Distributive justice in the implementation of science-based targets for businesses

A systematic literature review

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Abstract

This thesis examines the integration of distributive justice into science-based targets (SBTs) for climate change mitigation by businesses, addressing concerns over the burden shift from public authorities to private entities. Through a systematic literature review, interdisciplinary research work addressing relevant contributory debates was thus extracted from Scopus, ScienceDirect, and Google Scholar within the scope 2015-2023. The study assesses the state-of-the-art of distributive justice in SBTs, the efficacy of interactions within the knowledge-to-action system and possible improvements for a better inclusion of distributive justice in SBTs. The findings indicate a lack of system-thinking in the research focused on distributive justice within SBTs, despite recognition of its significance for equitable climate action. The thesis reveals a need for enhanced mechanisms in the knowledge-to-action system to ensure equity, transparency, accountability, and inclusivity. Finally, the study calls for a more just and effective approach to corporate climate action, advocating for improvements in the creation and application of SBTs that incorporate distributive justice principles.

Keywords: climate goals, corporate environmental responsibility, distributive justice, knowledge-to-action, knowledge transfer processes, systematic literature review

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Abbreviations

SBTs	Science-Based Targets
SBTi	Science-Based Target initiative
GHG	Greenhouse gas
KTA	Knowledge-to-Action
SPPI	Science-Policy-Practice Interface
SDA	Sectoral Decarbonisation Approach
ACA	Absolute Contraction Approach
SLR	Systematic Literature Review
RQ	Research questions
CF	Conceptual framework

1. Introduction

1.1 Problem background

In a context where the urgency of the climate crisis and the reluctance of societies to address it are increasingly stressed by the international scientific community, the emergence of a strong bridge between theoretical and practical solutions seems like a requirement. The international scientific community, intergovernmental and non-governmental organisations are thus underscoring the necessity of implementing science-oriented policy goals based on the limit of a 1.5°C or 2°C global warming above pre-industrial levels set by the Paris Agreement (United Nation Secretary-General, 2019; IPCC, 2022).

Moreover, the quest for a sustainable future requires the involvement of all stakeholders in the process of achieving transformations that ensure the coexistence of human societies with the natural environment (Andersen *et al.*, 2021). Indeed, sustainability, in its most commonly accepted definition, extends beyond environmental considerations to encompass economic and social dimensions (Hauschild, Kara and Røpke, 2020). In this regard, the role of corporations' interactions with scientific knowledge production and policy-making instances becomes pivotal. As key contributors to societal development, companies need to align their strategies with sustainability goals (IPCC, 2022). This requirement involves not only minimising environmental impact but also ensuring equitable distribution of benefits and burdens.

In the developing field of sustainable business practices, **science-based targets (SBTs)** represent an emerging mechanism through which companies are given the opportunity to incorporate climate action and environmental management into their strategies through greenhouse gas (GHG) emissions reductions. Developed by the Science-Based Target initiative (SBTi), SBTs are defined as "a clearly-defined pathway for companies to reduce greenhouse gas (GHG) emissions, helping prevent the worst impacts of climate change and future-proof business growth" (SBTi, 2024). Additionally, "targets are considered 'science-based' if they are in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – limiting global warming to 1.5°C above pre-industrial levels" (*ibid*). Quantified science-informed overarching global goals, such as the 2°C limit in temperature rise set by the Paris Agreement, are thus disaggregated into SBTs

for the corporate world, i.e., adapted to the businesses' voluntary practice (Andersen *et al*., 2021).

However, as the use of SBTs has been recently spreading as a way for businesses to account for environmental sustainability, two issues arise from their implementation. Primarily, it tends to shift the responsibility of corporate GHG emissions reduction from governmental policy-makers to companies, placing part of the climate mitigation burden on private stakeholders (Andersen *et al*., 2021). This may induce a problematic shift of the responsibility to address related distributive justice issues to companies (Maia and Garcia, 2023). Furthermore, in the same perspective, the science basis of SBTs may not adequately deal with justice (Immink *et al*., 2022; Gifford *et al*., 2023).

1.2 Problem overview

The path to sustainability is complex, requiring the intertwining of scientific methodologies with practical corporate responsibility. Combining the environmental goals of the Paris Agreement and social goals of equality, justice and peace (United Nation Secretary-General, 2019) to ensure a sustainable and fair future implies an effective collaboration between the knowledge production sphere (scientific research), the decisional sphere (policy-makers) and private actors within the practical sphere. These three interacting spheres can be regarded as a knowledge-to-action (KTA) system (Cash *et al*., 2003; Best and Holmes, 2010; Hegger and Dieperink, 2015; Hagerman *et al*., 2021). As the creation and implementation of SBTs are engrained in a KTA system, failures can trigger unfair distributions of the burdens of sustainability. Shifting the responsibility of addressing the climate crisis on private actors also raises the question of what is distributive justice in terms of climate mitigation. Moreover, it poses the query of the motivations and ability of businesses to address distributive justice in the interpretation of SBTs, their implementation and their outcomes. The risk remains that, eventually, the distribution of the burden of sustainability will increase or create inequalities. In other words, a malfunctioning KTA system may impact, on the one hand, the consideration of distributive justice in the formulation and application of SBTs and, on the other hand, the adequacy and rationality of climate action at a time of necessary structural societal transformations to ensure a sustainable future. Observing how these issues are treated in scientific literature may give insight on the intersecting debates of social and environmental sustainability across the KTA system. To this purpose, through a systematic literature review, this thesis delves into the interactions between the scientific community, policy-makers and businesses on the matter of distributive justice in SBTs. **Overall, the question of the extent of the ability of SBTs to enable a just climate transition is overarching.**

1.3 Aim and research questions

This thesis studies the creation and application process of "science-based targets" in relation to distributive justice. Through a systematic literature review, I aimed at understanding how scientific research deems the inclusion of distributive justice in the knowledge-to-action system of science-based targets.

More specifically, in this thesis, I focus on the following research questions:

1. What is the state-of-the-art of distributive justice in SBTs in the scientific literature?
2. Does the scientific literature reflect an appropriate and effective knowledge-to-action system enabling the inclusion of distributive justice concerns in the creation process of SBTs?
3. How could the knowledge-to-action system be improved to ensure the application of distributive justice in the implementation of SBTs by businesses?

1.4 Delimitations

This thesis focuses on dimensions of distributive justice in corporate science-based targets through the perspective of the knowledge-to-action system. The results were obtained through a systematic literature review conducted across three databases (Scopus, ScienceDirect and Google Scholar) on scientific articles published between 2015 and 2023.

Distributive justice is a concept that is not restricted to a single theory or a single definition. The different theories of distributive justice applicable to the climate crisis context are described and delimited in Chapter 2. This thesis does not adopt any specific distributive justice theory but rather points out the benefits and problems stemming from the most common principles adopted, as observed in the scientific literature addressing climate distributive justice.

In literature, "science-based targets" tend to have multiple meanings. However, as this thesis focuses on the science-based targets created by the Science-based Target initiative (SBTi) for a business application, the term "science-based targets" is only used with this meaning. Global or national targets based on scientific knowledge, e.g., the goals of the Paris Agreement, are described as "science-oriented" or "science-informed" goals. They relate to a more theoretical concept of political climate goals based on scientific data.

The KTA system is understood as a system linking three spheres: the scientific research, often described as "science", the policy-making institutions, or "policy", and the companies putting the science-based targets into practice, covered by the term "practice". This thesis therefore used the triad "science-policy-practice" as a way to simplify and encompass all entities of the KTA system. Although there is a proximity with the "science-policy-practice interface" (SPPI) concept used in the field of science and technology studies, the research questions, aim, discussion and conclusions remain within the conceptual framework of the KTA system. This proximity with the SPPI was, however, used in the research strings of the systematic literature review in order to have a more comprehensive view on the state-of-the-art of the scientific literature on this thesis' topic. Additionally, although other entities, such as the civil society (Figure 1), take part in this KTA system, this research focused on the science, policy and practice spheres only, as main drivers of the implementation of SBTs. The limited amount of scientific literature incorporating the civil society in the SBTs' development process also motivated this choice.

2. Empirical background

Navigating guidelines, protocols and standards that correlate to corporate GHG emissions reduction can be challenging as they convey different normative features, scopes and exclusion criteria. They however usually pursue three intersecting goals: Providing guidance, providing tools and methods, and providing certification (Table 1).

Table 1. Overview of the main initiatives tackling corporate GHG emissions reductions

Initiative	Description	Main driving actors	Year of creation
The Greenhouse Gas (GHG) Protocol	GHG emissions accounting and reporting standard including guidance and tools for the private and public sectors.	World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)	2001
Net-Zero Initiative	Framework providing common principles, guidelines and tools for companies to contribute to a global net-zero target.	Carbone 4	2018
CarbonNeutral Protocol	Protocol that consists in practical guidelines for businesses, products and/or activities to reach carbon neutrality and be certified carbon neutral.	Climate Impact Partners	2002
PAS 2060	Standard providing common definitions, requirements, methods and certification for various actors (e.g. companies, governments, communities, families or individuals) to achieve carbon neutrality for a product, service, organisation, community, event or building.	British Standards Institution (BSI)	2009
Science-Based Targets initiative (SBTi)	Initiative providing science-based targets, pathways, tools, guidance and validation to companies for corporate GHG emissions reductions and net-zero certifications.	Carbon Disclosure Project (CDP), United Nations Global Compact, World Resources Institute (WRI) and World Wide Fund for Nature (WWF)	2015

For instance, the GHG Protocol focuses on providing guidance, standards and certification in the measurement and management of GHG emissions (Greenhouse Gas Protocol, 2016). Other frameworks for corporate carbon neutrality also exist, that do not directly refer to SBTs but adopt a similar approach, such as the Net-Zero initiative (Net Zero Initiative, 2024) and the CarbonNeutral Protocol (Climate

Impact Partners, 2024). Additionally, PAS 2060 aims at defining and certifying carbon neutrality (British Standards Institution, 2024). Nevertheless, overall, the most complete framework directly associated with corporate GHG emissions reduction yet remains the one provided by the SBTi through SBTs. The SBTi provides tailored standards, methods, tools and certifications to reduce corporate emissions, or, in the case of their Net-Zero Standard, to achieve corporate carbon neutrality.

2.1 The Science-Based Targets Initiative

The Science-Based Targets initiative (SBTi) was developed in 2015 through a partnership between the Carbon Disclosure Project (CDP), the United Nations Global Compact, the World Resources Institute (WRI) and the World Wide Fund for Nature (WWF) (Bjørn *et al*., 2022; Science Based Targets Initiative, n.d.). The organisation developed a framework and tools for businesses to set science-based targets (SBTs), i.e. targets aligned with climate scientific knowledge and the Paris Agreement goals in terms of GHG emissions reductions. The overall aim thus consists in easing the translation of science into concrete goals and measures that can be implemented by companies. Trexler and Schendler (2015, pp.931–932) describe SBTs as a tool "to quantify a company's 'fair share' of the total GHG emissions reductions required to meet a given future goal, whether limiting climate change to 2°C, or returning carbon dioxide (CO_2) concentrations to 350 parts per million (ppm) by 2100".

At the business scale, the companies can develop their own targets aligned with the SBTi framework. The targets are then submitted to the SBTi for validation, communicated to the shareholders and other stakeholders within the companies and disclosed publicly. The progress made in relation to the targets must then be annually monitored and reported, usually in sustainability reports.

The SBTi differentiates near-term targets (5-10 years) and long-term targets (by 2050 or sooner, but beyond 10 years) and considers scope 1, 2 and 3 emissions following the distinction of the GHG Protocol (The Greenhouse Gas Protocol, 2004). Near-term targets are the most widespread and officially encompass scope 1 (direct emissions) and scope 2 (indirect emissions from purchased electricity, heat or steam). Near-term targets also encompass scope 3 emissions (other indirect emissions linked to materials, fuels, transports, etc.) when they cover more than 40% of the total emissions (SBTi, 2023). However, as measuring and monitoring scope 3 emissions is still considered difficult and often inaccurate, these are often overlooked by businesses (Ferreira, 2023).

The SBTi favours two target-setting methods (Bjørn, Lloyd and Matthews, 2021; Carrillo Pineda *et al*., 2021). First, the Sectoral Decarbonisation Approach (SDA) is rooted in the convergence principle which sets targets based on the quantity of GHG emitted in relation to production (e.g. the so-called emissions intensity: the tons of CO_2 equivalents emitted per ton of products produced). This method is limited by the fact that it does not necessarily entail a reduction in absolute emissions. For instance, an increase in the production may increase absolute emissions but not be reflected in carbon-intensity based metrics. The second method is the Absolute Contraction Approach (ACA) focusing on absolute emissions and setting a similar fixed emission reduction rate for each company based on global decarbonisation pathways (Bjørn, Lloyd and Matthews, 2021). However, the ACA method does not automatically reflect an improvement of the companies' environmental performance, as the emissions can be dragged down artificially when production is reduced.

Additionally to the regular framework for SBTs, the SBTi has launched the Net-Zero Standard aiming at guiding businesses to set both near-term and long-term net-zero SBTs (Watson *et al*., 2023). According to Watson *et al*. (2023, p.11), "net-zero" targets meet science-oriented global climate goals when scope 1, 2 and 3 emissions are reduced to zero at the net-zero target date. The net-zero level of GHG emissions then has to be maintained, following the 1.5°C scenarios in accordance with the Paris Agreement goals.

The Net-Zero Standard is rooted into the mitigation hierarchy (Watson *et al*., 2023). Businesses setting net-zero SBTs are thus urged to prioritise actions to tackle emissions within their own value chain. The prevention, reduction and elimination of the sources of emissions within the value chain are the only ones taken into account by the Net-Zero Standard. Nevertheless, as additional positive actions, the businesses are encouraged by the SBTi to further their engagement beyond their value chain, through neutralisation (e.g. protecting and developing carbon sinks, investing in GHG removal technologies using capture and permanent storage or acquiring high-quality carbon credits). Finally, offsetting practices beyond a business' value chain are not accepted by the SBTi, neither in the achievement of SBTs nor in the achievement of net-zero SBTs (Watson *et al*., 2023).

2.2 Climate change mitigation and distributive justice

The debates surrounding climate change mitigation strongly correlate with distributive justice. In both the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and the 2015 Paris Agreement, equity was emphasised as a principle of major importance in climate action (Dooley et al., 2021; Rubiano

Rivadeneira and Carton, 2022). As a significant part of the mitigation measures undertaken for businesses, it is therefore a necessity that SBTs adopt and apply distributive justice principles as a central consideration.

2.2.1 The theories of distributive justice

The concept of distributive justice encompasses an array of different theories across the fields of economic, political and moral philosophy, such as utilitarianism, libertarianism, liberal egalitarianism, the needs-based approach or the market-based approach. The aim is common: identifying principles underlying a "fair" distribution of resources, benefits and burdens across societal actors, although the fundamental principles significantly differ and many philosophers, economists or lawyers, such as Aristotle, John Rawls or Karl Marx, have theorised their own vision of distributive justice (Fleischacker, 2004; Olsaretti, 2018a).

In its simplest form, distributive justice is commonly associated with terms like equity and fairness (Harris, 2000). However, determining what is equitable or fair remains the challenge. Overall, the definition of distributive justice is in constant evolution following different schools of thoughts and its manyfold application domains such as gender, education, health, work, migration, ethnicity, cultural and religious groups and climate change mitigation (Olsaretti, 2018b).

2.2.2 Fairness and equity principles

The question of how to equitably distribute the burden of mitigating the consequences of the climate crisis amongst countries, stakeholders and generations is central to the climate debate (Page, 2008; Mandard, 2024). Indeed, it is considered that fairness in burden and benefit distribution would render an enhanced acceptance and implementation of climate change mitigation measures by the parties (Mandard, 2024). Davidson (2021) points out that adopting a distributive justice perspective is necessary to achieve a fair division of the climate change mitigation burden, i.e. the carbon budgets, the climate mitigation costs, the adaptation costs and the management of climate damage. In that sense, Mandard (2024, p.3) highlights four general principles of distributive justice in relation to climate equity, specifically 1) "To each according to his needs", 2) "To each according to his position", 3) "To each the same" and 4) "To each in due proportion". In this regard, scientific literature has identified and formulated multiple climate equity and fairness principles directly associated with climate change mitigation, listed in Table 2.

Table 2. Overview of the main climate equity and fairness principles in literature

Principle	Description	Source
Equal per capita	Each individual has an equal right to a certain carbon budget, the emissions and subsequent reductions are divided per capita.	Ringius, Torvanger and Underdal (2002), Page (2008), Mattoo and Subramanian (2012), Davidson (2021), Schulan, Tank and Baatz (2023), Mandard (2024).
Grandfathering	All actors bear the same percentage of the mitigation burden relative to a common base year regardless of historical responsibility.	Ringius, Torvanger and Underdal (2002), Mattoo and Subramanian (2012), Davidson (2021), Schulan, Tank and Baatz (2023).
Historical responsibility	Each actor has a certain carbon budget which takes past emissions into account. The actors that polluted the most historically bear the greatest burden.	Ringius, Torvanger and Underdal (2002), Page (2008), Mattoo and Subramanian (2012), Davidson (2021), Mandard, (2024).
Polluter pays	The burden is divided proportionally to the current emissions.	Ringius, Torvanger and Underdal (2002), Mattoo and Subramanian (2012), Davidson (2021).
Beneficiary pays	The burden of the mitigation costs is proportional to the actors' enrichment resulting from the climate damage that triggered the mitigation costs.	Page (2008), Davidson (2021), Mandard (2024).
Ability to pay/capacity principle	The climate burden is distributed in proportion to the Gross Domestic Product (GDP) per capita.	Ringius, Torvanger and Underdal (2002), Page (2008), Mattoo and Subramanian (2012), Davidson (2021), Mandard (2024).
Cost-effectiveness	All actors should have the same marginal mitigation costs and the mitigation burden should be divided accordingly.	Ringius, Torvanger and Underdal (2002), Davidson (2021), Mandard (2024).
Basic needs principle	The mitigation burden should not be borne by actors yet unable to satisfy their basic needs.	Ringius, Torvanger and Underdal (2002), Mattoo and Subramanian (2012), Mandard (2024).
Sufficientarianism	The mitigation burden is borne only by the actors that secured a threshold of sufficiently good quality of life.	Page (2008), Davidson (2021), Schulan, Tank and Baatz (2023), Mandard (2024).

Davidson (2021) observed that these principles, as well as the overall consideration of equity and fairness in climate change mitigation are significantly related to the distributive justice theories of libertarianism, egalitarianism and utilitarianism. For instance, grandfathering in the allocation of carbon budgets would be a result of libertarianism on the basis of the principle of first come, first served. In addition, in the perspective of the distribution of burdens and resources in climate mitigation, grandfathering underpins the tragedy of the commons in which individual interests take precedence over the common interest (Hardin, 1968). Similarly, according to

Davidson (2021), the application of utilitarianism in carbon budget allocation would rather favour the fairness principle of cost-effectiveness.

2.2.3 Science-based targets and distributive justice

Science-based targets lie at the core of the intersecting questions of climate change burden allocation and distributive justice. First of all, science-oriented global climate goals are regularly criticised for their inequity, potentially explaining their inability to motivate nations to address the climate crisis (Dooley et al., 2021; Mandard, 2024). The Paris Agreement is probably the best example of it. Davidson (2021, p.12) highlights four issues related to distributive justice in the 2°C target of the Paris Agreement: 1) How to allocate carbon budgets among international and local actors, 2) who should bear the costs of mitigation (here GHG emissions reduction), 3) who should bear the costs of adaptation to climate change, and 4) who should bear the costs of the damages due to climate change. The lack of consensus on these issues underpins the broader lack of consensus on the question of which distributive justice vision should be embodied in climate change mitigation.

Secondly, similar issues stem from the SBTs proposed by the SBTi for businesses. Indeed, on the one hand, Andersen *et al*. (2021, p.3) considers that the SBTi claims to "establish the equitable division of responsibility of individual entities" in order to meet science-oriented global goals. Nevertheless, this claim of "equitable division" does not consider the voluntary feature of SBTs or the debates inherent to distributive justice in climate change mitigation. For instance, which equity principle should be considered among companies in the development of their SBTs? Should the historical responsibility or the "equal per capita" principle be taken into account? On the other hand, SBTs have many limitations inherent to their scope, methodology and development process, the main one being that they entitle businesses as a main authority in corporate climate action over policy-makers, circumventing a potential democratic control over the fairness of the measures implemented (Tilsted *et al*., 2023).

3. Conceptual model

Science-Based Targets emerge from a complex knowledge transfer system, from the production of knowledge through scientific research, to the application of these targets by stakeholders such as businesses. The interactivity of this system can be illustrated by the Knowledge-to-Action (KTA) system framework.

3.1 The concept of Science-Based Targets

Science-based targets (SBTs) have emerged as a solution to set framed and iterative goals to address corporate greenhouse gas (GHG) emissions. The definition and scope of this term, however, still varies in literature. For instance, Andersen *et al*. (2021) suggest that corporate SBTs are targets stemming from the disaggregation of science-oriented global goals[1] described as being "established through intergovernmental process at the level of the entire planet" (Andersen *et al*., 2021, p.2). An example of this is the 2015 Paris Agreement negotiated at the COP21 where governments committed to a goal of limiting the temperature rise below 2°C above pre-industrial levels. These goals are then divided into smaller-scale targets based on the environmental impact of the units putting them into application, which, in the case of SBTs, are companies. Following the definition given by the Science-Based Targets initiative (SBTi) (Chapter 1) and Andersen *et al*. (2021), if all actors would achieve SBTs, the science-oriented global goals established by the Paris Agreement would be achieved.

According to Andersen *et al*. (2021), creating and implementing science-based targets through the disaggregation of science-oriented global goals requires several transdisciplinary steps that can be summed up into a knowledge development phase, a dialogue phase and a practical phase (Figure 1).

[1] These science-oriented global goals are described as "overall science-based targets" in Andersen *et al*. (2021). However, this denomination has not been widely accepted in the literature. Moreover, to avoid confusion with the corporate science-based targets established by the SBTi that this thesis focuses on, I do not use the denomination of "overall science-based targets".

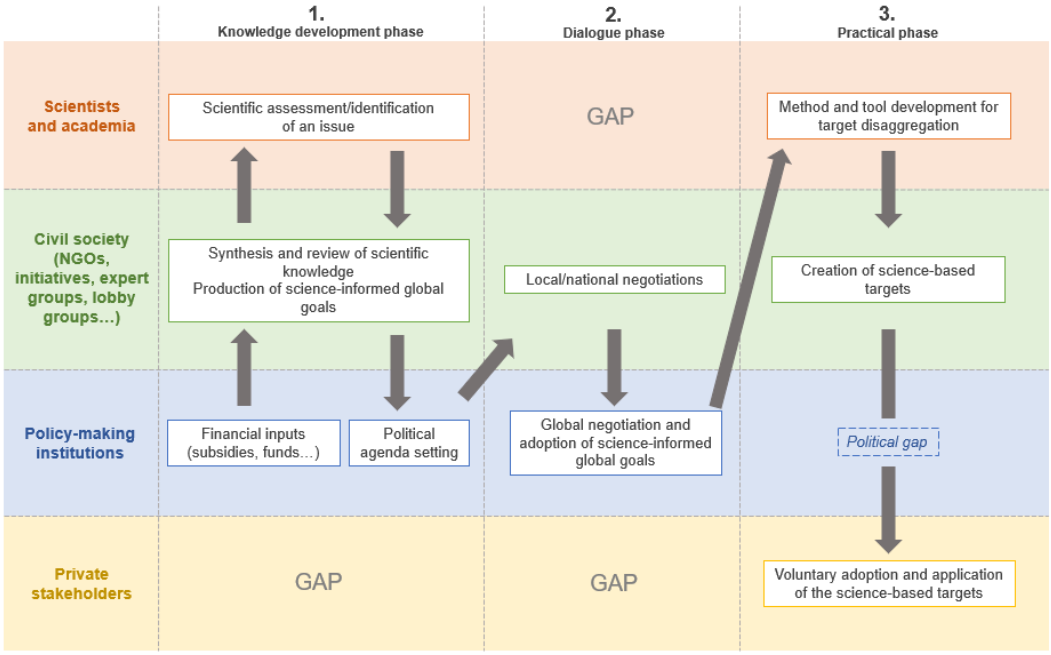

Figure 1. Extended schematic process of the development of science-based targets adapted from Andersen et al. (2021)

Figure 1 represents an extension of Andersen *et al*. (2021, p.3) displaying the schematic process of the development of SBTs. Different spheres of the KTA system are distinguished underpinning extended interactions across three phases. As displayed in Figure 1, the development process of SBTs involves four types of actors interacting with each other, specifically scientists and academia, the civil society (i.e. NGOs, organisations, expert groups or interest groups), policy-making institutions (national and global governing institutions), and private stakeholders (businesses). First, in the knowledge development phase, an appraisal and synthesis of the available research must take place, for instance illustrated by the IPCC reports or the Global Carbon Project reports. The second step is a dialogue phase and involves local and global negotiations resulting in the adoption of science-oriented global goals (e.g. the annual UNFCCC Conference of Parties). The third step aims at putting these science-oriented global goals into practice through their disaggregation, ending up in the creation of corporate SBTs by the SBTi and their voluntary application by businesses.

Although this is mainly a top-down process, it also includes bottom-up interactions, particularly in between each phase. Most importantly, Figure 1 highlights the existing gaps in the development of SBTs, such as the absence of direct inclusion of private stakeholders in the two first phases. The political gap underlined in the practical phase also illustrates the lack of investment of policy-makers in the mainstreaming and enforcement of SBTs (Bernauer and McGrath, 2016), which may also pose issues in terms of distributive justice (Mandard, 2024).

3.2 System-thinking in the knowledge-to-action (KTA) system framework

The knowledge-to-action framework conceptualises the bridge between the scientific evidence of a phenomenon and subsequent policy and practice. It can be defined as "an exchange of knowledge between relevant stakeholders that results in action" (Graham *et al*., 2006, p.22). Successive approaches to the KTA framework include 1) linear approaches, 2) relationship approaches and 3) systemic approaches (Best and Holmes, 2010).

Linear approaches imply the existence of a one-way relationship for knowledge transfer. Researchers produce knowledge which is then spread and adapted to the use of policy-makers and practice. The main characteristic of linear approaches in the KTA framework is that knowledge is seen as a product transferring from the knowledge producer to the knowledge user through simple, linear and effective channels of diffusion and communication (Best and Holmes, 2010).

Relationship approaches consider different agents (science, policy and practice) interacting to create and use knowledge. The production of knowledge also stems from policy-makers and practitioners, and this knowledge is also used by researchers. Assigned roles for knowledge production and knowledge use become malleable and the KTA process is fuelled by collaboration and exchange *(*Sarkki *et al*., 2014), particularly between policy-makers and researchers. However, the diffusion of knowledge follows the one-way principle of the linear approaches, from knowledge producer to knowledge user.

Finally, a systemic thinking of the KTA framework is being increasingly advocated. A systemic comprehension of the multiple interactions enabling the dissemination of knowledge is embedded in the constant evolution of the science-policy-practice dynamics along the KTA process. The systemic approaches also underpin the interdependence of the different stakeholders in the knowledge production process and the necessity of multi-sided interactions (Best and Holmes, 2010; Weichselgartner and Kasperson, 2010).

Cash *et al*. (2003) support the development of effective KTA systems in order to lead and influence the public and private sectors towards sustainability. Without a functioning system, enabling the quick and efficient translation of knowledge to an active transition to sustainability in society, the contribution made by the scientific research remains most likely powerless to prevent a significant degradation of life on Earth.

The authors point out that the knowledge produced in that sense had to meet three criteria - credibility, salience and legitimacy (CRELE) - to be properly adopted by policy-makers and relevant stakeholders. In order to be credible, the scientific evidence should reflect accuracy, validity and technicality. Salience, or relevance, encompasses the adequacy of the KTA system's response to what is required for the implementation of knowledge in society. Finally, the criterion of legitimacy addresses the quality, objectivity, inclusivity and fairness of the research towards the stakeholders involved. Overall, the ability of the KTA system to influence behaviours increases with the development of these three criteria.

3.3 Developing a knowledge-to-action system for science-based targets

Theoretically, the KTA system of SBTs could be summarised in three non-linear simplified steps: the production of knowledge, the adaptation of knowledge into policy and their application into practice by businesses. It involves three intersecting entities: science, policy and practice. In a systemic perspective, all three entities interact in-between each other to create and implement SBTs. This conception of the KTA system overlaps with the concept of the science-policy-practice interface (SPPI), used to identify and enhance the ways knowledge is transferred into action. Wyborn *et al*. (2017, p.5) described the SPPI as "the processes and settings in which decision makers in government, civil society, and business use, misuse, or reject scientific research in forming their thinking, analyses or decision-making". The proximity with the SPPI is acknowledged and used in the research process of this thesis. Regardless, whereas this thesis used the triad of science, policy and practice as the main entities of the researched system, it remains within the bounds of the KTA framework in an attempt to keep a clear and systemic conception of SBTs. Science is understood as the peer-reviewed knowledge produced through scientific methodologies. Policy consists in the regulations and normative measures undertaken by political decision-making institutions at the local, national or global scale. Finally, the practice encompasses the private actors putting the scientific knowledge and the political regulations into practice, in the case of this thesis, companies.

The systemic approach of translating knowledge into action has been framed by Graham *et al*. (2006). The system, which can be adapted to the creation process of SBTs, is organised around two interacting components: "knowledge creation", represented as a funnel, and the "action cycle". The KTA system's concept developed by Graham *et al*. (2006) was reproduced in this thesis and adapted in

order to illustrate a theoretical ideal KTA system of corporate science-based targets (Figure 2).

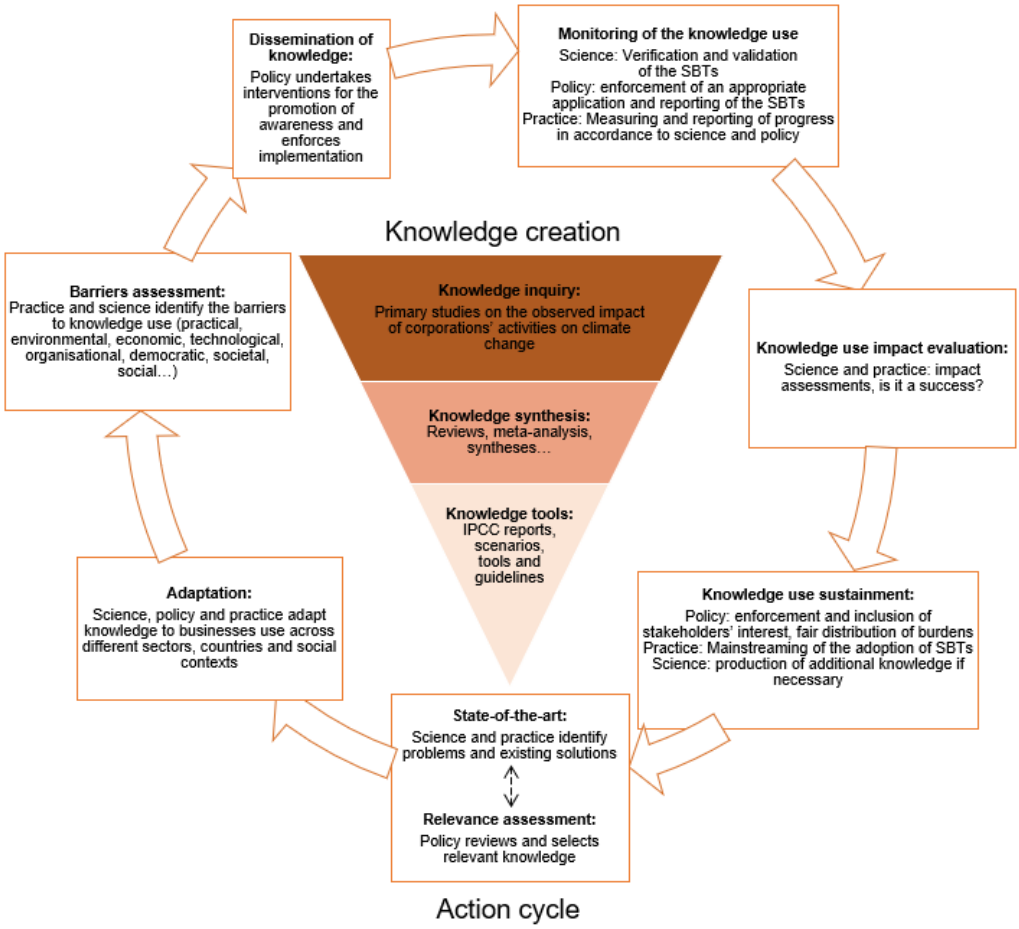

Figure 2. Ideal Knowledge-to-Action system of SBTs adapted and modified from Graham et al., (2006)

This conceptual framework of an "ideal" KTA system adapted in this thesis from Graham *et al*. (2006) suggests interactions between science, policy and practice as often as possible (Figure 2). The KTA process starts in the knowledge creation funnel where three generations of knowledge are tailored. In the knowledge inquiry phase, primary studies are being published, for instance on the effects of climate change and possible mitigation solutions, driven by the science sphere. The knowledge production is prolific, unorganised and the research quality varies. Then, the knowledge primarily produced is reviewed, appraised and synthesised in order to select valuable knowledge. Finally, tools, frameworks and guidelines including practice and policy inputs are produced. In the case of the creation of SBTs, this would include the IPCC reports and scenarios, as well as the Carbon Disclosure Project reports, measures and reporting tools and frameworks.

The knowledge produced then enters the action cycle: the problems and existing solutions, in the case of SBTs, different approaches to address corporate environmental impacts, are identified, and subsequently assessed and selected by the policy-makers according to their relevance. The knowledge selected is then applied to the business scale according to sectors, socio-ecological context and national and local specificities. The barriers to the practical implementation are then observed, most likely by the practice and science sphere, possibly by the policy sphere. The dissemination and enforcement of the knowledge use (here SBTs) is then implemented by the policy sphere, leading to the monitoring and reporting of the implementation of the targets by the science, policy and practice spheres. The impact of the knowledge use is then measured in order to assess the success or failure of the practical implementation of the knowledge produced. Finally, sustaining the knowledge implies observing the flaws of the implemented system and intervening to limit them in order to maintain the system in a loop system logic leading to a new state-of-the-art, fuelled by the knowledge creation funnel.

4. Method

4.1 Research design

This thesis focuses on understanding how the interactions that take place in the knowledge-to-action system of SBTs impact the inclusion of distributive justice concerns. To reach this research aim, three research questions are raised:

(1) What is the state-of-the-art of distributive justice in SBTs in the scientific literature?
(2) Does the scientific literature reflect an appropriate and effective knowledge-to-action system enabling the inclusion of distributive justice concerns in the creation process of SBTs?
(3) How could the knowledge-to-action system be improved to ensure the application of distributive justice in the implementation of SBTs by businesses?

In order to answer these questions both qualitatively and quantitatively, a Systematic Literature Review (SLR) was conducted. The first research question was answered in the appraisal and quality assessment step of the SLR (Section 5.1). The synthesis and analysis parts of the SLR then addressed the second research question (Sections 5.2 and 5.3). Finally, the third research question was considered and discussed in the analysis and the discussion (Section 5.3 and Chapter 6).

4.2 Systematic Literature Review

In order to assess the knowledge-to-action system in the creation process of corporate SBTs and how it relates to distributive justice in scientific literature, a Systematic Literature Review (SLR) was conducted in this thesis following the PSALSAR procedure (Mengist, Soromessa and Legese, 2020). It included six steps using both quantitative and qualitative analysis and was based on the SALSA (Search, Appraisal, Synthesis, and Analysis) framework (Grant and Booth, 2009), to which two steps are added.

The six steps of the PSALSAR procedure include:

- A **protocol** aiming at defining the research scope of the SLR.
- A **search** step aiming at identifying and applying the searching strings to the selected databases.
- An **appraisal** step screening the results of the search delivery through inclusion and exclusion criteria and quality assessment criteria.
- A **synthesis** phase extracting relevant data from the selected papers and creating a framework to categorise it.

- An **analysis** articulating the results of the synthesis and drawing a structure for the discussion.
- A **reporting** phase consisting in describing the procedure of the SLR conducted and the publication of the results.

4.2.1 Protocol

In order to identify the research scope, the PICOC (Population, Intervention, Comparison, Outcome and Context) framework advocated by Mengist, Soromessa and Legese (2020) and described by Booth, Papaioannou and Sutton (2012, p.86) was used. It is fragmented into five steps detailed in Table 3. The first step includes identifying the population of the review, i.e. who or what the research focuses on. The second step considers the intervention or the exposure, in other words the employed techniques to address the identified problem and the research gaps that the SLR aims at covering. The comparison underlines the alternative solutions to the presented intervention. Furthermore, the outcome focuses on the aims of the research and how the assessment of the observations will be conducted. Finally, the context assesses the context and settings of the population such as the time span or the geographic area.

Table 3. SLR research scope based on the PICOC framework.

Concept	SLR application
Population	Scientific research work on the inclusion of distributive justice in science-based targets (SBTs) across the knowledge-to-action (KTA) system.
Intervention	Identification of gaps in the KTA system of SBTs and what distributive issues it triggers, according to scientific literature.
Comparison	Difference between the identified KTA system and the ideal KTA system described in chapter 3.
Outcome	Qualitative and quantitative analysis of the trade-offs in the KTA system, the gaps between science, policy and practice and the identified distributive justice issues.
Context	Collected available literature on SBTs outcomes in terms of distributive justice between 2015 and 2023

The PICOC framework shown in Table 3 was applied to the research questions of this thesis: (1) What is the state-of-the-art of distributive justice in SBTs in the scientific literature? (2) Does the scientific literature reflect an appropriate and effective knowledge-to-action system including distributive justice concerns in the creation process of SBTs? (3) How could the knowledge-to-action system be improved to ensure the application of distributive justice in the implementation of SBTs by businesses?

Therefore, the population of the SLR consisted in primary and secondary research work on the interactions between SBTs and distributive justice within the KTA system. The intervention consisted in the identification and analysis of research gaps in the KTA system of SBTs in terms of distributive justice. The comparison encompassed the gaps between an "ideal" KTA system inclusive of distributive justice issues and the reality of the KTA system of SBTs in literature. Based on the aim of the research and the research questions, the outcome considers the state-of-the art of distributive justice in SBTs, the trade-offs in the existing KTA of SBTs and the possible improvements. Finally, this SLR takes place in the context of the existing knowledge and research on SBTs outcomes regarding distributive justice since the creation of the SBTi and the SBTs in 2015.

4.2.2 Search strategy and delivery

The search strategy step aims at identifying the best way to answer the research questions through the SLR within the boundaries of the research scope. The appropriate databases are identified and accurate search strings, i.e. research requests, are coined (Fernández del Amo *et al*., 2018). Moreover, the search delivery step consists in using the determined search strings in the selected databases and classifying the results obtained (*ibid*).

Due to the important societal interactions and debates inherent to the topic of this SLR, a diversity of scientific material was expected to be found. In order to reach the largest coverage possible, three open databases were selected: Scopus, ScienceDirect and Google Scholar. Scopus is an international abstract and citation database of, among others, peer-reviewed journals, conference series, book series and trade journals (Tober, 2011; Elsevier, 2023). This database extends scientific literature to debates in action. For broader results, the search includes plurals and spelling variants. Therefore, "science-based target" included "science-based targets". ScienceDirect is a database of multidisciplinary full-text peer-reviewed journal articles and book chapters provided by the publisher Elsevier and capturing purely academic content (Tober, 2011; Mengist, Soromessa and Legese, 2020). Like Scopus, ScienceDirect includes plurals in the search. Google Scholar, operated by Google, offers a full-text search tool with a broader scope of sources but fewer search query features than Scopus or Science Direct. The large number of sources searched can be beneficial to the review but also alter the quality of the search results, including non-academic material. Furthermore, the plurals are not included. "Science-based target" and "science-based targets" must therefore be split in two different search strings.

For an enhanced coverage, the choice was made to conduct the search through all fields instead of the usual TITLE-ABS-KEY syntax. This choice entails the

necessity for rigorous inclusion and exclusion criteria and quality assessment. In Scopus, the ALL field searches the query string in the article title, source title, language, author, editor, affiliation, abstract, keywords, references, DOI, ISBN, ISSN, CODEN, issue, volume, publication year, sequence bank, sequence bank number, article number, chemical name, CAS registry number, manufacturer, publisher, or conference fields. In ScienceDirect, the selected field of search includes all parts of the documents excluding references. In Google Scholar, the only possible selection of fields is between all parts of the documents or in the title only. The former was selected.

Considering the identified aspects and features of the selected databases, the search was conducted in all fields of search using the search strings presented in Table 4. The search strings were divided into "main" search strings, i.e. the most relevant search strings to the topic of this thesis and "secondary" search strings, i.e. added for enhanced coverage in the research process. In addition, still in the pursuit of appropriate coverage, "science-policy-practice interface" (SPPI) was used as a search string although the conceptual framework of this thesis focuses on the KTA system and not on the SPPI.

Table 4. Search delivery for each database

Databases	Stage	Search strings	No of articles	Date of acquisition
Scopus	Main	"Science-based target" AND "distributive justice"	6	13/12/2023
	Main	"Science-based target" AND "science-policy-practice-interface"	1	13/12/2023
	Main	"Science-based target" AND "knowledge-to-action"	2	13/12/2023
	Secondary	"Science-based target" AND "equity"	56	13/12/2023
	Secondary	"Science-based-target" AND "fairness"	18	13/12/2023
	Secondary	"Science-based target" AND "trade-off"	17	13/12/2023
	Secondary	"Science-based target" AND "justice"	56	13/12/2023
	Secondary	"Science-based target" AND "inclusive"	36	13/12/2023
	Secondary	"Science-based target" AND "research gap"	3	13/12/2023
Science Direct	Main	"Science-based target" AND "distributive justice"	5	13/12/2023
	Main	"Science-based target" AND "science-policy-practice interface"	1	13/12/2023

	Main	“Science-based target” AND “knowledge-to-action”	2	13/12/2023
	Secondary	“Science-based target” AND “equity”	87	13/12/2023
	Secondary	“Science-based target” AND “fairness”	74	13/12/2023
	Secondary	“Science-based target” AND “trade-off”	96	13/12/2023
	Secondary	“Science-based target” AND “justice”	47	13/12/2023
	Secondary	“Science-based target” AND “inclusive”	61	13/12/2023
	Secondary	“Science-based target” AND “research gap”	20	13/12/2023
Google Scholar	Main	(Science-based targets” OR “science-based target”) AND “distributive justice”	84	13/12/2023
	Main	(“Science-based targets” OR “science-based target”) AND “science-policy-practice interface”	8	13/12/2023
	Main	(“Science-based targets” OR “science-based target”) AND “knowledge-to-action”	22	13/12/2023
	Secondary	(“Science-based targets” OR “science-based target”) AND “equity”	2310	13/12/2023
	Secondary	(“Science-based targets” OR “science-based target”) AND “fairness”	586	13/12/2023
	Secondary	(“Science-based targets” OR “science-based target”) AND “trade-off”	617	13/12/2023
	Secondary	(“Science-based targets” OR “science-based target”) AND “justice”	1490	13/12/2023
	Secondary	(“Science-based targets” OR “science-based target”) AND “inclusive”	1680	13/12/2023
	Secondary	(“Science-based targets” OR “science-based target”) AND “research gap”	263	13/12/2023

The search strategy and delivery led to the first screening criteria of this SLR. Due to the large difference between the amount of search results between Scopus and ScienceDirect on the one hand, and Google Scholar on the other hand, and in order to enhance the feasibility and relevance of this research, only the main three search strings were used for the Google Scholar: (Science-based targets” OR “science-based target”) AND “distributive justice”, (“Science-based targets” OR “science-

based target") AND "science-policy-practice interface" and ("Science-based targets" OR "science-based target") AND "knowledge-to-action".

4.2.3 Appraisal and quality assessment criteria

The appraisal step of the SLR evaluated the relevance, reliability and validity of the search results and screened the selected literature through a grid of inclusion and exclusion criteria. It also assessed the quality of the literature and refined the selection for synthesis and analysis through different filters.

Table 5. SLR inclusion and exclusion criteria based on Mengist, Soromessa and Legese (2020, p.6 and Yang et al. (2021, p.4)

Criteria	Decision
Papers published before 2015 and after 2023	Exclusion
The paper should be written in English	Inclusion
The paper is a research or a review article published in a peer-reviewed journal	Inclusion
Full-text is not accessible, non-reviewed publications (grey literature), books and book chapters, theses, reports…	Exclusion
Papers that are duplicated within the search documents	Exclusion
Papers that do not mention science-based targets in the main text body	Exclusion

As displayed in Table 5, the collected papers were sorted according to appraisal criteria. First, the papers published before 2015 and after 2023 were excluded. Then, only the articles published in English in peer-reviewed journals were included, meaning that theses, reports, book chapters and other types of non-scientific literature were excluded. Review papers were included as they provided an interesting insight on primary research. Papers that were not accessible were excluded. Then, all the articles selected in different databases were gathered together to make sure that they were not duplicated. Finally, publications that did not mention science-based targets in the main body skim of the text were excluded. Eventually, after appraisal, 215 articles were left for the quality assessment.

In addition to the inclusion and exclusion criteria, a quality assessment was conducted in order to account for rigour, coverage, validity, credibility and relevance in the SLR. The determined quality assessment criteria were presented in Table 6, based on Yang *et al*. (2021) and Mengist, Soromessa and Legese (2020).

Table 6. SLR quality assessment (Mengist, Soromessa and Legese, 2020, p.6; Yang et al., 2021, p.4)

Domain assessed	Criteria	Applied in this project
Rigour	Are the SLR's inclusion and exclusion criteria described and appropriate?	See 4.2.3
Coverage	Is the literature search likely to have covered all relevant studies on the topic?	See 4.2.2
Relevance	Do all the selected studies mention SBTs in the body of the text?	See 4.2.3
Relevance	Are all the selected studies research or review articles relevant to the objectives of this SLR?	See 4.2.3
Validity	Do the collected studies contain adequate data and information?	See 4.2.4 and 4.2.5
Credibility	Were the selected publications peer-reviewed to assess the quality and validity of the study?	See 4.2.3 and 4.2.5

The rigour of the SLR was ensured through the appraisal process presented in section 4.2.3., and through multiple verification of the conformity of the studies selected to the inclusion and exclusion criteria described in said section. These criteria asserted for the quality and accessibility of the studies selected as well as their fitness to the scope of this SLR. Among these criteria, the requirement that all studies selected were published, peer-reviewed articles also accounted for credibility. Multiple verification and rigorous compilation through Excel were then conducted to ensure the appropriate coverage of the topic. Furthermore, in order to account for the quality of the SLR, two relevance criteria were assessed. First of all, the mention of SBTs in the body of the text, including figures, tables and keywords but excluding references, footnotes and the abstract, was taken into account in order to ensure that the articles selected fit within the scope of this review by including SBTs in their research process. The relevance of the articles selected in relation to the objective of this SLR was then assessed by reading the abstract and the conclusions. At this stage, the choice was made to exclude perspectives and other opinion publications as this thesis aims at observing research processes rather than opinions. Finally, through reading the main body of the text, the validity and the credibility of this SLR was ensured. Through this quality assessment, 143 articles were excluded, leaving 72 articles for synthesis and analysis. The data extracted from the articles was compiled and classified in accordance to the quality and validity of the results and conclusions of each article.

4.2.4 Synthetical framework

Following the appraisal and quality assessment steps, the selected articles were processed through a synthetical framework. Criteria were created to enable the extraction of information and their compilation, classification and processing in Excel. These criteria aimed at synthesising and categorising the results to a certain

feature, such as the relevance in relation to the research questions (RQ) or to the conceptual framework (CF). The synthetical framework is presented in Table 7.

Table 7. SLR synthetical framework

Synthesised feature	Criteria	Possible result	Type of subsequent analysis
Time occurrence	Year of publication	2015-2023	Quantitative
Type of article	Is the article a research or a review paper?	"Research" or "review"	Quantitative
Relevance to the RQ and CF	Are SBTs the main topic of the article?	No = 0, yes = 1	Quantitative
Relevance to the RQ and CF	Does the article include the KTA system or SPPI in the research?	No = 0, yes = 1	Quantitative
Relevance to the RQ	Does the article include any conception of justice or equity in the research?	No = 0, yes = 1	Quantitative
Systemic perspective	How does the article link science, policy and practice?	"Science" and/or "Policy" and/or "Practice"	Quantitative and qualitative
Angle adopted	What dimension of sustainability is considered in the article?	"Social" and/or "Environmental" and/or "Economic"	Quantitative and qualitative
Implications	Link to the research aim of the thesis and the RQ	One-sentence summary	Qualitative

Following the criteria described in Table 7, each selected paper was assessed and synthesised. The first two criteria were gathered through the meta-data of each article available in the three databases and within the articles themselves. The third, fourth and fifth criteria were assessed by reading each article, on an empirical basis. In spite of the focus of my conceptual framework on the KTA system, the SPPI was included due to its proximity to the KTA system framework, for enhanced coverage. The sixth and seventh criteria data were compiled both through an empirical reading and through the recurrence of keywords in the main body skim of the text. Finally, the eighth criterion consisted in a one-sentence summary of the most relevant data extracted from the reading process and the previous steps, a necessary process for the qualitative analysis.

Eventually, the possibility of categorisation results was also detailed in Table 7. Their type varied between an attributed score, a multiple-choice answer, and, in the case of the last criterion, a more detailed description. These results were processed and coded for the qualitative and quantitative analysis.

4.2.5 Analytical framework

Assessing the total of relevant papers published during the research scope of this thesis (2015-2023) provided an overview of the effectiveness of the knowledge-to-action system to include distributive justice in the implementation of science-based-targets in the literature. Based on the synthetical framework (section 4.2.4.), both the quantitative and qualitative data extracted were analysed. Quantitatively, the obtained data was statistically combined and compared. Qualitatively, the publications' content was analysed within the scope of the research questions in order to extract comprehensive and holistic information and observe research trends. The results of the quantitative and the qualitative analyses (section 5.3) were then combined to be further discussed (section 6).

5. Results

In this section, the results extracted from the different stages of the Systematic Literature Review (SLR), from the pre-processing stages of identification of search results, screening and eligibility assessment to the processing stages of synthesis and analysis, are described.

5.1 Preprocessing stages

After identification through the search strings, the selected articles were screened for appraisal and quality assessment following different grids of criteria detailed in sections 4.2.2 and 4.2.3 (Figure 3).

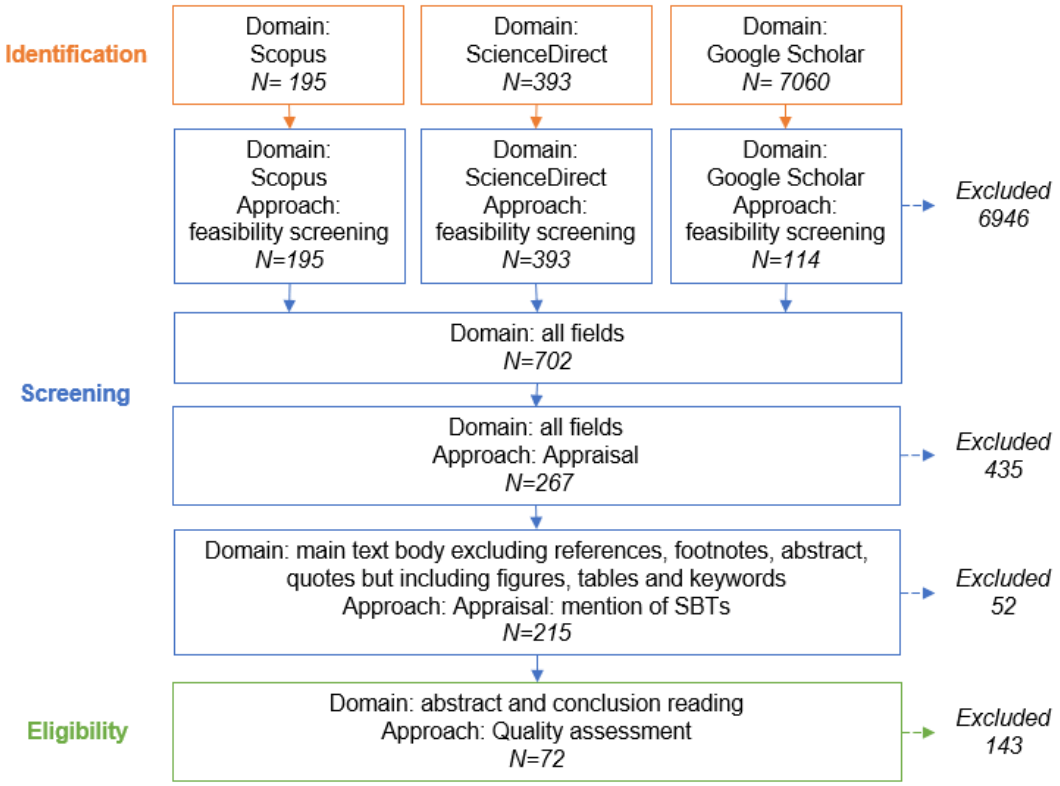

Figure 3. SLR appraisal and quality assessment stages adapted from Mengist, Soromessa and Legese (2020, p.7)

The total of the papers collected amounted to 195 search results for Scopus, 393 for ScienceDirect and 7060 for Google Scholar. A large gap is thus observable between, on the one hand, the number of search results for Scopus and ScienceDirect, and on the other hand, the number of search results for Google Scholar. Due to the lack of precision of Google Scholar's research tool, using the

same number of search strings for Scopus, ScienceDirect and Google Scholar resulted in the inclusion by the latter of a large number of search results irrelevant to my research. In order to enhance the feasibility and quality of the research, the choice was therefore made to focus only on three search strings on Google Scholar; "(Science-based targets" OR "science-based target") AND "distributive justice", ("Science-based targets" OR "science-based target") AND "science-policy-practice interface" and ("Science-based targets" OR "science-based target") AND "knowledge-to-action", leading to a total of 114 articles extracted from Google Scholar. The search results from different databases were then combined, resulting in a total of 702 articles.

Subsequently to the appraisal and the application of most inclusion and exclusion criteria, 435 articles were excluded, leading to a total of 267 articles. The mention of SBTs in the main body of the text was considered within the appraisal, leading to a total of 215 articles. Quite logically, it resulted in the fact that most of the articles selected focused on issues associated with businesses rather than global and local areas or individuals. The eligibility of these articles was then assessed through the quality assessment.

The relevance of the articles in accordance to the research questions was assessed by reading the abstract and conclusions of each article and, when necessary (due to uncertainty), by reading the whole article. Perspectives and other opinion papers were also excluded due to this thesis' ambition to analyse the state-of-the-art and the ins and outs of scientific research. Eventually, through the quality assessment, 143 articles were excluded leading to a total of 72 articles left for synthesis and analysis.

5.2 Processing stages

During the synthesis step, various results were translated into quantitative and qualitative data to be analysed, following the established synthetical framework (Section 4.2.4).

5.2.1 Meta-data

First of all, the publication year occurrence showed that the number of publications relevant to our research questions has been increasing over the recent years (Figure 4).

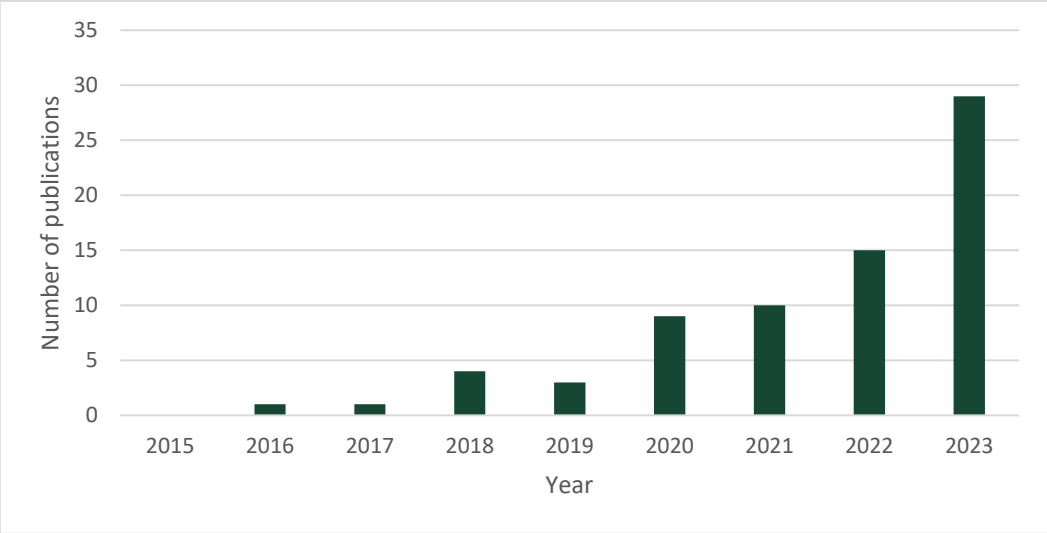

Figure 4. Occurrence of the publications selected for the systematic literature review

As shown in Figure 4, no relevant articles were published in 2015. One paper only was published respectively in 2016 and 2017, four in 2018, three in 2019, nine in 2020, ten in 2021 and 15 in 2022. With a total of 29 articles published, 2023 was the most prolific year. Among these papers, 59 are research articles and thirteen are review articles.

5.2.2 Relevance

Among the range of articles selected for the systematic literature review due to their interest for my research, only 22 publications were considered to focus on SBTs as a main topic. In the same vein, only six publications made mention of the knowledge-to-action system or the science-policy-practice interface and 27 included a certain conception of distributive justice or equity (Figure 5). 31 publications were therefore judged relevant for this research although they did not pertain to these criteria.

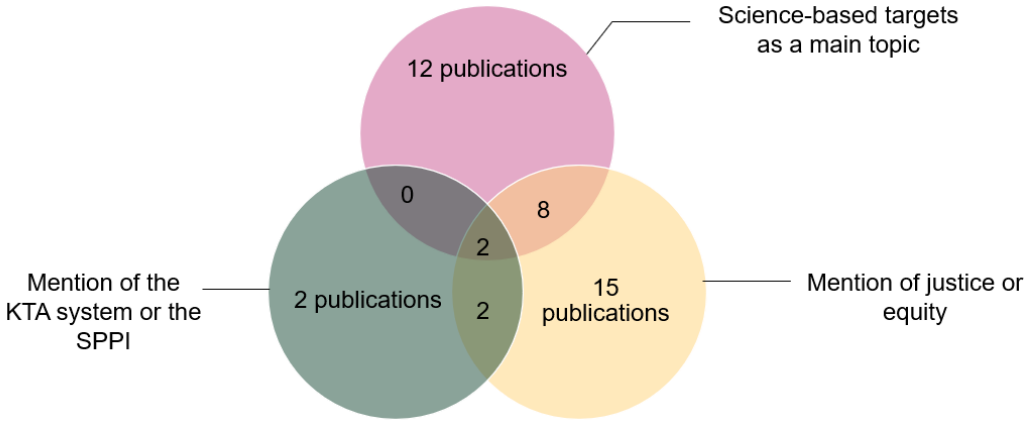

Figure 5. Synthesis of the results of the relevance criteria from the systematic literature review

When put in perspective (Figure 5), these data show that, most often, the feature of having SBTs as a main topic is met alone (12 publications) or in combination with a mention of justice or equity (10 publications). In the same way, the feature of a mention of the KTA system or the SPPI is always either combined with having SBTs as a main topic, or a mention of justice or equity, but never alone. In addition, the criteria of a mention of justice or equity is most often met alone (13 publications) or in combination with having SBTs as a main topic (ten publications). Finally, only two articles, or ~3% of the selected articles met all three relevance criteria (Hagerman *et al.*, 2021; Kozar *et al.*, 2023).

5.2.3 Scope of focus

Synthesising the systemic units of analysis of the selected studies revealed which agents of the KTA system (science, policy or practice) each article mainly focused on (Figure 6).

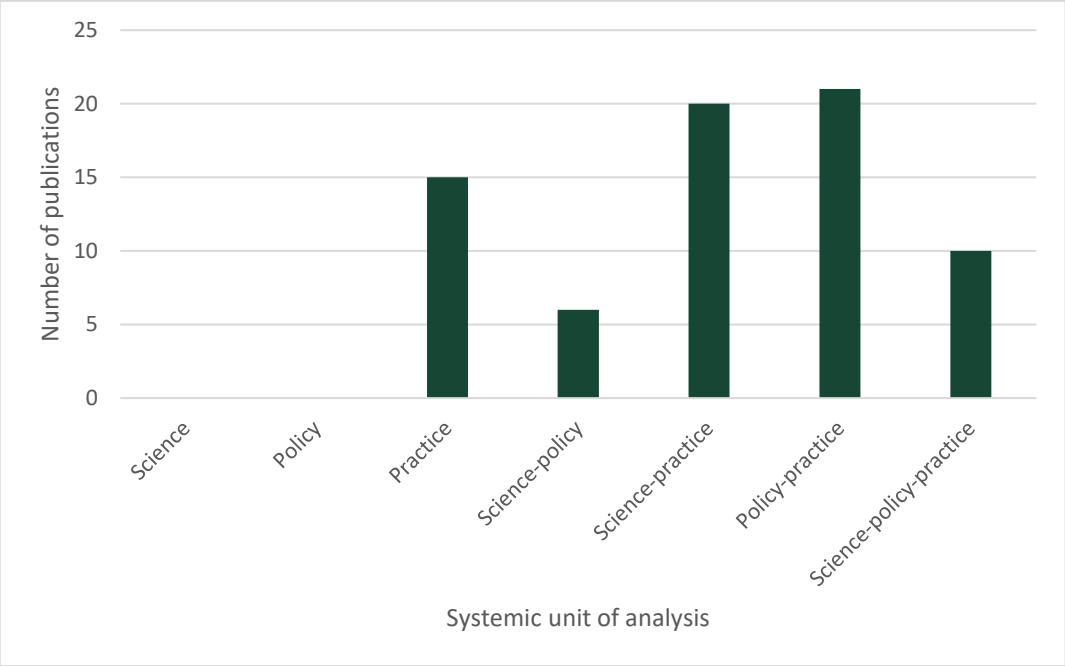

Figure 6. Recurrence of scope of focus within the KTA system from the systematic literature review

Thus, if no selected publication focused solely on the scientific actors or the policy domain, a total of 15 articles were identified as focusing their analysis on practical application only, predominantly within companies and industries. They encompassed various sectors, ranging from the construction sector to the textile industry or the agricultural sector, providing a comprehensive overview of perspectives on SBTs and distributive justice. More systemically, six articles explored the interactions between science and policy, 20 between science and practice and 21 between policy and practice. Lastly, ten publications were considered to include science, policy and practice within the analytical framework of the studied system, i.e., only 13% of all selected publications. This analysis thus displays an insufficient number of papers that address all three entities.

5.2.4 Sustainability dimension

In addition to the previous results, the 72 articles selected for synthesis and analysis were also assessed according to which dimensions of sustainability are central to their research. This was achieved through reading of the whole article. The three most commonly accepted dimensions of sustainability (Hauschild, Kara and Røpke, 2020) were considered: social (S), environmental (Env) and economic (Eco).

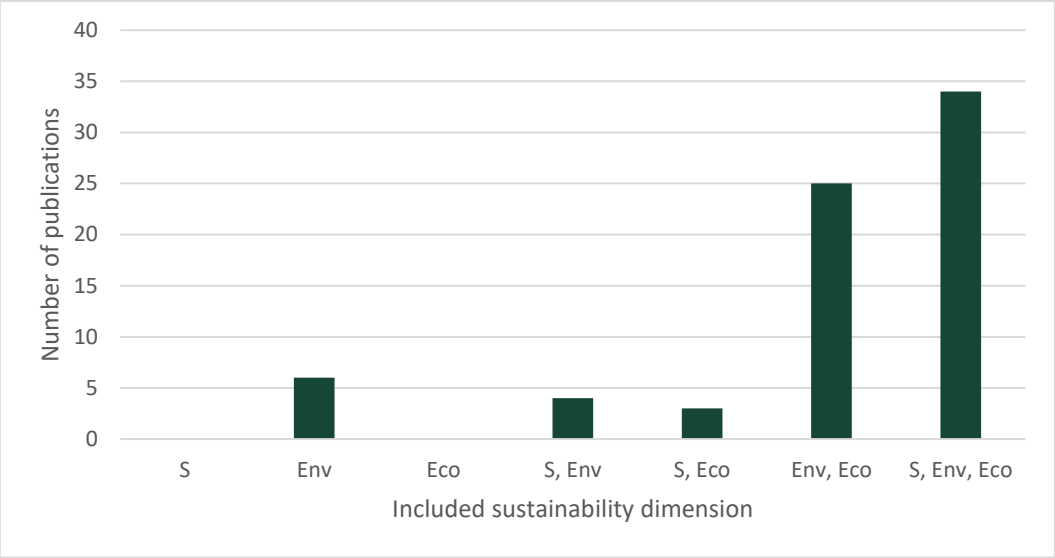

Figure 7. Recurrence of sustainability dimensions in the publications analysed in the systematic literature review

As expected, due to the topic of this research, no paper focused only on social or economic dimensions but six publications adopted an environmental perspective only. Moreover, four articles combined social and environmental dimensions, three combined social and economic dimensions and 25 publications combined environmental and economic dimensions. Finally, 34 articles were considered to combine all three dimensions in their analysis.

5.3 Analysis

5.3.1 Quantitative analysis

The summary quantitative results of the different stages of this SLR were gathered in the previous sections (Sections 5.1 and 5.2). If considered on their own, they provide little information for achieving the aim of this research. Nevertheless, when combined, they become more revealing. For instance, statistically analysing the combination of the relevance and the scope of focus results synthesised in 5.2 may determine the intensity of system-thinking on the issues of science-based targets and distributive justice within the knowledge-to-action system. The best illustration of it is the fact that the only two papers that combined the three relevance criteria (SBTs as a main topic, mention of the KTA system or the SPPI, and a conception of justice or equity) turned out to be including science, policy and practice in their scope of focus. This result suggests enhanced systemic interactions in the knowledge production process of these two papers.

Moreover, this combined approach revealed that almost 42% of the articles with SBTs as a main topic centred their analysis in the policy-practice sphere and 25% on practitioners only. These numbers show a low contribution of research on the "science" domain in "science-based targets", and suggest repercussions on the efficiency, legitimacy and relevance of SBTs.

In addition, crossing the data extracted from the relevance criteria and from the sustainability dimension criteria showed that social aspects in the implementation and application processes of SBTs are not studied enough. Among the 22 articles that have SBTs as a main topic, only nine include a social dimension to their research. Comparatively, 17 of these 22 publications include an economic dimension.

Regardless, 60% of the selected articles with a research process overarching a science-policy-practice scope include a conception of justice or equity (alone and in combination with other criteria). This result could be interpreted in the favour of a systemic perspective including all three entities.

Finally, interestingly, 100% of the papers mentioning the KTA system or the SPPI alone focused on the interactions between science and policy. When combined with a conception of justice or equity, 50% included practice along science and policy. This could suggest a lack of inclusion of the practitioners within the KTA system.

5.3.2 Qualitative analysis

Through the reading of the publications collected, four major trends were identified in the consideration of science-based targets (SBTs) and distributive justice as part of the knowledge-to-action system (KTA) in the available literature.

Major trends

(1) The scope of SBTs is considered insufficient to have a significant impact.

In this regard, the fact that SBTs focus on companies' GHG emissions only and not, for instance, also on biodiversity loss is often pointed out (Bjørn, Richardson and Hauschild, 2019; zu Ermgassen *et al*., 2022). Indeed, the fact that some companies, e.g. in the mining sector, have a stronger negative impact on land, biodiversity and water use than on carbon emissions is not considered within the scope of SBTs (Crona *et al*., 2023). Moreover, several publications also advocate for SBTs focused

on resources use and flows of sensitive or polluting materials such as metals or plastic (Watari and Yokoi, 2021; Watari, Nansai and Nakajima, 2021; Diana *et al*., 2022).

The scope of SBTs is considered narrow and inadequate to successfully mitigate corporate emissions (zu Ermgassen *et al*., 2022). In this regard, Gifford *et al*. (2023) points out that just climate targets should aim towards lower goals than the 1.5°C established by the Paris Agreement in order to reduce significant harm to Earth systems, as the consequences of the climate crisis are already visible. Moreover, the vague boundaries of scope 3 emissions, their limited inclusion within the SBTi metrics, and the fact that companies have little (economic) incentives to address them and include them in their SBTs is also a major barrier to truly impactful mitigation action through the SBTs (Giesekam, Tingley and Cotton, 2018; Wang and Sueyoshi, 2018; McDonnell, Rempel and Gupta, 2022; Johnson, Rötzel and Frank, 2023). Wright and Caudill (2020, p.14) for instance consider that "performance targets for GHG emissions intensity currently used by the company do not assure that progress towards sustainability is achieved even if the corporate target is met.". Hadziosmanovic *et al*. (2022) also consider that the alignment of the SBTi with the Paris Agreement pathways reveals challenges, as all the scenarios applicable today exceed the current temperature goals. In addition, the scale of SBTs is also questioned; using the example of a food chain, Kozar *et al*. (2023) highlights the necessity of linking SBTs in-between sectors and at multiple scales. Implementing SBTs at the national level is also suggested by Usubiaga-Liaño and Ekins (2021).

Overall, the lack of system-thinking in the implementation of SBTs is substantively underpinned. According to Wright and Caudill (2020), the focus of SBTs on environmental burdens and positive impacts invisibilises the social positive or negative impacts it could create, ignoring the overarching interactions and interdependencies between environmental and social justice. In the same way, the fact that companies are considered individually prevents any consideration of a relative performance (Larrea *et al*., 2022). In order to implement effective and systemic SBTs, Erbil, Eroğlu and Türk (2022) underlines the necessity of adopting a broader perspective between academia, policy-makers and practitioners.

(2) Distributive justice is a very central issue inherent to SBTs.

Aligned with the concerns regarding the scope of SBTs, the existence of trade-offs between environmental sustainability and social sustainability but also between small and large companies, shows the lack of system-thinking in the conception of SBTs (Bjorn *et al*., 2020; Grabs and Garrett, 2023). The interdependencies between

environmental and social justice and the socio-ecological context in which SBTs are designed and implemented are ignored, creating inequalities (Haffar and Searcy, 2018; Wright and Caudill, 2020).

Furthermore, the standardisation triggered by the SBTs is also criticised as it ignores unique context-based challenges (Giesekam, Tingley and Cotton, 2018). For instance, Malik *et al.* (2021) stress the fact that the SBTi should consider the negative social impacts that the application of SBTs have in other countries, for instance in terms of working conditions. Yet, in practice, linking social and environmental sustainability in impact assessments remains a challenge (Bjørn, Richardson and Hauschild, 2019). In that sense, Millar and Searcy (2020) advocate for the inclusion of participatory processes to assist the scientific research in order to improve the social aspects of SBTs implementation and develop locally relevant indicators.

However, more ethical concerns regarding the allocation principles adopted by the SBTi are also emphasised in the literature. According to Maia and Garcia (2023, p.8), SBTs' lack of "ethical foundation for allocating global allowable emissions to individual organisations". SBTs are based on the principle of grandfathering (Table 2), giving to all companies a predefined and non-differentiated "right to use the pollution space" (Hauschild, Kara and Røpke, 2020). No historic responsibility or differentiation between companies from developed and developing countries is taken into account by the SBTi, which is often considered unfair by the companies themselves or external stakeholders (Immink *et al*., 2022; zu Ermgassen *et al.*, 2022). The blames of grandfathering particularly target the ACA methodology used by the SBTi, its insufficient integration of equity principles and lack of consideration of access and vulnerability factors (Hadziosmanovic *et al*., 2022; Immink *et al*., 2022; Gifford *et al*., 2023). In order to introduce more justice and equity in the distribution of carbon budgets, a more ethical allocation principle is therefore needed (Kara, Herrmann and Hauschild, 2023).

The literature advocates for the inclusion of theories and assessments of justice by the SBTi, for instance based on the population of the companies' country (Immink *et al*., 2022; Gifford *et al*., 2023). Overall, in a perspective of distributive justice, a better dialogue is needed between science and policy for a fair implementation of SBTs (Jabot, 2023).

(3) The notion of targets being "science-based" is in itself contested.

In a very concrete way, all SBTi pathways rely on assumptions and forecasts, rather than considering the remaining global carbon budget, leading to uncertainties on

the adequacy of SBTs (Hadziosmanovic *et al*., 2022). In addition, due to the normative structure and political negotiations taking place in the creation process of SBTs, the targets implemented by the businesses are significantly less ambitious than they were at the initial stage of knowledge production and thus cannot be considered fully "science-based" anymore (Bjørn, Richardson and Hauschild, 2019; Hebinck *et al*., 2021).

Gifford *et al*. (2023) also considers that the transfer of scientifically established targets into the policy and the practice spheres eventually increases social inequalities due to the neoliberal structure these targets take place in. Science and the term "science-based" are considered to be instrumentalised by the policy and the practice sphere in order to advocate for the "best practice" and provide legitimacy : "climate science incorporates both science and politics therefore feeding political goals" (Hopkins *et al*., 2023, p.9).

According to Erbil, Eroğlu and Türk (2022), the boundaries of what is considered scientific are also vague. In that sense, SBTs would therefore consist more in policy-based targets with a scientific input. Indeed, Erbil, Eroğlu and Türk (2022) highlight that science does not produce direct results in policy implementation and application. The authors also raise the question of the legitimacy of science as "science cannot be considered an absolute authority and it cannot be independent of social activities" (*ibid*).

(4) The policy sphere is not sufficiently involved in SBTs.

Indeed, according to Kuo and Chang (2021), the promotion of SBTs to companies by the Japanese government enhanced the appropriate use of SBTs. On the contrary, Gössling *et al*. (2023) observed that the lack of governance over SBTs generates a lack of commitment from companies. The researchers pointed out the necessity for policy regulations and enhanced governance in different sectors such as the food chain (Kozar *et al*., 2023) or the information and communications technology (ICT) sector (Freitag *et al*., 2021).

More broadly, the policy sphere fails to enforce SBTs, control the validity of net-zero claims or the homogeneity of corporate targets in-between companies, leading to insufficient corporate efforts in terms of decarbonisation and GHG emissions reduction (Larrea *et al*., 2022). For instance, Immink *et al.* (2022) consider that policy-makers should implement the mandatory disclosure of GHG emission reduction targets and reporting for all companies. Wang and Sueyoshi (2018) also point out the uneven and particularly insufficient corporate efforts to limit scope 3 emissions due to the lack of political pressure. In addition, long-term targets would

be harder to achieve without a stronger involvement of the policy sphere *(*Ayoub *et al.*, 2020). Eventually, Dragomir, Dumitru and Perevoznic (2023) consider that, due to the lack of regulative enforcement of SBTs, companies just end up imitating other companies with successful practices in order to stay competitive, ignoring contextual and systemic considerations.

Furthermore, the issue of SBTs being a voluntary practice, associated with the absence of penalisation when companies do not meet their targets, is also highlighted in the literature (Schweitzer *et al*., 2023). In this context, relying on corporate SBTs to decarbonise does not seem reasonable (Christiansen *et al*., 2023). Considering that SBTs place the burden of climate action on private actors and decentralised public actors, the implementation of strong regulations, benchmarks and reporting and monitoring frameworks seems like a requirement (Streck, 2020). Indeed, currently, SBTs can be set without taking local context and distributive justice considerations into account (Gifford *et al*., 2023).

Overall, Erbil, Eroğlu and Türk (2022) show the difficult interactions between science and policy and the discrepancies between scientific conclusions and policy implementation and application. For instance, Abdoli, Kara and Hauschild (2020) suggest that the non-alignment of climate policies with SBTs results in companies favouring their profit targets over SBTs in order to be able to comply with the climate policies, potentially triggering a paradox with an increased negative impact on the environment. Similarly, Lahn and Sundqvist (2017) advocate for a stronger link between science, international policy and the understanding of SBTs in the context of world politics, to improve the equity and mainstreaming of SBTs worldwide.

Additional trends

Six additional trends were found in the process of this SLR. Less recurrent in literature than the major four trends above, these additional trends suggest the existence of further significant issues associated with SBTs, requiring more research.

First of all, **the discourse behind corporate SBTs is a subject of controversy.** SBTs are based on the alignment of carbon reduction and continued growth (Gössling *et al*., 2023). The idea of reducing emissions while simultaneously maximising growth is rooted in the widely criticised concept of “green growth” (Lux, Fromont and Vo, 2023). According to Hopkins *et al*. (2023), coupling growth and environmentalism is also a form of eco-modern masculinities. Overall, by promoting environmental action within the boundaries of economic growth, SBTs

also promote reformist discourses, making radical discourses invisible and therefore limiting the opportunities to create structural change in our society (Quahe, Cornell and West, 2023). Indeed, shifting the climate mitigation burden on private actors also transfers authority on sustainability matters to companies, legitimising "climate capitalism" as the primary context in which change takes place (*ibid*). In the same perspective, Gifford *et al*. (2023) go further and consider that setting corporate SBTs is, in itself, a neoliberal action that does not ensure the control of corporate emissions.

SBTs methodologies are also questioned. For instance, Gössling *et al*. (2023) suggest that SBTs are not adapted to certain sectors such as tourism, aviation or shipping. Giesekam, Tingley and Cotton (2018) draw the same conclusion regarding the construction sector; as SBTs mainly focus on scope 1 and 2 emissions, they become less relevant in sectors with major scope 3 emissions. Moreover, Schweitzer *et al*. (2023) underlines that, the fact that the SBTi enables the companies to pick between two calculation methods in the target-setting process (absolute emissions or sector-based emissions), tend to lead to underestimated emissions and reduced ambition from the companies setting SBTs.

In addition, **there is a risk of SBTs being used as a greenwashing practice**. Schumacher, Chenet and Volz (2020) consider that the verification and validation process of the SBTi is flawed, as it is mostly performed internally, which can lead to potential conflicts of interest. Moreover, Dragomir, Dumitru and Perevoznic (2023) and Bolay *et al*. (2022) observed that, sometimes, SBTs were set and reported by the companies after being achieved. A company's commitment to the SBTi provides it with an artificial image of "being green" even though there may be no real motivation shown by the company to actually reduce its emissions (Dragomir, Dumitru and Perevoznic, 2023). In addition, the weakness of reporting regulations (*ibid*) and the issues stemming from the scope of SBTs and net-zero SBTs (Hemmings *et al*., 2023) also enable greenwashing. Finally, Hopkins *et al*. (2023) assess that the expression of "science-based" and the notion of distributive justice are used as part of a discourse and greenwashing practices to provide legitimacy to financial or political goals.

There are tensions between the short-term and the long-term SBTs. On the one hand, Giesekam, Tingley and Cotton (2018) highlight that the companies tend to adopt year by year reductions rather than implementing long-term targets, that are considered more difficult to meet, particularly without political incentives (Ayoub *et al*., 2020). The existence of important trade-offs between financial goals and long-term SBTs also convinces the businesses to focus mostly on short-term targets (Haffar and Searcy, 2019). On the other hand, Dragomir, Dumitru and Perevoznic,

(2023) point out that companies tend to adopt only medium and long-term targets for scope 3 emissions, as they are more ambiguous and require little progress disclosure.

Gender inequalities are inherent to SBTs. Hopkins *et al.* (2023) underpin the underlying existence of gender inequalities in the conception and implementation of corporate SBTs: the discursive instrumentalisation of both "science-based targets" and "distributive justice" is observed in gendered industries such as the aviation sector to advocate for legitimacy and justify, in this case, the expansion of aviation. The authors also point out the fact that science in itself is already gendered and that, overall, women are more likely to support real decarbonisation efforts. Furthermore, according to Arora-Jonsson and Gurung (2023), women should be more integrated in conversations between science, policy and practice for more equity in climate change mitigation.

Finally, **positive impact stemming from the SBTi and corporate SBTs are also appraised by the literature**. First and foremost, Maia and Garcia (2023) observe that companies that comply with the SBTi targets overall have a better performance in terms of carbon emissions reduction than those who do not. Bendig, Wagner and Lau (2023) also demonstrate that corporate SBTs actually increase companies' financial performance. The inclusion of GHG emissions triggered by plastic production by the SBTi is also considered beneficial (Diana *et al*., 2022). In a broader perspective, Kuo and Chang (2021) consider that the SBTi provides a structure to companies willing to reduce their carbon emissions, limiting the confusion between different frameworks and guidelines. The scientific information is synthesised and conveyed by the SBTs from the science sphere to the practice sphere (Scriven *et al*., 2022), illustrating a successful co-production of knowledge between science and non-scientific stakeholders for sustainability (Quahe, Cornell and West, 2023).

6. Discussion

While SBTs offer a promising pathway for corporations to contribute to sustainability, the systematic literature review (SLR) showed various types of limitations in the conceptualisation and implementation of SBTs in terms of distributive justice. These limitations raise critical questions about the inclusivity and fairness of the knowledge-to-action system within the development of SBTs. Additionally, the multiplicity of usage of the term "science-based targets" in the literature, sometimes comprehended as a tool for companies to increase their sustainability within the framework of the SBTi, sometimes observed at a national scale or even at other undefined scales, increases the confusion on what SBTs are, where they stand in the knowledge-to action (KTA) system, and how they participate to climate change mitigation.

By discussing the results of the quantitative and qualitative analysis of the SLR, I attempted to answer the following research questions: (1) What is the state-of-the-art of distributive justice in SBTs in the scientific literature? (2) Does the scientific literature reflect an appropriate and effective knowledge-to-action system enabling the inclusion of distributive justice concerns in the creation process of SBTs? (3) How could the knowledge-to-action system be improved to ensure the application of distributive justice in the implementation of SBTs by businesses? Each of these questions are discussed in the following sections.

6.1 The state-of-the-art of distributive justice in science-based targets

Distributive justice in science-based targets (SBTs) is discussed in scientific literature through different perspectives. The growing focus on the SBTi and SBTs raises the question on how the weight of mitigating climate change can be distributed in a fair and equitable way. SBTs tend to shift the responsibility to fight climate change from public to private actors, due to the limited involvement of the policy sphere (Larrea *et al*., 2022) and the authority given to companies to make important decisions in terms of climate change mitigation (Quahe, Cornell and West, 2023). Yet, according to Andersen *et al*. (2021, p.3), "such applications in the private sector cannot substitute for public policy". This poses three major distributive justice issues.

First of all, the lack of political and normative regulations of SBTs leads to the omission of the consideration of the social and societal context in the

implementation of SBTs, creating trade-offs between environmental and social sustainability and, eventually, creating inequalities (Giesekam, Tingley and Cotton, 2018; Haffar and Searcy, 2018; Bjorn *et al*., 2020; Wright and Caudill, 2020). In other words, the narrow scope and the lack of system-thinking of corporate SBTs tend to create a standardisation of the environmental action, invisibilising the diversity of society and the diversity of possible mitigation measures (Giesekam, Tingley and Cotton, 2018; Bjørn, Richardson and Hauschild, 2019; zu Ermgassen *et al*., 2022).

In the continuity of this first distributive justice issue, a second issue arises from the – increasingly criticised – allocation principle of SBTs: grandfathering (Hauschild, Kara and Røpke, 2020), associated to the "polluter pays" principle. Corporate SBTs attribute the same reduction target rate of GHG emissions to all companies, either in terms of absolute emissions or in a sector-based perspective, based on produced value. Such allocation principles neither take the emissions prior to the setting of the targets into account (historical responsibility), nor the different characteristics of the companies in their national context (Hadziosmanovic *et al*., 2022; Immink *et al*., 2022; Gifford *et al*., 2023). This is often considered unfair, sometimes deterring companies from committing to the SBTi.

Thirdly, Trexler and Schendler (2015) point out that corporate SBTs are unlikely to achieve the science-oriented global climate goals (such as the 2°C target of the Paris Agreement). In a context of negligible political environmental leadership and weak or absent carbon taxation, the incentives to set efficient SBTs are lacking and conflicting with economic interests (Haffar and Searcy, 2019; Hopkins *et al*., 2023). The number of companies able and willing to set efficient SBTs would end up being insufficient and accounting for only an insignificant share of the global emissions (Trexler and Schendler, 2015). Furthermore, it would lead businesses to favour low-costs targets with a limited positive impact on the environment, affecting the quality of the actions put into application and therefore their environmental outcome (*ibid*). The quantitative analysis also showed that, overall, companies tend to try to limit the level of ambition of the SBTs they adopt (Schweitzer *et al*., 2023), postpone certain goals into a vague and distant future (Dragomir, Dumitru and Perevoznic, 2023), or even use SBTs as a greenwashing practice (Bolay *et al*., 2022). In that sense, Dahlmann, Branicki and Brammer (2019) highlight that companies' decision to implement science-based climate targets are based on two types of intentions: on the one hand, businesses that have a real intention to understand their climate impact and what's at stake, and on the other hand, businesses considering these targets as a management tool enhancing their image to consumers. The latter type of intention reveals no real will to improve their environmental performance and rather follows the perspective of the economic man (Söderbaum, 2009). Regardless,

the climate crisis remains an issue to be tackled. Postponing or corrupting the use of corporate SBTs, and by extension of science-oriented global climate goals, only creates further discrepancies and inequalities in terms of intergenerational justice.

6.2 The limitations of the knowledge-to-action system of science-based targets

The overall analysis of the knowledge-to-action (KTA) system of science-based targets (SBTs) showed flaws and a certain discontinuity. For instance, the quantitative analysis demonstrated that the literature insufficiently adopts a systemic perspective combining science, policy and practice on the question of distributive justice in SBTs (Section 5.3.1). The scientific research instead tends to focus on interactions between two spheres only; science and policy, policy and practice, or science and practice. Involvement gaps in the development process of corporate SBTs are also an issue (Figure 1).

Simultaneously, the qualitative analysis showed the lack of interactions between science, policy and practice and the challenges it triggered regarding distributive justice in SBTs.

The "**science**" dimension of SBTs faces criticisms in terms of ethical concerns and legitimacy. Indeed, SBTs provide companies with a science-driven approach to set emission reduction goals in line with the global effort to mitigate climate change. However, as SBTs are the product of political negotiations through the disaggregation of science-oriented global goals, they cannot be considered as fully "science-based" (Bjørn, Richardson and Hauschild, 2019; Andersen *et al*., 2021; Hebinck *et al*., 2021; Hopkins *et al*., 2023). Moreover, the very notion of "science-based" prompts us to critically examine what defines science and, consequently, the meaning of Science-Based Targets. In 1963, Price defined a scientist as "any person who has ever published a scientific paper" (Okubo, 1997, p.8). In a situation as vital as tackling the climate crisis, it is obviously unthinkable to apply this definition to the creation process of SBTs. More recently, Edward O. Wilson (1999, p.58) defined science as "the organised, systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable laws and principles". In line with this definition, a range of criteria, close to the requirements of SMART (specific, measurable, assignable, realistic and time-related) targets, was proposed by Andersen *et al*. (2021) to define science-based targets. These criteria can be synthesised as theoretical achievability, quantitative measurability and rationality. In other words, it must be theoretically possible to achieve a SBT within the applied timeline, a SBT must be quantitatively monitored and its progress, success or failure

must be measurable, and a SBT must have a clear aim based on the objective analysis of an ethical, social or environmental issue. These criteria, if they aim at ensuring credibility, rigour and relevance in SBTs, cannot however prevent trade-offs in intersecting goals nor ensure effective systemic interactions. In that sense, Erbil, Eroğlu and Türk (2022) highlight that science needs to be included in a systemic perspective in order to address trade-offs, for instance between environmental and social goals. To sum up, the denomination of "science-based" is instrumentalised and inaccurate as corporate SBTs are not strictly and only "science-based", and they should not be, in order to enable a systemic mechanism in the transfer of knowledge into action.

The main issues of the **policy** sphere are its lack of involvement in corporate SBTs in terms of regulation and endorsement (Immink *et al*., 2022; Dragomir, Dumitru and Perevoznic, 2023; Schweitzer *et al*., 2023) and, overall, the difficult interactions with science (Lahn and Sundqvist, 2017; Abdoli, Kara and Hauschild, 2020). As pointed out by Andersen *et al*. (2021), the extension of SBTs to the public sector would thus be a necessity in order to re-centre the responsibility of addressing the climate crisis on the shoulders of political decision-making institutions, and potentially have a significant impact in the mitigation of the climate crisis. Eventually, however, the array of tools produced by the SBTi and other standards may create a distraction to the implementation of environmental global policies and measures that are necessary but considered to be potentially impactful to the current economic system and therefore rejected (Trexler and Schendler, 2015; Gössling *et al*., 2023; Lux, Fromont and Vo, 2023). Thus, presenting SBTs as a scientifically approved panacea could both misleadingly minimise the seriousness of the climate crisis' challenges and the importance of significant mitigation policies, and give a false impression of progress to the public.

Finally, the **practice** sphere suffers from the discontinuity between the science sphere and the policy sphere. Distributive justice issues stem from this discontinuity (Section 6.1) and, without the proper incentives, tools and frameworks, companies have been shown to struggle to limit their environmental impact, often leading to greenwashing practices (Giesekam, Tingley and Cotton, 2018; Ayoub *et al*., 2020; Bolay *et al*., 2022; McDonnell, Rempel and Gupta, 2022; Johnson, Rötzel and Frank, 2023). Moreover, the scope of SBTs considered by the SBTi is unfortunately limited. Observing the climate crisis as a phenomenon simply resulting from GHG emissions, without adopting a systemic perspective encompassing the global destruction of Earth systems, e.g. biodiversity losses, would be detrimental. Expanding the scope of SBTs to all planetary boundaries is therefore important, as underlined by the scientific research (Rockström *et al*., 2009; Quahe, Cornell and West, 2023). Tilsted *et al*. (2023) also argue that the SBTi narrowed down the

scientific input to create the SBTs which inevitably leads to limited possibilities of decarbonised futures, therefore less likely to have a positive outcome in the mitigation of the climate crisis. In other words, the standardisation of science necessary to the creation of SBTs for businesses has become a barrier to the original purpose of SBTs. In that sense, according to Quahe, Cornell and West (2023), science-based targets are rooted in the opposition between reformist and radical discourses, similar to the distinction between weak and strong sustainability. Whether they aim at adapting the current system to sustainability or at helping change an unsustainable system is determined by the scientific knowledge selected to build them.

6.3 Implications and limitations of the research

The SLR showed that SBTs remain a valuable tool in the process of mitigating the climate crisis (Maia and Garcia, 2023). Yet, the lack of interactions observed between the science, policy and practice within the KTA system of SBTs appears to be detrimental in terms of distributive justice. Indeed, the observed KTA system showed a different structure than what an "ideal" KTA system may look like (Figure 2), with many gaps and inequalities. For instance, this research showed that the practice sphere provides little input to the knowledge creation funnel and is missing from the action cycle before the monitoring stage (Wang and Sueyoshi, 2018; Gössling *et al*., 2023). Additionally, the policy sphere seems to disappear after the relevance assessment (Hebinck *et al*., 2021; Immink *et al*., 2022). The policy sphere fails to incentivise and endorse the application of SBTs and many social implications are overlooked, showing a lack of system-thinking (Bjorn *et al*., 2020; Gifford *et al*., 2023; Grabs and Garrett, 2023; Hopkins *et al*., 2023). Therefore, for an optimised mitigative impact, SBTs need to be created, implemented and applied in a more systemic perspective. An enhanced KTA system, with an increased participation and inclusion of all stakeholders from the science, policy and practice spheres at each stage of the process, would end up being beneficial in terms of both distributive justice and climate change mitigation.

Nevertheless, further research using other methods to assess this phenomenon could contribute to a more accurate observation of the KTA system of SBTs. Indeed, this thesis is limited by the fact that the KTA system of SBTs (in these terms) is rather unexplored, requiring the inclusion of a larger scope of research in order to produce results. Another limitation of this thesis is the use of an "ideal" KTA system as a fixed point, stepping away from the reality and challenges of implementing SBTs as a common corporate tool at a global scale. A more thorough observation of the political measures implemented could also benefit the research. Finally, the consideration of "distributive justice" had to remain purposely vague as the

understanding of what is fair and what is not remains subjective and varies from individual to individual.

7. Conclusions

In spite of its flaws, SBTs stands out, amongst other standards and frameworks for corporate GHG emissions reductions, as an interesting tool to include businesses in the necessary effort to mitigate the climate crisis. The structure and synthesis of scientific knowledge provided by the SBTi enable necessary interactions between science and practice.

However, to better include distributive justice considerations in the creation and the implementation of SBTs, the KTA system needs to be improved. Indeed, the current state-of-the-art of the literature on this topic seems to show a KTA system broken into separate entities with few interactions covering science, policy and practice at once. Whereas efficient SBTs require a multidisciplinary, participative and holistic approach, the scope of the science basis of SBTs is narrow and the contributions of the policy sphere are hesitant. More specifically, a stronger involvement of the policy sphere in the enforcement and the mainstreaming of SBTs seems like a requirement. Yet, whether it is in terms of corporate GHG emissions reductions or in terms of distributive justice, the mechanisms to assess and validate the fairness, efficiency and the motivations behind the measures undertaken by the companies, are lacking. SBTs place the responsibility to implement corporate GHG emissions reductions on companies only, simultaneously shifting the responsibility to tackle related distributive justice issues on these same companies. In other words, the absence of the policy sphere in the KTA system of SBTs induces an absence of the policy sphere in the response to the distributive justice issues that SBTs trigger, stemming from the lack of consensus on distributive justice in global climate mitigation.

In this context, an appropriate application of SBTs depends almost only on businesses. The potential success of the SBTi in corporate emissions reductions thus entirely relies on the goodwill of companies and their technical and financial ability to address their own emissions. Moreover, achieving SBTs does not mean achieving environmental sustainability and, even less so, social sustainability. Without incentives or political support, the trade-offs between environmental and social sustainability remain unaddressed and, overall, the choice of target-setting methods inherent to the SBTi does not account for social or environmental justice.

Another issue stemming from SBTs is the question of their raison d'être. According to the definition provided by the SBTi (Chapter 1), SBTs attempt to help prevent the impacts of climate change and "future-proof business growth". This definition implies the pursuit of sustainable business growth, stemming from a perspective of

weak sustainability. This stance is a subject of controversy as it invisibilises environmental radical discourses supporting a strong vision of sustainability. In the same way, SBTs' allocation principles, grandfathering and the "polluter pays" principle are engrained in western neoliberal discourses supporting climate capitalism, which are yet unable to end greenwashing practices and inequalities in the distribution of the climate mitigation burden.

In this perspective, more scientific research is needed in order to put fair and equitable SBTs throughout the whole KTA system into practice. Although the research focusing on distributive justice in SBTs has been increasing, the number of scientific publications tackling this specific issue remains minimal, highlighting a significant research gap. Moreover, when it comes to analysing the systemic interactions that take place between science, policy and practice in the development process of SBTs, this review concludes that there is a better inclusion of distributive justice concerns when studies observe SBTs through a systemic perspective and acknowledge multi-sided interactions.

Therefore, adopting a systemic perspective would be beneficial. Including participatory throughout the SBTs' process of translating knowledge into action mechanisms is a good example of it. A systemic perspective would indeed most likely make distributive justice considerations more visible and prevalent in the implementation and application of SBTs, limiting greenwashing and inequalities.

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Popular science summary

This thesis studies how justice is considered in science-based targets (SBTs). SBTs are goals set by companies to reduce their greenhouse gas emissions. Through a systematic literature review, which consisted of the compilation and analysis of as many relevant academic publications as possible, this research reveals that the development and application processes of SBTs sometimes neglect social impacts. This leads to an underdevelopment of justice aspects within these targets, and less effectiveness in the fight against climate change and inequalities. Thus, this thesis concludes that, for SBTs to be socially fair and environmentally sustainable, they must address both the environmental and social dimensions of climate actions. This research also suggests improving the way knowledge about climate change is turned into action. For SBTs to be meaningful and just, more people need to be involved in the decision-making process, governments should be more involved, and companies must be held accountable for their actions.

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