-zero targets. In addition, the study of the IAD framework in the net-zero action arena responds to the call to work on technical accounting methods to improve carbon accounting practice (He et al., 2022) and the need for research on how science-based targets devise the pathway for a low-carbon world (Bjørn et al., 2022). This article, which I lead and is co-authored with Carlos Larrinaga and Deborah Rigling Gallagher, has been accepted for publication in the *British Accounting Review* within the Special Issue on “Corporate Carbon Accounting and Management for Green Transition toward Carbon Neutrality”.

Chapter II investigates how science-based targets connect the global temperature limit with business operations, with a specific focus on how accounting technologies and further

devices mediate this translation. This work is motivated by the observation often made in the literature that accounting details and technologies play critical roles in the construction of markets (Lohmann, 2009; Mackenzie, 2009). This chapter draws on different pieces of literature that present ecological matters as a collective action problem involving rules and calculative devices as elements of an infrastructure. In particular, Kornberger et al. (2017) is a mainstay in this research to illustrate how accounting practices operate in a relational, heterarchical, and generative form. Then, the chapter resorts to the Institutional Analysis and Development (IAD) framework (Ostrom, 2005) to characterize science-based targets as an infrastructure. Continuing with the case of SBTi for the empirical setting, data collection relies on semi-structured interviews and archival documentation from ten large multinational companies (MNCs) with significant impact on climate change and that participated in the SBTi. The analysis suggests that companies, which operate within a set of collective action problems that emerge in decarbonization, are not on track to fulfill their committed targets, among other reasons, due to accounting overflows despite corporate efforts to frame science-based targets. Indeed, accounting tensions emerged within the four accounting devices analyzed in chapter I, i.e., timeframe, target boundary, methods, and monitoring mechanisms. Taken as a whole, the study shows a disconnection between the global goals of limiting climate change and the construction of net-zero emissions at the corporate level. These insights contribute to studying accounting technologies (MacKenzie, 2009; Antonini et al., 2020) without necessarily falling into some kind of functionalism or technocracy (Correa et al., 2023). This article, which I lead and is co-authored with Carlos Larrinaga, has been accepted for presentation in the European Accounting Association 40<sup>th</sup> Doctoral Colloquium.

Chapter III investigates the construction of the GHG inventory and corporate net-zero target and their translation into an action plan for decarbonization with tangible consequences for the organization. Elaborating on the notion of commensuration, or the translation of different qualities into a common metric (Espeland & Stevens, 1998, 2008), this article problematizes the reduction of emissions arising from corporate activities into a single metric for decarbonization (i.e., tons of carbon dioxide equivalent (tCO<sub>2</sub>e)). In this translation, calculations do not emerge in a smooth and linear process (Miller, 1992; Robson, 1992) but rather as an infrastructure (Kornberger et al., 2017) in which values and data converge within a specific context to address a collective action problem, as it is decarbonization. The unit of observation to address the research objective is the corporate transition plan, which emerges as a tool to ensure a credible and consistent corporate strategy

to implement net zero pledges beyond disclosure (UN HLEG, 2022). This article utilizes a qualitative multiple case study of corporate transition plans with two companies that have committed to achieving net-zero emissions by 2050 and play a significant role in decarbonization due to their size, influence, and long-standing trajectory on sustainability policies and actions. The empirical fieldwork was conducted during 2023, and data sources include semi-structured interviews, archival data, and participant observation. The analysis is structured in two sections that problematize two strengths of commensuration: providing comparability and creating the basis for decision-making (Espeland & Stevens, 1998, 2008). The findings show that commensuration of emissions arising from corporate activity into a common metric for decarbonization encloses a “hot situation” (Callon, 1998, p. 260) with controversies, uncertainty, and the emergence of different viewpoints or interpretations. Commensuration is not fully achieved due to the difficulty of calculating emissions, or the multiple decisions that companies face in the construction of the GHG inventory and net-zero target. These controversies create a decoupling between the net-zero target and the strategy for emissions reductions. These findings help explain that the pathway towards achieving net-zero emissions becomes subject to varying interpretations despite its technical underpinnings. This chapter problematizes the challenges arising in “making things the same” (Mackenzie, 2009, p.447) in the case of net-zero emissions and mobilizes key aspects that accounting should work on to help ensure a low-carbon future.

Chapter IV provides a concluding discussion that synthesizes the final observations reached in the previous chapters and provides insights into the academic contributions and practical implications in the context of carbon accounting for addressing the grand challenge of decarbonization.

## References

- Alvesson, M., & J. Sandberg. (2011). "Generating research questions through problematization." *Academy of Management Review*, 36 (2), 247-271. <http://dx.doi.org/10.5465/amr.2009.0188>
- Alvesson, M., & K. Sköldbberg. (2018). *Reflexive Methodology: New Vistas for Qualitative Research*. London: SAGE.
- Antonini, C., Beck, C., & Larrinaga, C. (2020). Subpolitics and sustainability reporting boundaries. The case of working conditions in global supply chains. *Accounting, Auditing and Accountability Journal*, 33(7), 1535–1567. <https://doi.org/10.1108/AAAJ-09-2019-4167>

- Ascui, F., & Lovell, H. (2011). As frames collide: Making sense of carbon accounting. *Accounting, Auditing and Accountability Journal*, 24(8), 978–999. <https://doi.org/10.1108/09513571111184724>
- Bebbington, J., & Larrinaga, C. (2014). Accounting and sustainable development: An exploration. *Accounting, Organizations and Society*, 39(6), 395–413. <https://doi.org/10.1016/j.aos.2014.01.003>
- Bebbington, J., Österblom, H., Crona, B., Jouffray, J. B., Larrinaga, C., Russell, S., & Scholtens, B. (2020). Accounting and accountability in the Anthropocene. *Accounting, Auditing and Accountability Journal*, 33(1), 152–177. <https://doi.org/10.1108/AAAJ-11-2018-3745>
- Bjørn, A., Tilsted, J. P., Addas, A., & Lloyd, S. M. (2022). Can science-based targets make the private sector Paris-aligned? A review of the emerging evidence. *Current Climate Change Reports*, 8(2), 53-69. <http://dx.doi.org/10.1007/s40641-022-00182-w>
- Burchell, S., Clubb, C., & Hopwood, A. G. (1985). Accounting in its social context: Towards a history of value added in the United Kingdom. *Accounting, Organizations and Society*, 10(4), 381-413. [http://dx.doi.org/10.1016/0361-3682\(85\)90002-9](http://dx.doi.org/10.1016/0361-3682(85)90002-9)
- Callon, M. (1998). An Essay on Framing and Overflowing: Economic Externalities Revisited by Sociology. *The Sociological Review*, 46(1\_suppl), 244–269. <https://doi.org/10.1111/j.1467-954x.1998.tb03477.x>
- Charnock, R., Brander, M., & Schneider, T. (2021). Thematic topics in environmental accounting. In J. Bebbington, C. Larrinaga, B. O’Dwyer, & I. Thomson (Eds.), *Routledge Handbook of Environmental Accounting* (pp. 351–364). Routledge. <http://dx.doi.org/10.4324/9780367152369>
- Correa, C., Laine, M., & Larrinaga, C. (2023). Taking the world seriously: Autonomy, reflexivity and engagement research in social and environmental accounting. *Critical Perspectives on Accounting*, 97, 102554. <http://dx.doi.org/10.1016/j.cpa.2023.102554>
- Crutzen, P. J. (2002). Geology of mankind. *Nature*, 415(3). <http://dx.doi.org/10.1038/415023a>
- Espeland, W. N., & Stevens, M. L. (1998). Commensuration as a social process. *Annual Review of Sociology*, 24(1), 313–343. <https://doi.org/10.1146/annurev.soc.24.1.313>
- Espeland, W. N., & Stevens, M. L. (2008). A sociology of quantification. *European Journal of Sociology*, 49(3), 401–436. <https://doi.org/10.1017/S0003975609000150>
- Folke, C., Jansson, Å., Rockström, J., Olsson, P., Carpenter, S. R., Chapin, F. S., ... & Westley, F. (2011). Reconnecting to the biosphere. *Ambio*, 40, 719-738. <http://dx.doi.org/10.1007/s13280-011-0184-y>
- Golubeva, O. (2022). Sustainability and technology: the contribution of “managerial talk” to the three pillars framework. *Accounting, Auditing and Accountability Journal*, 35(9), 412–441. <http://dx.doi.org/10.1108/AAAJ-09-2021-5462>

- Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M. C., Shyamsundar, P., ... & Noble, I. (2013). Sustainable development goals for people and planet. *Nature*, *495*(7441), 305-307. <http://dx.doi.org/10.1038/495305a>
- He, R., Luo, L., Shamsuddin, A., & Tang, Q. (2022). Corporate carbon accounting: a literature review of carbon accounting research from the Kyoto Protocol to the Paris Agreement. *Accounting & Finance*, *62*(1), 261-298. <http://dx.doi.org/10.1111/acfi.12789>
- Hopwood, A. G. (1987). The archaeology of accounting systems. *Accounting, Organizations and Society*, *12* (3), 207-234. <http://dx.doi.org/10.1016/B978-008044725-4/50011-4>
- Hughes, T. P., Carpenter, S., Rockström, J., Scheffer, M., & Walker, B. (2013). Multiscale regime shifts and planetary boundaries. *Trends in Ecology & Evolution*, *28*(7), 389-395. <http://dx.doi.org/10.1016/j.tree.2013.05.019>
- IPCC. (2021). Summary for Policymakers. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. In Press.
- Kornberger, M., Pflueger, D., & Mouritsen, J. (2017). Evaluative infrastructures: Accounting for platform organization. *Accounting, Organizations and Society*, *60*, 79-95. <http://dx.doi.org/10.1016/j.aos.2017.05.002>
- Lamont, T. A., Barlow, J., Bebbington, J., Cuckston, T., Djohani, R., Garrett, R., ... & Graham, N. A. (2023). Hold big business to task on ecosystem restoration. *Science*, *381*(6662), 1053-1055. <http://dx.doi.org/10.1126/science.adh2610>
- Lohmann, L. (2009). Toward a different debate in environmental accounting: The cases of carbon and cost-benefit. *Accounting, Organizations and Society*, *34*(3-4), 499-534. <http://dx.doi.org/10.1016/j.aos.2008.03.002>
- MacKenzie, D. (2009). Making things the same: Gases, emission rights and the politics of carbon markets. *Accounting, Organizations and Society*, *34*(3-4), 440-455. <http://dx.doi.org/10.1016/j.aos.2008.02.004>
- Miller, P. (1992). Accounting and objectivity: the invention of calculating selves and calculable spaces. *Annals of Scholarship*, *9*(1/2), 61-86.
- Miller, P., & Power, M. (2013). Accounting, organizing, and economizing: Connecting accounting research and organization theory. *The Academy of Management Annals*, *7*(1), 557-605. <http://dx.doi.org/10.5465/19416520.2013.783668>
- Österblom, H., Bebbington, J., Blasiak, R., Sobkowiak, M., & Folke, C. (2022). Transnational corporations, biosphere stewardship, and sustainable futures. *Annual Review of Environment and Resources*, *47*, 609-635. <http://dx.doi.org/10.1146/annurev-environ-120120-052845>
- Ostrom, E. (2005). *Understanding institutional diversity*. Princeton, NJ: Princeton University Press. <https://doi.org/10.2307/j.ctt7s7wm.13>

- Ostrom, V., & Ostrom, E. (1977). Public goods and public choices. In E. S. Savas (Ed.), *Alternatives for Delivering Public Services: Toward Improved Performance* (pp. 7–49). Boulder, CO: Westview Press. <https://doi.org/10.4324/9780429047978-2>
- Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S. E., Donges, J. F., ... & Rockström, J. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, *9*, eadh2458. <https://doi.org/10.1126/sciadv.adh2458>
- Robson, K. (1992). Accounting numbers as “inscription”: Action at a distance and the development of accounting. *Accounting, Organizations and Society*, *17*(7), 685-708. [http://dx.doi.org/10.1016/0361-3682\(92\)90019-O](http://dx.doi.org/10.1016/0361-3682(92)90019-O)
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Foley, J. A. (2009). A safe operating space for humanity. *Nature*, *461*(7263), 472-475. <http://dx.doi.org/10.1038/461472a>
- SBTi. (2019). *Foundations of Science-Based Target Setting – Version 1.0*.
- Steffen, W., Crutzen, P. J., & McNeill, J. R. (2007). The Anthropocene: are humans now overwhelming the great forces of nature. *Ambio-Journal of Human Environment Research and Management*, *36*(8), 614-621. [http://dx.doi.org/10.1579/0044-7447\(2007\)36%5B614:TAAHNO%5D2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36%5B614:TAAHNO%5D2.0.CO;2)
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223), 1259855. <http://dx.doi.org/10.1126/science.1259855>
- Tregidga, H., & Laine, M. (2022). On crisis and emergency: Is it time to rethink long-term environmental accounting? *Critical Perspectives on Accounting*, *82*, 102311. <https://doi.org/10.1016/j.cpa.2021.102311>
- U.N. HLEG (2022). *Integrity Matters: Net Zero Commitments By Businesses, Financial Institutions, Cities and Regions*. Report from the United Nations’ High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities.
- Young, O. R., Berkhout, F., Gallopin, G. C., Janssen, M. A., Ostrom, E., & Van der Leeuw, S. (2006). The globalization of socio-ecological systems: An agenda for scientific research. *Global Environmental Change*, *16*(3), 304-316. <http://dx.doi.org/10.1016/j.gloenvcha.2006.03.004>

# CONCLUDING DISCUSSION

---

## Final observations

The starting point and initial ambition of this doctoral dissertation were to explore the role of accounting in translating the global goal of net-zero emissions at the corporate level across three articles that unfold distinct yet interdependent issues on the grand challenge of climate change. This section discusses the main findings and final observations derived from this doctoral project.

The first article positioned accounting as the elephant in the room in the initiatives seeking decarbonization. With a particular focus on the Science-Based Target Initiative (SBTi) as a mainstay in providing the private sector with science-based guidance to reach net-zero emissions (SBTi, 2021), this chapter problematizes through the Institutional Analysis and Development (IAD) framework (Ostrom, 2005) four elements that seem to mediate the role of carbon accounting in the net-zero arena: timeframe, target boundary, method, and monitoring mechanisms.

Regarding, first, the timeframe for decarbonization, findings show that the complexity of accounting in a changing environment increases the need to consider short-term actions (Unerman & Chapman, 2014). This aligns with the urgent calls to face climate change as an emergency crisis (Tregidga & Laine, 2022). Then, solutions to account for a more stable timeframe towards net-zero could include milestones for a target year to ensure the plausibility of science-based emissions reductions.

The priorities for conventional accounting differ from sustainability accounting (Antonini et al., 2020; Antonini & Larrinaga, 2017), meaning that the core of the problem in emissions reduction resides outside of the financial entity boundary (i.e., scope 3 emissions). In this regard, even though accounting for the target boundary is problematic, the analysis suggests that tracking the key materials across the supply chain helps companies identify which parts of the process are more carbon-intensive and, therefore, find alternative materials. In addition, companies could use activity-based data, instead of financial data, to estimate scope 3 emissions more accurately. Likewise, given the dynamic nature of businesses, in which

changes in the corporate financial scope also have a re-baseline effect on its GHG inventory, it seems pertinent to suggest that accounting should pay attention to the GHG inventory from the acquired company to ensure that the corporate strategy is consistent with net-zero targets.

Third, concerning methods to reduce emissions, SBTi recommends using the absolute contraction approach but provides flexibility in using intensity targets. Recognizing the limitations of eco-efficiency effects, particularly in contexts where impacts transcend organizational boundaries and extend over extended periods (Egan & Schaltegger, 2023), the findings suggest that companies should rely on absolute linear annual emissions reductions to ensure the pathway to a low-carbon future.

Eventually, following Ostrom (2005), monitoring mechanisms are essential to ensure credible action. Even though SBTi is a voluntary initiative, companies could connect their performance on emissions reductions with financial mechanisms, such as sustainability-linked debt or incentives.

The accounting complexities underlying the four elements (timeframe, target boundary, method, and monitoring mechanisms) remained unchanged despite the evolution of SBTi guidelines to increase climate ambition. This provides an opportunity to continue advancing in the study of carbon accounting technicalities (He et al., 2022). In addition, the findings of this research extend to further initiatives in the carbon accounting area, including the key sustainability accounting frameworks: the European Sustainability Reporting Standards (ESRS), the IFRS Sustainability Disclosure Standards (IFRS – S1, S2), and the U.S. Securities and Exchange Commission (U.S. SEC) proposed rule.

The second article expands on the translation of the global temperature limit into science-based targets at the level of the organization by conceptualizing science-based targets as emerging from an infrastructure (Kornberger et al., 2017, p.79) that responds to a collective action challenge (Ostrom, 2005). Drawing on semi-structured interviews with ten significant companies from a climate change perspective that have their science-based targets set, this chapter sheds light on how companies shape their SBTi targets and, more specifically, the time, space, methods, and monitoring implications of the accounting technologies mobilized in such definition. The findings raised critical insights on the collective action challenges of decarbonization and corroborate that the tensions in the four accounting devices explained in the previous chapter create a disconnection between the global goal of limiting climate



change and the construction of net-zero emissions at the corporate level. The interviews provided insights that are briefly discussed below.

Achieving net-zero emissions is understood as a goal occurring within an ecosystem in which key actors involve suppliers, customers, the sector, and public policies. In this decarbonization network, collective action challenges emerge, including free-riding, the dilemma of competitors taking the quota of carbon-intensive materials, or the insufficient incentives to decarbonize businesses. In parallel, interviewees provided specific insights about the challenges in framing the timeframe, target boundary, method, and monitoring mechanisms.

The temporal boundaries set by the interviewed companies are initially aligned with the requirements of the SBTi. However, evidence shows that companies are not on track to fulfill their committed targets. For example, companies set new ambition targets before the reduction in the target year has been reached, or otherwise, the target date is postponed as companies realize that their targets are too ambitious. In this regard, SBTi's recent moves to foreground the short-term suggest the need to promote early action (Sun et al., 2021) and urgent transformations to achieve long-term goals (Rockström et al., 2017).

Interviewees explained that setting the target boundary was particularly problematic when accounting for scope 3 emissions because most of scope 3 emissions are estimated. The GHG Protocol provides the guidelines for calculating scope 3 emissions but displays multiple emission factors and activity data to measure them, which may lead to a situation that can be characterized by the fallacy of “misplaced concreteness” (Daly, 1987, p.83; also see Kolk et al., 2008) in quantifying the corporate GHG inventory.

In relation to the methods, most of the interviewees' organizations set absolute reductions, but these present difficulties in the context of business growth. In this situation, intensity emissions eased the challenge by showing progress on emissions by unit, regardless of the company's expansion. However, eco-efficiency criteria associated with intensity methods do not necessarily promote sustainable development (Passetti et al., 2014).

Eventually, the going concern of making substantive reductions in a target date is directly related to the (lack of) monitoring mechanisms. Interviewees manifested the existence of sustainability-linked incentives in their corporate strategy, but most of these measures had little ambition and did not face any consequences other than reputational risk. Ostrom (2005)

emphasized that monitoring mechanisms are critical to overcoming collective action problems.

Drawing on the insights from the first and second article, the third article explores the construction of the GHG inventory and corporate net-zero target and their translation into the corporate action plan through a qualitative case study research strategy carried out in two global companies committed to reaching net-zero emissions across their value chain by 2050.

The multiple case study, which comprised semi-structured interviews, archival data, and participant observation in two companies during 2023, provided the basis for addressing the research objective of this article along with the theoretical insights emerging from the concepts of commensuration (Espeland & Stevens, 1998, 2008) and accounting infrastructures (Kornberger et al., 2017).

The results suggest there is a “hot situation” (Callon, 1998, p. 260) emerging in the translation of global net-zero to the corporate level. In particular, the methodology to quantify the corporate GHG inventory and net-zero target becomes controversial due to the underlying difficulty and uncertainty in calculating emissions. Accounting for the corporate GHG inventory is not straightforward because two key issues involved in quantification, i.e., framing the corporate scope for decarbonization and calculating scope 3 emissions, risk falling in the fallacy of “misplaced concreteness” of numbers (Daly, 1987, p.83) by omitting complexity and relevant information (Lohmann, 2009). Likewise, setting the net-zero target creates, in some way, an illusory picture of emissions reduction (see Järvinen et al., 2022) and requires further work on the technical matters that, in fact, play a critical role (MacKenzie, 2009).

Following the results of the empirical case, this chapter illustrates how these controversies create a decoupling between the net-zero target and the strategy for decarbonization. Both companies build on a partial GHG inventory and rely on feasibility criteria to establish the pathway for decarbonization with instruments such as the Marginal Abatement Cost Curve (MAAC), sustainability-linked debt, or sustainable procurement.

The attempt by accounting standards to create a “one-size-fits-all” inventory and net-zero targets does not address the challenges that entail developing the corporate transition plan. This study suggests that the pathway towards achieving net-zero emissions becomes subject to varying interpretations, which shows that commensuration is not only a technical exercise but also a social and political process (Levin & Espeland, 2002). Therefore, it seems critical

to focus on the corporate decarbonization levers for identifying, measuring, and reducing emissions, independently of where emissions occur in the supply chain. This way, companies could create a more accurate picture of the GHG inventory and, even more importantly, identify the options for emissions reduction and translate these risks and opportunities into financial statements.

### **Academic contributions and implications for practice**

Overall, this thesis responded to how the global goal of reaching net-zero emissions is translated at the corporate level. In doing so, it highlighted that accounting plays a pivotal role in driving sustainable development forward (Bebbington & Larrinaga, 2014) due to its constitutive capacity (Burchell et al., 1980), according to which accounting does not merely represent carbon emissions but holds the potential to create a new climate reality in organizations. Likewise, co-construction of knowledge with organizations has been crucial to identify some of the key challenges that emerge from quantifying corporate emissions and setting net-zero targets. The findings of this doctoral dissertation seek to contribute to previous accounting research and raise implications for policymakers and regulators.

This doctoral dissertation responds to the call to work on technical accounting methods to improve carbon accounting practice (He et al., 2022) and the need for research on how science-based targets devise the pathway for a low-carbon world (Bjørn et al., 2022). In particular, the three articles follow the calls often made in the literature about the opportunity and political significance of studying accounting detail and accounting technologies (MacKenzie, 2009; Antonini et al., 2020).

In a modest way, this doctoral dissertation introduces the IAD framework (Ostrom, 2005) in the field of net-zero emissions, providing a novel perspective within the environmental accounting literature to address collective action challenges. Likewise, investigating accounting details (MacKenzie, 2009) or, in other words, accounting technologies (Correa et al., 2023) that frame the net-zero target, contributes to the accounting literature by opening the box used to measure the GHG inventory and set net-zero targets and problematizing the accounting tensions in the corporate strategy for decarbonization.

This doctoral dissertation has significant practical implications for policymakers and regulators developing climate reporting frameworks that respond to the transition to a low-carbon economy. The three articles have addressed some of the challenges practitioners face in measuring and reducing emissions and have highlighted key aspects that policymakers

could focus on to help ensure a low-carbon future. This research is a call to action, empowering policymakers and companies to create solid strategies in the fight against climate change.

## References

- Antonini, C., Beck, C., & Larrinaga, C. (2020). Subpolitics and sustainability reporting boundaries. The case of working conditions in global supply chains. *Accounting, Auditing and Accountability Journal*, 33(7), 1535–1567. <https://doi.org/10.1108/AAAJ-09-2019-4167>
- Antonini, C., & Larrinaga, C. (2017). Planetary Boundaries and Sustainability Indicators. A Survey of Corporate Reporting Boundaries. *Sustainable Development*, 25(2), 123–137. <https://doi.org/10.1002/sd.1667>
- Bebbington, J., & Larrinaga, C. (2014). Accounting and sustainable development: An exploration. *Accounting, Organizations and Society*, 39(6), 395–413. <https://doi.org/10.1016/j.aos.2014.01.003>
- Bjørn, A., Tilsted, J. P., Addas, A., & Lloyd, S. M. (2022). Can science-based targets make the private sector Paris-aligned? A review of the emerging evidence. *Current Climate Change Reports*, 8(2), 53-69. <http://dx.doi.org/10.1007/s40641-022-00182-w>
- Burchell, S., Clubb, C., Hopwood, A., Hughes, J., & Nahapiet, J. (1980). The roles of accounting in organizations and society. *Accounting, Organizations and Society*, 5(1), 5–27. [http://dx.doi.org/10.1016/0361-3682\(80\)90017-3](http://dx.doi.org/10.1016/0361-3682(80)90017-3)
- Callon, M. (1998). An Essay on Framing and Overflowing: Economic Externalities Revisited by Sociology. *The Sociological Review*, 46(1\_suppl), 244–269. <https://doi.org/10.1111/j.1467-954x.1998.tb03477.x>
- Correa, C., Laine, M., & Larrinaga, C. (2023). Taking the world seriously: Autonomy, reflexivity and engagement research in social and environmental accounting. *Critical Perspectives on Accounting*, 97, 102554. <http://dx.doi.org/10.1016/j.cpa.2023.102554>
- Daly, H. E. (1987). AN Whitehead's fallacy of misplaced concreteness: examples from economics. *Journal of Interdisciplinary Economics*, 2(2), 83-89. <http://dx.doi.org/10.1177/02601079X8700200202>
- Egan, M., & Schaltegger, S. (2023). Accounting for corporate environmental rebounds. A conceptual approach. *Journal of Cleaner Production*, 419, 138175.
- Espeland, W. N., & Stevens, M. L. (1998). Commensuration as a social process. *Annual Review of Sociology*, 24(1), 313–343. <https://doi.org/10.1146/annurev.soc.24.1.313>
- Espeland, W. N., & Stevens, M. L. (2008). A sociology of quantification. *European Journal of Sociology*, 49(3), 401–436. <https://doi.org/10.1017/S0003975609000150>
- He, R., Luo, L., Shamsuddin, A., & Tang, Q. (2022). Corporate carbon accounting: a literature review of carbon accounting research from the Kyoto Protocol to the Paris

- Agreement. *Accounting and Finance*, 62(1), 261–298. <https://doi.org/10.1111/acfi.12789>
- Järvinen, J.T., Laine, M., Hyvönen, T., & Kantola, H. (2022). Just look at the numbers: A case study on quantification in corporate environmental disclosures. *Journal of Business Ethics*, 175, 23-44. <http://dx.doi.org/10.1007/s10551-020-04600-7>
- Kolk, A., Levy, D., & Pinkse, J. (2008). Corporate responses in an emerging climate regime: The institutionalization and commensuration of carbon disclosure. *European Accounting Review*, 17(4), 719-745. <http://dx.doi.org/10.1080/09638180802489121>
- Kornberger, M., Pflueger, D., & Mouritsen, J. (2017). Evaluative infrastructures: Accounting for platform organization. *Accounting, Organizations and Society*, 60, 79-95. doi: <https://doi.org/10.1016/j.aos.2017.05.002>
- Levin, P., & Espeland, W. N. (2002). Pollution Futures: Commensuration, Commodification and the Market for Air. In A. Hoffman, & M. Ventresca (Eds.), *Organizations, Policy, and the Natural Environment* Stanford University Press.
- Lohmann, L. (2009). Toward a different debate in environmental accounting: The cases of carbon and cost–benefit. *Accounting, Organizations and Society*, 34(3-4), 499-534. <http://dx.doi.org/10.1016/j.aos.2008.03.002>
- MacKenzie, D. (2009). Making things the same: Gases, emission rights and the politics of carbon markets. *Accounting, Organizations and Society*, 34(3-4), 440-455. <http://dx.doi.org/10.1016/j.aos.2008.02.004>
- Ostrom, E. (2005). *Understanding institutional diversity*. Princeton, NJ: Princeton University Press. <https://doi.org/10.2307/j.ctt7s7wm.13>
- Passetti, E., Cinquini, L., Marelli, A., & Tenucci, A. (2014). Sustainability accounting in action: Lights and shadows in the Italian context. *British Accounting Review*, 46(3), 295–308. <https://doi.org/10.1016/j.bar.2014.05.002>
- Rockström, J., Gaffney, O., Rogelj, J., Meinshausen, M., Nakicenovic, N., & Schellnhuber, H. J. (2017). A roadmap for rapid decarbonization. *Science*, 355(6331), 1269-1271. <http://dx.doi.org/10.1126/science.aah3443>
- SBTi (2021). *SBTi Corporate Net-Zero Standard – Version 1.0* (Issue October).
- Sun, T., Ocko, I. B., Sturcken, E., & Hamburg, S. P. (2021). Path to net zero is critical to climate outcome. *Scientific reports*, 11(1), 22173. <http://dx.doi.org/10.1038/s41598-021-01639-y>
- Tregidga, H., & Laine, M. (2022). On crisis and emergency: Is it time to rethink long-term environmental accounting? *Critical Perspectives on Accounting*, 82, 102311. <https://doi.org/10.1016/j.cpa.2021.102311>
- Unerman, J., & Chapman, C. (2014). Academic contributions to enhancing accounting for sustainable development. *Accounting, Organizations and Society*, 39(6), 385–394. <https://doi.org/10.1016/j.aos.2014.07.003>