Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship

Stockholm University

Master's Thesis, 60 ECTS
Social-ecological Resilience for Sustainable Development
Master's programme 2020/22, 120 ECTS

Motivations for setting science-based targets for environmental impacts in eight Swedish sustainability frontrunner companies

Ylva Skoogh

Motivations for setting science-based targets for environmental impacts in eight Swedish sustainability frontrunner companies

Abstract

The aim of this study was to find out if, how and in particular why companies are setting science-based goals and targets related to the Planetary boundaries framework (PBs), the Science-Based Target initiative (SBTi) and the Science-Based Targets Network (SBTN) guidelines, or science-based targets more broadly, for environmental impacts. A sub-question was what role culture, in particular values of people and companies, might play for that. A sample of eight sustainability frontrunner companies in Sweden with awareness of the Planetary boundaries framework was investigated with a predominately qualitative method.

The results showed that the companies have several motivations for setting science-based targets, mostly related to the fact that they are, want to be and want to be seen as leaders in tackling sustainability issues and that science-based targets can contribute to that. The most important motives were related to the company's identity, brand and core values, expectations from stakeholders, to be strategic and focus on what is important, to focus on actions and follow them up, trustworthiness/credibility and ethical considerations.

The connection to values was quite clear as suggested by the two most important motivations of 'identity, brand, and core values' and 'expectations from stakeholders'. The most important stakeholder groups in this regard are employees, consumers, and owners, in that order. Expectations from stakeholders is connected to changing values in society. In a few cases, sustainability has been a part of the companies' core values from the very beginning, albeit not always labelled as such, or in most cases for a very long time, and is considered as a 'part of the DNA'.

Keywords: motivations, science-based targets, Science-Based Targets Initiative, SBTi, Science-Based Targets Network, SBTN, environmental impacts, Sweden, Swedish, companies, planetary boundaries framework, culture, values of people and companies

Table of content Page

Introduction

The planetary boundaries framework

In the year 2000 natural scientists suggested that the Earth had entered a new geological epoch, the Anthropocene, driven by the total impact of human activities on the planet (Crutzen and Stoermer 2021). A few years later the notion of the 'great acceleration' was introduced, suggesting that human impact is not only huge but also accelerating (Steffen, Crutzen, and Mcneill 2008).

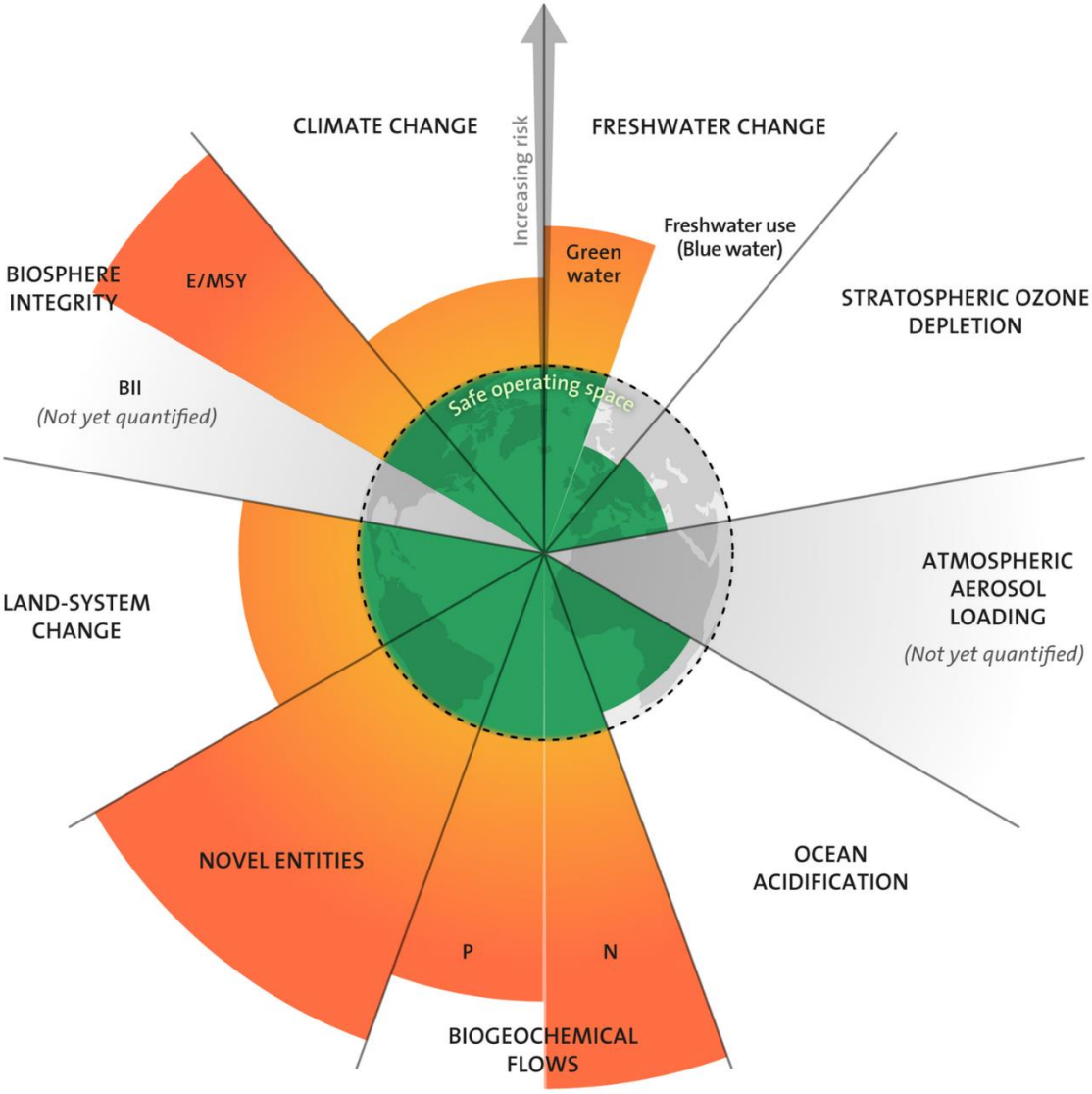
This prompted a group of researchers to define a 'safe operating space' for human impact on the planet to avoid destabilizing the Earth system (Rockström et al. 2009). Rockström and colleagues (2009) suggested nine 'planetary boundaries' (PBs) that are crucial for the functioning of the Earth system. Their analysis suggested that three of these nine Earth processes had transgressed their suggested boundaries – climate change, biodiversity loss, and interference with the nitrogen cycle - and that the last two were at rates that would erode the resilience of major components of the Earth system.

The 2009 study was later scientifically reconfirmed (Steffen et al. 2015) with updated boundary estimates. Steffen at al. (2015) also suggested that two more PBs had been transgressed (interference with the phosphorous cycle and land use change). In addition, they recognized two of the PBs as 'core' based on their importance for the Earth system functioning; climate change and biosphere integrity (previously biodiversity loss).

Since 2015, the scientific work about the PBs has expanded tremendously and much more than there is space to account for here. However, it is important to note a few of the recent updates. In 2022, scientists concluded that the PB for 'novel entities' (previously chemicals), has been transgressed (Persson et al. 2022). Another study suggested that 'green water' should be included in the PBs and found that with this inclusion the freshwater boundary has also been transgressed (Wang-Erlandsson et al. 2022).

For an illustration of the planetary boundaries framework with the latest updates from 2022 see Figure 1 below!

Figure 1. Planetary boundaries illustration (2022)



Credit: "Azote for Stockholm Resilience Centre, based on analysis in Wang-Erlandsson et al 2022". Source: [Planetary boundaries - Stockholm Resilience Centre]

Also in 2022, a group of scientists showed that with existing inequalities, technologies, and behaviours, just access to basic necessities for about a third of human population that lack such necessities, would produce up to 26% additional negative impact on the Earth's natural systems and further crossing PBs. This would

equal the impacts caused by the wealthiest 1-4% of the global population (Rammelt et al. 2022).

Finally, Rockström et al. (2021) has recently extended the PBs framework to include targets for a "safe and just corridor" to ensure that goals are equitable, i.e. 'just', in addition to 'safe'. To align safe and just dimensions, they propose that the more stringent of the safe or just target ranges defines the corridor. The proposed targets for such a 'safe and just corridor' were launched at the World Economic Forum in 2023 (Rockström & Gupta presentation at the WEF).

To not risk destabilizing the Earth system and undermine the life support system of the biosphere (Rockström et al., 2009; Steffen et al., 2015), it is of outmost importance that human activities stay within the 'safe operating space' of the PBs and that development continues within the 'limits of the planet' as stated in the Agenda 2030 (General 2015). Governments are trying to negotiate how to accomplish this within the UN system and elsewhere, for example the EU. The results are international agreements such as the Montreal protocol, the Paris agreement for combatting climate change and the Agenda 2030, and the European Green Deal.

National governments are also enacting legislation, for example The Swedish Climate Act stipulating that Sweden shall be net-zero with respect to carbon emissions by 2045 (Swedish EPA 2019) and the Swedish Environmental Objectives (Naturvårdsverket 2017). However, it has been argued that in addition to national governments, regions, municipalities, and cities, corporations must also be engaged in tackling these unprecedented challenges for humanity (e.g., Folke et al. 2019; Österblom et al. 2017).

For example, with regards to climate change Bolton and Kacperczyk (2021) noted that although over one hundred countries representing half of the world's GDP, have made net-zero commitments for carbon reductions in their nationally determined contributions (NDCs), the brunt of the decarbonization effort will be borne by the private sector considering that the 500 largest global corporations together

produce around one third of the world's GDP and consequently a similar share of global greenhouse gas emissions. However, it is crucial for all actors, including companies, that the PBs are operationalized for them to be able to act in the specific contexts that they are operating. Therefore, an important part of the PBs science and practice has been to work out how to do this, which is the topic of the next section.

Operationalizing the PBs and company applications

Since the 2015 update article about the PBs (Steffen et al. 2015), scholars have increasingly investigated how to operationalize the PBs across scales and business sectors. For example, work has been done with respect to how to divide the global 'safe operating space' into national fair shares (Häyhä et al. 2016), to operationalize the PBs at the EU level (Häyhä et al., 2018), and how to integrate the PB for water into water management at different scales (Zipper et al. 2020).

Discussions in the academic literature about the PBs in a business context are for example an investigation of how to apply the PBs in strategic decision-making in companies (Clift et al. 2017), resilience-based targets setting (Haffar and Searcy 2018), how to adopt a circular economy within the PBs (Desing et al. 2020), and the PBs and corporate reporting (Veldman and Jansson 2020).

Examples of empirical or applied research about the PBs in business are, for example an industry case study (Ryberg et al. 2018), an environmental sustainability assessment of a utility company (Ryberg et al. 2020) and a life cycle impact assessment applied to cosmetic products (Vargas-Gonzalez et al. 2019). Researchers at the Stockholm Resilience Centre (SRC) have explored how a circular economy approach could enable textiles companies to stay within the PBs (Palm, Cornell, and Häyhä 2021), and AlbaEco/SRC made an analysis of a company from a PBs perspective (Houdini 2018). Another business application is The World Business Council for Sustainable Development's use of the PBs as an input for their Vision 2050 (van der Zee 2008).

In a review of corporate responsibility reports Bjørn et al. (2017) found that although the number of reports had increased tenfold during 2010-2014, the share that made reference to 'ecological limits' had remained stable at around 5% and references to the 2° climate target was the most common by far. References to the PBs began in 2011 and had increased since then, but the number was only a very small fraction of the total (27 out of over 200 references to ecological limits in 40 000 anglophone reports as of November 2014).

A more general kind of operationalization is the development of guidelines for science-based targets for business; Science-Based Targets initiative (SBTi)[1] that was launched in 2015 with the goal to enable organizations to set science-based emissions targets for climate in line with the Paris agreement of 1.5C, and Science-Based Targets Network (SBTN)[2] that launched its first guidance in 2020 with the goal to set targets for 'nature'. These two initiatives cover the major PBs such as climate (SBTi), freshwater, land, ocean, and biodiversity (SBTN). These specific targets, as well as any other targets related to the PBs framework, are the focus of this work.

Science-based targets for environmental sustainability: definitions and literature

Before going in-depth into the literature about science-based targets, we need to clarify what it means that a target for environmental issues is science-based.

To define 'science-based' in relation to setting targets for major planetary concerns, Andersen et al. (2021) propose three characteristics; first, achievability, i.e., biophysical possibility within the specified time frame, second, that the target should be quantifiable, and third, that the target should be supported by a rationale. The authors emphasize that setting targets for addressing major planetary concerns is a societal and political process and that there is no such thing as a 'scientific target'.

[1] The SBTi is a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF) (https://sciencebasedtargets.org/about-us)

[2] The SBTN brings together experts from more than 60 NGOs, business associations and consultancies to develop guideline to set science-based targets for the whole Earth system. (sciencebasedtargetsnetwork.org)

Andersen et al. (2021) further distinguish between overall science-based targets for the world and specific targets for individual entities (e.g., a company) that are based on the overall targets. They suggest, that according to this definition, overall science-based targets are The Paris Agreement 2-1,5 C target (Nations 2018), the Strategic Plan for Biodiversity 2011-2020 (International Year of Biodiversity 2010), and the Land Degradation Neutrality Target (LDN Target Setting | UNCCD). In contrast, they argue that the Agenda 2030 SDG 15 ('Life on land'), which was only partially quantified, and the SDG 14 ('Life below water'), which was not quantified at all, cannot be regarded as *science-based* targets. The specific SBTs are based on the contribution of an entity or sector towards causing a major planetary concern, such as greenhouse gas emissions by a company (Krabbe et al. 2015). The SBTi guidelines for example, focus on businesses and determines targets for individual companies, where possible via sector targets.

The literature about SBTs for Climate (SBTi) can give an indication of the drivers and motivations for setting science-based targets beyond climate, and I will therefore use this to frame my study.

In a review of the literature on SBTs for Climate (SBTi) Björn et al. (2022) found three strands of research; existing company engagement with SBTi including drivers to set SBTs, appraisal of SBT methods and governance, and prospects for SBT diffusion. They further found evidence that SBT adoption corresponds to increased climate action of companies but argue that there is a need for more research to understand how SBTs may facilitate a just transition to low-carbon societies. The findings in the literature about company engagement with the SBTs and the drivers for that are particularly relevant for my study and some of these will be discussed more in depth below.

Bolton and Kacperczyk (2021) investigated voluntary firm commitments to SBTi and CDP (formerly the Carbon Disclosure Project) of publicly traded companies. They identified country, industry and company characteristics associated with commitments to the SBTi and CDP. They found that higher firm commitments were related to being a European company, having lower and decreasing emissions, that the company had

set an internal target for emissions, and that other companies in the industry had committed. High and low emitting industries were less likely to commit. Company characteristics were larger firm size, better financial fundamentals, stock listed in the MSCI index, higher stock price volatility and more anti-takeover protections, and stronger external governance forces such as analyst coverage and higher institutional ownership concentration. The internal governance variables that were positively related to commitment were more women board members. In contrast, larger boards, higher average member tenure, more members with a finance background were all negatively related to commitment. The relationship was negative for CDP but positive for SBTi regarding media attention. This is consistent with the view that SBTi attracts truly good firms that had positive media attention prior to their commitment according to the authors.

Freiberg, Grewal, and Serafeim (2021) found that companies that had set, and successfully achieved more difficult internal targets, were more likely to set an SBT according to the SBTi. Companies that had more carbon-intensive operations and perceived more imminent climate change risks with greater impacts on their business were also more likely to set an SBT. They also found that SBT targets became more ambitious compared to internal targets and that SBT-adopting firms increased actions to reduce emissions. Finally, the SBT setting companies expected monetary savings and carbon emissions reductions increased after adopting SBTs. The authors claim that their results are consistent with real effects for target setting but they concluded that it was too early to assess the overall impact of the SBTi on corporate carbon emissions.

In a survey of eight UK companies Piper and Longhurst (2021) identified credibility and standardization as two predominant motivations for setting SBTs for climate. Motivations differed slightly between companies in interviews such as a desire to pursue a sustainable carbon trajectory, to protect a company's reputation and to be seen as a strong leader. Target-setting decisions tended to be driven by economics rather than climate change concerns according to the interviewees. However, they were in favour of adopting the SBTi since it would be beneficial to the company in several ways such as futureproofing, linking individual climate actions to coherent

measures, developing a sustainable carbon trajectory, to make comparisons to other companies, and protecting the company's reputation.

Kuo and Chang (2021) investigated a sample of almost 2000 Japanese firms to see if firms can effectively utilize carbon management tools such as SBT and internal carbon pricing (ICP) to enhance their carbon management reputation (CMR). The results indicated that the firms which implemented an ICP strategy, and if they had set SBTs in particular, had better CMR. They also found that implementation of both approaches can create significant effects on the improvement of CMR for firms in high carbon emission industries (HCEI), but for non-HCEIs only adopting the SBTi would be more cost-effective.

A review by Giesekam et al. (2021) of to what extent over 80 early adopters were meeting their SBTs showed that a majority of targets assessed were on track. A significant proportion of companies setting SBTs already had a high CDP score, supporting the notion of past success as a driver for SBT adoption. Target achievement appeared to be influenced by the target scope, and in particular scope 3 targets were lagging. Choice of baseline year could be a determinant of target progress as many of the targets that had been achieved were short term and it is unclear whether target achievement is a result of strong action or weak ambition according to the authors. They further suggest that with more SBT adopters and longer time series data longitudinal analysis might be conducted and conclude that there is scope for qualitative work in identifying motives for participation in the SBTi.

This study - aim and research questions

This study will build upon a previous study (Skoogh, 2016), which had the aim to find out if awareness of the PBs had had an impact on corporate strategies in eight Swedish companies. The main findings were that the respondents showed a strikingly similar understanding of the PBs, but at the same time they reported a varying degree of responses on the organizational level with regards to its use and influence on corporate social responsibility activities and corporate strategy. Five companies answered that the PBs had had at least some impact on strategies, one person said "not

yet but it might in the future", and two answered it had had no impact at all. Explanations for these variations were not investigated.

However, the PBs concept was very new then and the boundaries suggested were on a planetary scale and therefore difficult to use as a reference when setting goals and targets by companies operating at smaller scales. In addition, not all the PBs were quantified.

Now, after over ten years since the first PBs article (Rockström et al. 2009) was published, the PBs body of science has developed considerably. In addition, after over six years since the previous study was conducted companies have had more 'reaction time' with regards to the PBs and it would be interesting to see if there have been any developments in business practice too.

The aim of this study is to find out if, how and why companies with an awareness of the Planetary boundaries framework are setting science-based goals and targets related to the (PBs), the Science-Based Target initiative (SBTi) and the Science-Based Targets Network (SBTN) guidelines, or science-based targets more broadly, for environmental impacts. A sub-question is what role culture and values of people and companies might play for that. A sample of eight sustainability frontrunner companies in Sweden with awareness of the PBs were investigated with a predominately qualitative method.

As highlighted above, the literature about drivers and companies' motivations for setting science-based targets in relation to the PBs work mostly concerns SBTs for climate (SBTi), other standards for reporting on carbon emissions such as the CDP (Adamsson et al. 2016) or climate actions tools (Walenta 2020). The few examples about science-based targets in business for other PBs than climate, i.e. for 'nature' or environmental issues more broadly, include suggested targets for biotic and abiotic resource use (Bringezu 2019), science-based water targets for antibiotics (Tell et al. 2019) and seafood companies setting time-bound and science-based goals as a result of collaboration within an ocean stewardship initiative (Österblom et al. 2022).

Although the SBTi has been operational since 2015, it is restricted to climate which is only one of the nine PBs. The SBTN guidance, that is covering the most important PBs from a business action point of view, was launched quite recently and will finalize its methodologies in 2023. Therefore, it is timely to investigate why companies might adopt science-based targets more broadly.

This study addresses the following **research questions**:

> What are the motivations for companies with an awareness of the PBs to set 'science-based' targets related to frameworks such as the planetary boundaries (PBs), the Science-Based Targets for Climate and for Nature (which are to a large extent based on the PBs) or science-based targets more broadly, when setting long-term goals and more specific targets for their environmental impacts?
> A sub question is what role culture, in particular values of people and companies, might play for that. By looking at values I expect to be able to operationalize culture and connect to motivations.

With this knowledge it could be easier to first, find companies that are more prone to take the overall message of the PBs into consideration, second to understand better the drivers and barriers for using the PBs in corporate strategizing, and in particular for setting science-based targets for environmental sustainability, which would be useful for policy makers, and third to tailor arguments for setting science-based targets to different groups of people and companies. Overall, I hope the study can contribute to understanding why companies align their goals and targets with results of the PBs science and adapt their strategies to contribute to a more sustainable development.

Theoretical framework

Complex adaptive systems framework and leverage points

The complex adaptive systems (CAS) framework has been inspiring my work. The study of CASs can be found in a range of disciplines such as ecosystems, the biosphere, economics, organisms, or brains (see e.g., Holland 1995; Levin 1998; Arthur 2021). Levin 1998 suggested that the definition of a CAS can be based on just a few essential elements; 1) diversity and individuality of components, 2) localized interactions between these components, 3) an autonomous process based on the results of the interactions that selects from the components (with natural selection as an example of an autonomous process).

Social-ecological systems, i.e. systems linking people and nature, are increasingly understood as complex adaptive systems (Levin et al. 2013). Companies are embedded in complex adaptive social-ecological systems and can be analysed from a CAS perspective (see e.g., Dooley 1997; Roome 2012; van de Wetering, Mikalef, and Helms 2017).

One CAS approach for a better understanding of the dynamics in the interface between organizational behaviour and sustainability is the 'Stages of corporate responsibility/sustainability' models. Early 'Stages of CSR' models build on the definition of Corporate Social Responsibility, i.e., that companies can do more with regards to social and environmental responsibility than is required by the law and that they can have competitive advantages in doing do so. All companies must follow the law and therefore they must do better than that baseline to gain advantages compared to other companies. The main stages suggested by Mirvis and Googins (2006) are: 1. Elementary, 2. Engaged, 3. Innovative, 4. Integrated, 5. Transforming.

A more recent work by Landrum (2018) with the aim of integrating 18 micro/ organizational level 'stages' models and 4 macro/societal level sustainability models (that where ranging from very weak to very strong approaches to sustainability), found that only two of the 18 micro models investigated had a stage beyond week sustainability (for two exceptions see e.g., Roome and Cahill 2004, Roome et al.

2012, and Senge et al., 2008). The reason for this was that the micro models were based on empirical studies. Landrum also found a need for an intermediate stage for micro models between weak and strong sustainability to cover the highest stage in (most) micro models that have a focus on transformation/systems change.

The five stages in her integrated model are: 1. Compliance 2. Business-centered 3. Systemic 4. Regererative 5. Coevolutionary. These stages are corresponding to the sustainability spectrum of 1. Very weak 2. Weak 3. Intermediate 4. Strong 5. Very strong sustainability. Her model does not include the nonparticipatory stage (noncompliance/defensive/dismissing /rejection/denier). Neither are companies with an initial purpose of contributing to sustainable development ('Born sustainable' with my own vocabulary) mentioned in her model although they might be categorized as regenerative or even coevolutionary.

Many natural systems are self-organizing, but in social-ecological systems such as the market economy, humans can intervene to induce change. Places where a small change in a system could lead to a large shift in behaviour are called leverage points. See e.g., Horcea-Milcu (2022) for a recent article about values as leverage points for sustainability transformation.

However, leverage points are different in terms of effectiveness and therefore it is important to understand how the system works and its fundamental paradigm (Meadows, 2008). Meadows argues that the goals/purpose of the system and the paradigm/mindset in particular, are the most effective places to intervene - except for transcending paradigms altogether.

> *"Paradigms are the sources of systems. From them, from shared social agreements about the nature of reality, come systems goals and information flows, feedbacks, stocks, flows, and everything else about systems"* (Meadows, 2008 p. 163).

A dynamic and systemic understanding of human behaviour

According to Schill and colleagues (Schill et al. 2019) endogenizing human behaviour within CAS requires recognizing human behaviour and its contexts as ever evolving and influencing each other, which in turn create new contexts such as social networks, norms and rules, culture, technologies, and ecologies.

The biosphere connection is very close and direct for some people while more remote and less direct for others (Schill et al. 2019). Regardless of this, all humans are dependent on the biosphere (Folke et al. 2016). The attempts to set science-based targets for climate and nature can be regarded as a way for societies, organizations, and ultimately individuals to reconnect to nature by considering their impact on natural processes and ecosystems (Folke et al. 2011).

An assumption of my study is that setting science-based targets for environmental issues is to some extent related to the cultural context and dominant values in societies and organizations. In a review of experimental results about human psychology Henrich, Heine, and Norenzayan (2010) found that the samples drawn entirely from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) societies, and mostly from American college students, are among the least representative populations for generalizing about humans. Many of the findings based on WEIRDs are associated with fundamental aspects of psychology, motivation, and behaviour. However, they argue that there are other domains where the guiding assumption is variation among populations such as personal values, levels of happiness and personality traits. The first domain of personal values is of particular interest for my study.

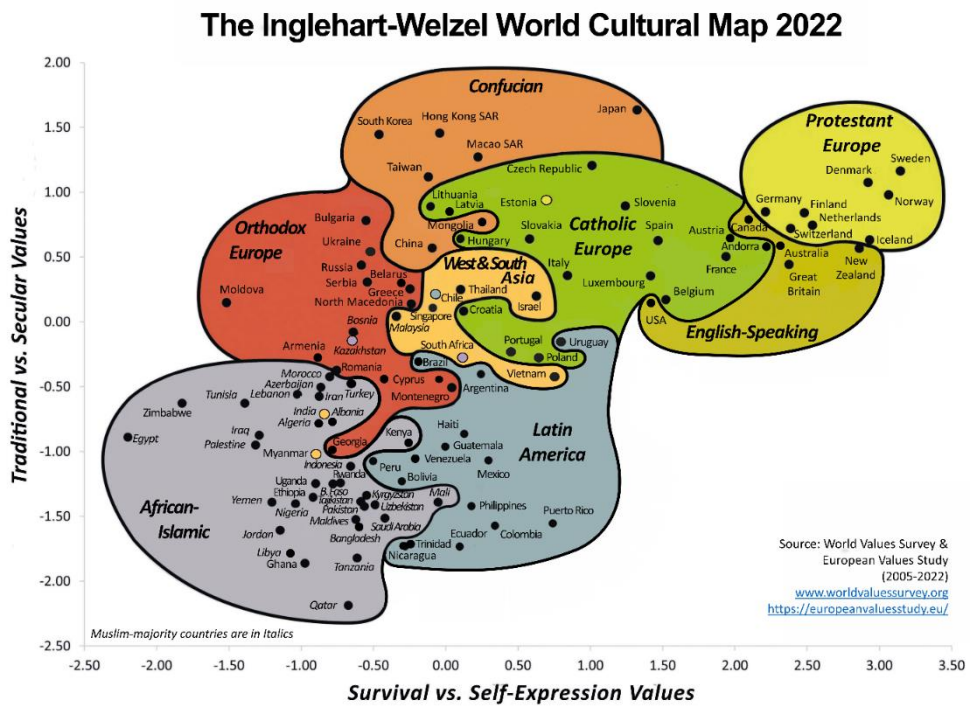
Culture and personal values dimensions

Hofstede and Inglehart are two of the world's most frequently quoted social scientists (see e.g., Beugelsdijk and Welzel 2018 for a synthesis of Hofstede and Ingleharts dimensions and dynamics of national culture). Their respective bodies of work based on value dimensions or value orientations began with empirical research (see

Appendix 1. for an overview of these strands of work). In contrast, Schwartz (2006) began with theory and his approach differs from those of Hofstede and Inglehart in the sense that his value orientations are related to each other in an integrated system. Basáñez (2016) argues that all cultures can be described as a mix of three hyper cultures – Honour, Achievement and Joy - related to pre-industrial, industrial, and post-industrial stages of development respectively.

A very short summary of the main findings of this body of values research by Hofstede and colleagues, Inglehart and colleagues, Schwartz and Basáñez, is that cultural differences can be explained by socio-economic development and generational effects, in addition to initial geographic and historical conditions (see also Beugelsdijk and Welzel 2018). These strands of work are summed up in Appendix 1 with an explanation to the Inglehart-Welzel World Cultural Map in Figure 2 below.

Figure 2. The Inglehart-Welzel Cultural Map 2022



Inglehart-Welzel World Cultural Map - World Values Survey (2022).
https://www.worldvaluessurvey.org

Case study description

Sweden's position on the value dimensions

Sweden is situated in one end on most of the values dimensions (see the table in Appendix 1. for an overview of the dimensions) and often at the very end point of those. For example, in the Inglehart-Welzel World Cultural Map 2022 (Figure 2 above) Sweden can be found in the upper right-hand corner. According to the research about value dimensions (see Appendix 1 for more details) the average Swedish person has values that can be summarized as:

- High in Self-expression/Individualism/Autonomy and Trust values (and low in the opposites)
- Low in Power Distance/Obedience/Hierarchy/Traditional values (and high in the opposites)
- Low in Masculinity values, and Survival values (and high in the opposites).

The high emphasis on Self-expression, including postmaterialist values, and the low rank on Masculinity values (see Appendix 1 for details about the environment and the values dimensions) would indicate that the average Swedish person has a relatively strong concern for the environment, and sustainability more broadly, that is supported by for example 'Sverigestudien' (Feuk & Zätterström 2022). With continued socio-economic development and associated generational values change, this might increase even more in the future.

To sum up Sweden is not a typical country with regards to human values. On the contrary it is more of an extreme case at the frontier of global values change. As such, it can provide an indication how values might change in other countries as well – at least the overall direction. However, it should be noted that these changes can take different paths and be reversed with prolonged socio-economic development setbacks. In addition, Sweden is not unique in the sense that countries with similar background and level of socio-economic development, such as the Nordic countries, The

Netherlands, Switzerland, Austria, Canada, and New Zeeland, have similar value orientations as Sweden.

Therefore, Sweden serves as a suitable context for a case study of companies and their future strategies with regards to environmental protection and setting science-based targets for environmental impacts.

Sample of companies and interviewees for the empirical study

The main criteria for including an interviewee were that 1) the interviewee should be a sustainability professional in a leading position in a Swedish company; 2) the interviewee should have known about the PBs for several years; and 3) their company should have made use the PBs for their sustainability and corporate strategies at least to some extent.

I wanted to interview the same people as in my previous study for two reasons. Firstly, I already knew that the people I previously interviewed, that were in roles such as head of sustainability, senior sustainability expert, and head of circular economy, have been aware of the PBs for several years (in general five to ten years). Secondly, using the same sample would enable me to make comparisons between the previous and the new study.

People in four out of eight companies in the previous study agreed to participate in the new study: namely White Arkitekter, IKEA/Ingka, Filippa K, and Saltå Kvarn. One more company, Ragn-Sells, was included via an interviewee from the previous study that had changed jobs. As my minimum sample was eight companies, I needed three more companies. I found these three, Houdini, H&M and COOP, via researchers at the SRC. These companies had been involved in PBs related research projects with the SRC, the interviewees were aware of the PBs and had been so for several years. Thus, they did fit with the requirements for the sample.

The interviewees in the final sample were senior sustainability professionals, mostly heads of sustainability within those companies. All interviewees except one English

speaking person were Swedish, and five were women and three men. Two companies in the sample were business to business brands (marked B2B in Table 1 below), the rest were business to consumer (B2B) brands. See Table 1. For an overview of the sample of companies and interviewees!

Table 1. Overview of the companies and interviewees included in the study.

Company	**Industry**	**Employees****	**Interviewee**
Saltå Kvarn*	Organic food brand	40-50	Head of sustainability & Communications
Houdini Sportswear	Outdoor sportswear brand	40-50	Sustainability coordinator
Filippa K*	Fashion brand	100-200	Head of sustainability
White Arkitekter*	Architectural (services) B2B	>700	Director of sustainability*
Ragn-Sells Recycling	Waste management B2B	2300	Head of sustainability*
COOP Sverige	Food retail	22 000 (2022)	Head of sustainability
H&M Group	Fashion retail	155 000	Sustainability business expert
IKEA/Ingka Group*	Furniture retail	166 000 (Financial Year 2021)	Head of circular economy*
* in previous study sample		**Latest report available April -22	

The companies in the sample are different in many ways but can be grouped in four categories:

1. IKEA (own group due to large and special case, IKEA is a 'universe' of its own)
2. HM, Houdini, Filippa K (fashion and outdoor clothes, same industry but not close competitors)

3. COOP and Saltå Kvarn (food sector, one retail and one food brand, they have a customer and supplier relationship)
4. White Arkitekter and Ragn-Sells (are providing services to other organizations in both private and public sectors, i.e., B2B).

As highlighted above, a prerequisite for including a company in the sample was that at least one person in a senior sustainability position had been aware of the PBs framework for several years. The fact that they had this awareness early on and made use of the knowledge in their companies is an indication that these people and their employers can be regarded as sustainability frontrunners. Thus, the sample is not a representative sample of Swedish companies in general.

Sustainability Frontrunners

The notion that the companies in my sample are sustainability frontrunners is supported by the fact that, according to the Sustainable Brand Index 2022 (SBI) (SBI 2022), three out of the six business to consumer companies (B2C) are ranked as number one, two and fourteen by Swedish consumers in the 2022 SBI ranking. However, how consumers perceive a brand is also influenced by how sustainable they perceive the industry. For example, the Clothes & Fashion Brands and Stores industry categories are ranked quite low in the Sustainable Brand Index Industry ranking (sb-index.com/sweden). Consequently, the fashion companies in my sample are ranked quite low in the SBI.

Business to business companies (B2B) are often less well known overall compared to B2C companies. Despite this, one of the B2B companies in my sample is ranked as number eighteen in the 2022 Swedish B2B ranking (sb-index.com/sweden) which can be regarded as quite high. The other B2B company belongs to an industry that is not included in the SBI at all. In addition, both heads of sustainability in the B2B companies are prominent figures in the Swedish sustainability community, which can also be an indicator of their companies' frontrunner position.

Methods

The method was mostly qualitative as the data I collected came primarily from interviews with sustainability professionals, in addition to documents such as sustainability reports.

Data collection

The documents I used were primarily the companies' most recent sustainability reports (see Appendix 2 for a list of documents).

Interview guide

For the interviews I used an interview guide in Swedish and English. It was semi-structured and increasingly more open towards the end of the interview to allow the interviewees to speak as freely as possible.

I tested both language versions of the interview guide with researchers at the SRC and made some improvements of it primarily to make the last few questions more focused on my research question. Then I did two more pilot interviews, one with another researcher at the SRC and one with a practitioner that was interviewed in my previous study but did not fit the requirements for the new sample. This made me confident that the interview guide worked well.

The interview guide consisted of the following components (see Appendix 3 for the complete interview guide in English):

1. Background information about the interview person.
2. Awareness of scientific developments of the PBs framework, operationalization, and business applications, and if they knew about companies that have used the PBs in practice.
3. Background facts about their company's process of sustainability and corporate strategies, use of frameworks, how they are setting goals and targets for sustainability issues and time horizons for those.

4. The relevance of the different PBs for their company.
5. If the awareness of the 'planetary boundaries' or 'limits of the planet' of the Agenda 2030 had had any impact on corporate strategies.
6. How they set goals and targets for environmental issues more specifically.
7. Motivations for setting science-based targets for environmental issues – with suggested motivations listed in the guideline. The open form of the question allowed for other motivations than the ones suggested in the guide.
8. If the drivers for setting science-based targets are mostly external or mostly internal.
9. If there are specific values or beliefs that they think can explain their company's approach to sustainability.
10. Final open wrap up question.

I distinguished in the interview guide and during the actual interview between setting science-based targets more generally and following the guidelines of the Science-Based Targets Initiative and Science-Based Targets Network. In the Swedish interview guide I made this distinction by using the Swedish expression '*vetenskapligt baserade mål och delmål*' to indicate the more general notion and the English expressions 'Science-Based Targets for Climate' (SBTi) and 'Science-Base Targets for Nature' (SBTN) to indicate when I meant exactly those initiatives. In the English interview I made this distinction explicit as well.

The interview process

Potential interviewees were contacted via mail and/or phone in the beginning of 2022 to ask if they could participate in the study. The first quarter of 2022 was not the best for this kind of request, since in addition to the work with sustainability reports that occupies many sustainability professionals this time of the year, they had worked for almost two years under Covid 19 pandemic restrictions. In addition to that the war in Ukraine broke out in February 2022.

The people that did not agree to participate seemed to decline primarily due to lack of time. The people in the companies that came via SRC contacts seemed to agree to participate due to extra interest in keeping a good relationship with the SRC.
All interviewees were very busy, and I had to reschedule some of the meetings. They participated despite time pressure, and I got the impression they did so because they wanted to support scientific work, had an interest in the topic and were curious of the results of my study.

Before conducting the interviews, I studied the company's sustainability work by reading their most recent sustainability report and other documents posted on their webpage. This allowed me to prepare for the interview, to think about follow up questions that I might want to pose and prepare me for how to interpret answers. The interviewees got the interview guide with the consent form in the week before the interview. This gave the opportunity to have look at the questions and think about how to answer them. Most did not seem to have done so – again due to lack of time.

Five interviews were conducted on Zoom and three in person. The interviews took between 30 and 90 minutes with an average of 55 minutes. Missing information was added afterwards by phone or e-mail. The interviews were recorded on my computer or phone and transcribed on MAXQDA. Seven interviews were conducted in Swedish and translated into English, one interview was conducted in English. The interviews were conducted in February-April 2022.

Data analysis

The results were compiled question by question and summarized. I analysed the answers to the background questions with the 'Stages of corporate sustainability framework' in mind to understand at which stage the companies seemed to be at and to see if they had experienced a progression over time or not.

For my key question about motivations for setting science-based targets question (question 7) I conducted a first analysis of the answers to get an overview and found

that I could distinguish the motivations according to importance based on how the interviewees answered.

Then I coded the importance of the motivations as follows; 0 = not important/no comment, 1=important/yes, 2= very important/hugely/absolutely/precisely, 3=most important. In most cases the interviewees used these exact words while commenting the list of motivations.

However, if they did not use these words but instead tone of voice to indicate importance, I made an interpretation of that to set the code as 0-3. The total score for each motivation is made up of the total number, i.e., a high score is an indication that either many that said that motivation was important, a few that said it was very important or both.

The background questions were useful for the interpretation of answers during the interviews and in the analysis. Summaries of answers to the background questions about the interviewees background, awareness of developments of the PBs science since 2015 and how the companies are developing sustainability and corporate strategies, and frameworks for setting goals and targets the companies are using are provided for in the Appendix 4.

Results

A summary of the interview results regarding how companies are setting goals and targets for environmental impacts are provided for in Appendix 4. The reader is advised to have a look at the appendix for a background to the section below about motivations.

Motivations for setting science-based targets for environmental impacts

Most of the interviewees mentioned several of the motivations for setting science-based targets (SBTs) for environmental impacts that were suggested in the interview guide (see question 7 in the interview guide) as important. The interviewees mentioned at least six of the suggested motivations and up to as much as 17 out of 18 as at least somewhat important. However, some motivations seemed more important than others. The ranking (see methods section for how the ranking was done) gave me some order of importance of motivations and the results are summed up in order of importance in Table 2 from high to low with exemplary quotes in the text below the table.

Table 2. Motivations for setting science-based targets for environmental impacts.

	Score
Motive related to the company's identity, brand, core values etc.	13
Expectations from stakeholders (consumers, employees…)	10
To focus on actions and follow up on them	10
To be strategic, focus on what is important (prioritize)	10
To be a leader in this field	10
Trustworthiness of our strategies (credibility)	9
Ethical considerations (the right thing to do because…)	8
Owner's requirements or priorities	6
New legislation, regulation, standards (or anticipation of that)	6
Changing values in society	6
Contribute to developing standards or best practice in business	6
Top management priorities or interests	5
Follow 'best practice' in business/our industry	5
Avoid accusation of 'greenwashing or cherry picking'	5
Innovation, creativity, employee engagement (goals are good for…)	4
Customer's requirements/to get the business	3
Profit motives (short or long term)	2
Others are doing it (e.g., competitors, customers/clients)	2

In the following section the motivations are commented and highlighted with quotes from the interviewees.

'Motive related to the company's identity, brand, core values etc.' came out in very top of all motivations on the list. It was mentioned by all interviewees but with varying importance:

> *"Here it is! Motivations related to the identity, brand, core values. That one! That is the one!"*
>
> *"(Our company) has very strong values and I would say that 'science-based targets' is a part of the identity."*

'To be a leader in this field', 'Expectations from stakeholders (consumers, employees…)', 'To be strategic, focus on what is important (prioritize)' and 'To focus on actions and follow up on them' all came out as second most important motivations:

> *"We want to be in the forefront, and we are (…) holding such a position, (…), we are at the forefront, before the competitors. That is what they are saying to us even (…). So that is an important reason why we are doing this." (edited)*

Which stakeholder group that is seen most important differs between respondents. Many emphasize employees as the most important group, while a few mention consumers or customers as most important.

'To be strategic, focus on what is important' is crucial for companies that want to take the lead and 'To focus on actions and follow them up' is connected to that to make sure to follow through.

> *"To focus on what is important. Science will help with that instead of, as mentioned, striving in different directions, so that you can work towards what is (a common goal)."*

The motives above are supported by the motivation about 'Trustworthiness of our strategies (credibility)'.

> *"That it should be science-based that is also our size, we have to have it or else we lose credibility, credibility for our strategies that is super important!"*

This also goes for 'Ethical considerations and doing the right thing'.

> *"(…) and altogether without taking stand if this is financially good (…). It will be if we follow it (science) because we survive. (…) I think it is self-evident."*

It should be added to the above that some interviewees think of social sustainability or business ethics when they comment ethical considerations.

'The owner's requirements or priorities' is mentioned as very important only by one interviewee. 'New legislation, regulation, standards (or anticipation of that)' is a motivation but not a very strong one. Moreover, interviewees discuss the importance of pushing for more stringent legislation as a way of driving change in the right direction. 'Changing values in society' is mentioned by many of the interviewees and related to 'Expectations from stakeholders'. To 'Contribute to developing standards or best practice in business' is important to many of the interviewees, but only very important to one of them.

'Top management priorities or interests' seems to be important in half of the companies but is not emphasised as very important except in one case. The direction can also differ. In most cases the top management is actively pushing for science-based targets, but it can also be a way to engage top management. 'Follow best practice in business/our industry' is less important, except for the B2B companies. 'Avoid accusation of greenwashing or cherry picking' is mentioned but less so than for example 'Trustworthiness and credibility'.

'Innovation, creativity, employee engagement (ambitious goals are good for…)' was mentioned by one respondent only.

'Customer's requirements/to get the business' is relevant for companies selling to other companies and quite important for one interviewee (a supplier to a large company) but some interviewees also mention that they need to push customers and

that not all customers care about science-based targets (or even sustainability more broadly).

'Profit motives (short or long term)' is mentioned as important only by two interviewees and one of them added that it is important long-term.

'Others are doing it (e.g., competitors, customers/clients)' is mentioned only by two interviewees and comes out in the bottom of all the suggested motivations. However, in particular B2B companies keep track of the competitors.

In addition to the suggested motivations, the interviewees made some spontaneous or final comments to this question. They mentioned here that setting science-based targets for environmental issues can help with several aspects of sustainability work in their companies. First, focusing the corporate strategy on the greatest challenges/risks and opportunities for the company to contribute to sustainability such as circular innovations. Second, facilitating communication and collaborating with other actors in the value chain such as customers and suppliers. Third, as SBTs are well worked out and thought through in a scientific process, companies can take them as a given and start focusing on solving environmental problems and turn these into business opportunities. Fourth, it helps to have a common goal in society that has substance and provides a clear picture that people and organizations can move towards. Fifth, to be able to lead change in the 'fast fashion' industry that is increasingly challenged as being unsustainable and to ensure a 'license to operate' for fashion companies.

To the question about external or internal drivers a majority of the interviewees answered that the drivers for setting science-based goals and targets are mostly internal, the rest that is it both internal and external. There is a tendency to relate external drivers to larger companies that might have higher expectations from the outside and more resources to commit to the SBTi, whereas smaller companies can use the methodology without a formal commitment to the SBTi.

Values related to sustainability

In the answers to the question if there are some specific values of beliefs that the interviewees think can explain their company's approach to sustainability, three themes emerged.

First, the interviewees make a connection to the owners. However, the ownership form can vary (partnership, entrepreneurial/family ownership, cooperative, listed on the stock market, privately held) so this is more related to the founders or owners' values. These are related to the purpose of the company and the brand name. Note that four of the companies' brand names relate directly to the founder's name; Filippa K, White Arkitekter, Ragn-Sells and IKEA. The latter is made up of the initials of the founder and his birthplace. The brand name of Saltå Kvarn (Saltå Mill in English) is related to the place or origin and the product (grain-based food). COOP is a consumer cooperative founded over one hundred years ago based on the cooperative idea.

Second, values of other stakeholders than owners, primarily employees and to some extent customers/consumers are important. It is important for the employees to be proud of their company and engaged in the sustainability work. Third, longevity, that sustainability has been a part of company values in some way or another since the inception/for a very long time and that it is 'in the DNA'.

> *"Oh, that is not an easy question… I think it has been part of the company values and culture for a very long time. … From the beginning really, when they began writing down different things what the corporate culture should stand for…and explains that we have been active for so long in this issue. Without those values that we have in the company it would have been hard of course to push for the issue. So, I think it begins there somewhere. They decided once upon a time that it is important with the social issues and the planet."*

> "*Many have worked at (the company) for a long time and share, very, very much the value of sustainability. Sustainability is core to our owners, the management team, and employees."*

The companies in the fashion industry seem to be struggling with 'fashion' as a concept that can be seen as the opposite of 'sustainability' and that fashion is perceived as problematic by many.

> *"Yes, we talk a lot about 'Mindful consumption'. The responsible conception and creation of like a 'limited wardrobe'. Timeless, classic garments, that can be kept in use and that we, as a brand, stand to help you to repair and to take back (garments) at end of life. Garments that have multiple lives."*
>
> *"It is such an incredibly important part of our company culture. (…) What do we think is important for us to be able to continue to do what we are doing? So, it is an incredibly strong identity for us and our colleagues and an expectation (...) Now we have come to the next step where we can drive the development forwards and make sure our whole industry goes in the right direction."*

To follow up questions about fashion, the interviewees agreed that the concept of 'fast fashion' is problematic, and that people that are not aware of the sustainability work that the companies are doing might only see fast fashion as "just pouring out new clothes".

Discussion

Motivations for frontrunner companies to set science-based targets

The motivations that came out in the top of the ranking are very much a reflection of the sample in the sense that these companies are, want to be and want to be seen as sustainability frontrunners in line with the literature about drivers and motivations for setting science-based targets for climate (Bolton and Kacperczyk 2021; Freiberg, Grewal, and Serafeim 2021; Giesekam et al. 2021).

The motivation related to the company's 'identity, brand, core values', and 'expectations from stakeholders' such as consumers and employees can in this regard be seen as two sides of the same coin. The first is related to the 'inside' of the company while the second is related to the 'outside' perception of the company. Employees can be regarded as in the middle ground. For example, potential employees are on the outside, while current employees are on the inside and can become ambassadors of the company's sustainability work (or cynics if they perceive the outside picture that the company is portraying do not fit with the inside reality).

Similarly, to be a leader, to be strategic and focus on what is important (i.e., to prioritize), to focus on actions and follow them up, and trustworthiness of strategies (i.e., credibility) are also highly related to each other, in addition to ethical considerations (i.e., to do the right thing).

In the other end and less important, are more defensive motivations such as that 'others are doing it', to 'avoid greenwashing or cheery picking', to 'get the business' or 'profit motives'.

That 'innovation, creativity, and ambitious goals might be good for employee engagement' came out relatively low is however, somewhat intriguing considering that this will be required to enable new solutions to make the transformation to a more sustainable development within the PBs. Such solutions that were mentioned by the interviewees were often discussed in terms of circular solutions and new business models.

As somewhat important came motivations related to a higher authority; either internal to the company such as owner's requirements, top management priorities or interests, or more external such as new legislation/regulation/standards, 'best practice' in their industry and changing values in society. The two latter might over time be drivers of new legislation.

How to build more sustainable brands

The companies can also be compared with respect to how advanced they are in terms of sustainability and what stage of CSR/corporate sustainability they are at.

The large retailers have leverage in changing their sectors as they have many suppliers and large consumer base. They are at different levels of integrating sustainability, but all say they want to transform their industry.

The service providers have sustainability as part of their business offer and an interest in promoting sustainable solutions as this is a business opportunity.

Among the clothes and fashion companies it can be interesting to compare their 'sustainability pathways' and how they approach the paradox of fashion and sustainability in particular with regards to their price positioning.

The small companies can be regarded as either 'born sustainable' or being at a very high stage of transforming to sustainability. However, with ambitions to grow this might come with challenges how the handle the transition from 'alternative' to 'mainstream' and to protect the brand as there might be risks of watering out the brand in the process.

The impact of culture and personal values

Learning of the respondent's background was helpful when interpreting their answers. For example, interviewees with many years in the company had a more in-depth knowledge about the history of the company, corporate strategy, and sustainability

work. However, interviewees that had joined the company more recently could answer questions about company culture more easily by comparing their experience with previous employers, while interviewees that had been very long at the same company seemed to have internalized the corporate culture to the extent that they had some difficulties in explaining the relationship with sustainability. It seemed to be just 'too much' to explain in the limited time we had left of the interview.

The connections to values were quite clear as suggested by the two most important motivations of 'identity, brand, and core values' and 'expectations from stakeholders'. Expectations from stakeholders is connected to changing values in society. In a few cases, sustainability has been a part of the companies' core values from the very beginning, albeit not always labelled as such, or in most cases for a very long time and is considered as a 'part of the DNA'.

Ability to set science-based targets

A starting point for setting science-based targets is the ability to do so. Here two factors are relevant; the availability of overarching targets, or 'overall targets' as mentioned in the sections about how science-based targets can be defined and 'specific' targets, for example sector targets, and the ability of the target setting company that is related to their resources and knowledge. Large companies often have the resources and knowledge to use standards or join initiatives such as the SBTi. However, highly motivated small companies have showed that it is possible also with less resources, by for example by collaborating with research institutions.

The Stockholm Resilience Centre as a knowledge hub

Researchers at the Stockholm Resilience Centre (SRC), affiliated with the Stockholm University, has been deeply involved with the development of the PBs framework and engaged in raising the awareness of the framework and its implications amongst people within the sustainability community in Sweden, and Stockholm in particular. People from the business sector (such as myself) have also attended courses at the SRC to learn more about social-ecological systems and social-ecological resilience. Others have engaged with the SRC via research projects about the PBs for companies.

The geographical location of the SRC and physical proximity to many headquarters of Swedish companies can be regarded as one factor contributing to the spread of ideas and frameworks such as the PBs in the local and national sustainability community. Six out of eight companies in my sample have their headquarters based in Stockholm, one of these is based in the proximity of Stockholm, and one of the other two has a large office in Stockholm although the head office is in Gothenburg. One company has their head office in Malmö.

Implications for researchers and decision makers

As mentioned above, knowledge is an important factor for companies' ability to set science-based targets. However, it is quite a challenge to sort out the overlapping frameworks of the PBs, Agenda 2030 SGDs and Science-Based targets initiative for Climate and Science-Based targets for Nature from a practitioner's point of view. Here scholars might help by summing up the research frontier of the PBs including applications, how the SDGs are compatible with the latest science or not, and how the SBTs for Climate and Nature overlap with the PBs in, for example, a synthesis report for business.

Pictures and graphics are important to capture the basic ideas of sustainability frameworks. They are also a way to synthesise large amounts of information in a comprehensible way. It is telling how important the PBs picture (Figure 1.), the Doughnut (Raworth 2018) and the SDGs visuals have had been for spreading the main messages for these ideas. The SRC 'cake' (SRC 'Wedding cake' 2016) that show nature as a foundation for social and economic SDGs might be correct from a conceptual point of view, but does it show the reality of a "big world on a small planet" (Rockström and Klum 2015)?

Governments can pave the way for new legislation about science-based targets in sustainability reporting by supporting voluntary science-based target setting in many ways. For example, the Swedish government required that the state-owned companies should publish sustainability reports ten years before they enacted legislation about

sustainability reporting in 2017 (Finansinspektionen). They might do the same with science-based targets.

Finally, on a grander scale it seems relevant to compare the failure of the market economy with the failure of the communist command economies. The top-down planned economies were often ridiculed as producing the wrong quantities of products due to lack of the price mechanism. However, it seems clear that the current market economy is not including the cost of climate change driving emissions to about twice the climate change that is good for us (see e.g., Martin et al. 2021; IPCC Special Report 2018 on Global Warming of 1,5°C SPM, and the IPCC Synthesis report for AR6, due in March 2023) or the cost of the unprecedented loss of biodiversity (Bongaarts 2019). On the other hand, it was estimated already in the 1990's that nature provided ecosystem services for free to humanity to a value about twice that of the world economy (Costanza et al. 1997).

Hence, the market economy seems to be only half right and in need of fundamental reform. With the effort to set science-based targets for climate and nature and to provide data about progress companies might, in the long run, contribute with the development of an additional information system to the financial reporting based on market prices, to guide human decision making and behaviour.

Positionality of the researcher

I am an experienced business practitioner and a strategy and sustainability consultant in Sweden. My educational background is a bachelor's in economics and management (international business and market strategy concentration), and a more recent master's in international relations (with European studies and international economics/finance concentration). I have lived and worked or studied abroad for over six years in at least seven countries (in Europe, the U.S.A and Singapore). These experiences helped in some of the aspects of the research project. However, I sometimes felt that I have a lot of tacit knowledge that is difficult to express, or that I might not have explained here in detail because I took for granted that it is common knowledge.

Conclusions

The aim of this study was to find out if, how and in particular why, companies are setting science-based goals and targets related to the Planetary boundaries framework (PBs), the Science-Based Target initiative (SBTi) and the Science-Based Targets Network (SBTN) guidelines, or science-based targets more broadly, for environmental impacts. A sub-question was what role culture, in particular values of people and companies, might play for that. A sample of eight sustainability frontrunner companies in Sweden with awareness of the PBs framework were investigated with a predominately qualitative method.

The results showed that the companies have several motivations for setting science-based targets, mostly related to the fact that they are, want to be and want to be seen as leaders in tackling sustainability issues and that science-based targets can contribute to that. The most important motives were related to the company's identity, brand and core values, expectations from stakeholders, to be strategic and focus on what is important, to focus on actions and follow them up, trustworthiness/credibility and ethical considerations.

The connection to values was quite clear as suggested by the two most important motivations of 'identity, brand, and core values' and 'expectations from stakeholders'. The most important stakeholder groups in this regard are employees, consumers, and owners in that order. Expectations from stakeholders is connected to changing values in society. In a few cases, sustainability has been a part of the companies' core values from the very beginning, albeit not always labelled as such, or in most cases for a very long time and is considered as a 'part of the DNA'.

The implications of the results are that frontrunner companies are motivated to set such goals and targets. However, the extent to which they can do that depend on awareness of and access to science-based target guidelines, standards and 'best practice' in business and in their industry.

As more and more companies begin to set science-based targets this can develop into standard practice and eventually these standards can be referred to in sustainability reporting standards and in legislation.

Thanks

I would like to thank my main supervisor, Caroline Schill, for her enduring support during the whole process and my co-supervisor, Tiina Häyhä, for guidance and feedback along the way. I also thank my expert reviewer Lisen Schultz for valuable feedback on the written thesis and oral presentation.

Finally, I would like to thank my company interviewees for taking their time to talk with me. I could not have completed this work without their cooperation.

Contact: Ylva Skoogh ylva.skoogh@integrate.se, +46-70-788 09 30.

References

Adamsson, Hampus, Andreas G F Hoepner, Pei-Shan Yu, Alexander Bassen, Timo Busch, Jesse Dillard, Donald Macdonald, Pelle Pedersen, and Hideki Suzuki. n.d. "Science Based Targets without Science Based Disclosure? Towards a Complete Carbon Data Science."

Andersen, Inger, Naoko Ishii, Thomas Brooks, Cynthia Cummis, Gustavo Fonseca, Astrid Hillers, Nicholas Macfarlane, et al. 2021. "SCIENCE POLICY Special Topic: Ecological Civilization-Insights into Humans and Nature Defining 'Science-Based Targets.'" *Natl Sci Rev* 8: 186. https://academic.oup.com/nsr/article/8/7/nwaa186/5896966.

Arthur, W. Brian. 2021. "Foundations of Complexity Economics." *Nature Reviews Physics*. Nature Publishing Group. https://doi.org/10.1038/s42254-020-00273-3.

Basáñez, M. 2016. *A world of three cultures: honor, achievement and joy*. Oxford University Press.

Beugelsdijk, Sjoerd, and Chris Welzel. 2018. "Dimensions and Dynamics of National Culture: Synthesizing Hofstede With Inglehart." *Journal of Cross-Cultural Psychology* 49 (10): 1469–1505. https://doi.org/10.1177/0022022118798505.

Bjørn, Anders, Niki Bey, Susse Georg, Inge Røpke, and Michael Zwicky Hauschild. 2017. "Is Earth Recognized as a Finite System in Corporate Responsibility Reporting?" *Journal of Cleaner Production* 163 (October): 106–17. https://doi.org/10.1016/j.jclepro.2015.12.095.

Bolton, Patrick, and Marcin T. Kacperczyk. 2021. "Firm Commitments." *SSRN Electronic Journal*, June. https://doi.org/10.2139/ssrn.3840813.

Bongaarts, John. 2019. "IPBES, 2019. Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." *Population and Development Review* 45 (3): 680–81. https://doi.org/10.1111/padr.12283.

Bringezu, Stefan. 2019. "Toward Science-Based and Knowledge-Based Targets for Global Sustainable Resource Use." *Resources* 8 (3). https://doi.org/10.3390/resources8030140.

Clift, Roland, Sarah Sim, Henry King, Jonathan L. Chenoweth, Ian Christie, Julie Clavreul, Carina Mueller, et al. 2017. "The Challenges of Applying Planetary Boundaries as a Basis for Strategic Decision-Making in Companies with Global Supply Chains." *Sustainability (Switzerland)* 9 (2): 1–23. https://doi.org/10.3390/su9020279.

Costanza, Robert, Ralph D'Arge, Rudolf De Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, et al. 1997. "The Value of the World's Ecosystem Services and Natural Capital." *Nature* 387 (6630): 253–60. https://doi.org/10.1038/387253a0.

Crutzen, Paul J, and Eugene F Stoermer. 2021. "The ' Anthropocene ' (2000)," no. 2000: 19–21. https://doi.org/10.1007/978-3-030-82202-6.

Desing, Harald, Dunia Brunner, Fabian Takacs, Stéphane Nahrath, Karolin Frankenberger, and Roland Hischier. 2020. "A Circular Economy within the Planetary Boundaries: Towards a Resource-Based, Systemic Approach." *Resources, Conservation and Recycling* 155 (October 2019): 104673. https://doi.org/10.1016/j.resconrec.2019.104673.

Dooley, Kevin J. 1997. "A Complex Adaptive Systems Model of Organization Change." *Nonlinear Dynamics, Psychology, and Life Sciences* 1 (1): 69–97. https://doi.org/10.1023/A:1022375910940.

Feuk Christine and Zätterström, Sandra. 2022. "Sverigestudien 2022-Vem Tar Ansvar För Att Samhället Fungerar."

Folke, Carl, Reinette Biggs, Albert V Norström, Belinda Reyers, and Johan Rockström. 2016. "Social-Ecological Resilience and Biosphere-Based Sustainability Science." https://doi.org/10.5751/ES-08748-210341.

Folke, Carl, Åsa Jansson, Johan Rockström, Per Olsson, Stephen R. Carpenter, F. Stuart Chapin, Anne Sophie Crépin, et al. 2011. "Reconnecting to the Biosphere." In *Ambio*, 40:719–38. Springer. https://doi.org/10.1007/s13280-011-0184-y.

Folke, Carl, Henrik Österblom, Jean Baptiste Jouffray, Eric F. Lambin, W. Neil Adger, Marten Scheffer, Beatrice I. Crona, et al. 2019. "Transnational Corporations and the Challenge of Biosphere Stewardship." *Nature Ecology and Evolution* 3 (10): 1396–1403. https://doi.org/10.1038/s41559-019-0978-z.

Freiberg, David, Jyothika Grewal, and George Serafeim. 2021. "Science-Based Carbon Emissions Targets." *SSRN Electronic Journal*, March. https://doi.org/10.2139/ssrn.3804530.

General, Assembly. 2015. "United Nations Transforming Our World: The 2030 Agenda for Sustainable Development." *Division for Sustainable Development Goals: New York, NY, USA*.

Giesekam, Jannik, Jonathan Norman, Alice Garvey, and Sam Betts-Davies. 2021. "Science-Based Targets: On Target?" *Sustainability (Switzerland)* 13 (4): 1–20. https://doi.org/10.3390/su13041657.

Haffar, Merriam, and Cory Searcy. 2018. "Target-Setting for Ecological Resilience: Are Companies Setting Environmental Sustainability Targets in Line with Planetary Thresholds?" *Business Strategy and the Environment* 27 (7): 1079–92. https://doi.org/10.1002/bse.2053.

Häyhä, Tiina, Paul L. Lucas, Detlef P. van Vuuren, Sarah E. Cornell, and Holger Hoff. 2016. "From Planetary Boundaries to National Fair Shares of the Global Safe Operating Space — How Can the Scales Be Bridged?" *Global Environmental Change* 40: 60–72. https://doi.org/10.1016/j.gloenvcha.2016.06.008.

Häyhä, Tina, Sarah E. Cornell, Holger Hoff, Paul Lucas, and Detlef van Vuuren. 2018. "Operationalizing the Concept of a Safe Operating Space at the EU Level – First Steps and Explorations." *Technical Report*, no. July: 76.

Henrich, Joseph, Steven J. Heine, and Ara Norenzayan. 2010. "The Weirdest People in the World?" *Behavioral and Brain Sciences*. Cambridge University Press. https://doi.org/10.1017/S0140525X0999152X.

Hofstede, Geert. 2011. "Dimensionalizing Cultures: The Hofstede Model in Context." *Online Readings in Psychology and Culture* 2 (1): 8. https://doi.org/10.9707/2307-0919.1014.

Hofstede, Geert, and Michael Harris Bond. 1988. "The Confucius Connection: From Cultural Roots to Economic Growth." *Organizational Dynamics* 16 (4): 5–21. https://doi.org/10.1016/0090-2616(88)90009-5.

Hofstede, Geert, and Michael Minkov. 2010. "Long- versus Short-Term Orientation: New Perspectives." *Asia Pacific Business Review* 16 (4): 493–504. https://doi.org/10.1080/13602381003637609.

Horcea-Milcu, Andra Ioana. 2022. "Values as Leverage Points for Sustainability Transformation: Two Pathways for Transformation Research." *Current Opinion in Environmental Sustainability*. Elsevier B.V. https://doi.org/10.1016/j.cosust.2022.101205.

Houdini. 2018. "Planetary Boundaries Assessment." https://houdinisportswear.com/sv-se/sustainability/planetary-boundaries-assessment.

Inglehart, Ronald, and Christian Welzel. 2005. *Modernization, Cultural Change, and Democracy: The Human Development Sequence*. *Modernization, Cultural Change, and Democracy: The Human Development Sequence*. Cambridge University Press. https://doi.org/10.1017/CBO9780511790881.

International Year of Biodiversity. 2010. "National Biodiversity Strategies and Action Plans (NBSAPs)." *Conventioon on Biological Diversity*. https://www.cbd.int/nbsap/.

Kirkman, Bradley L, Kevin B Lowe, and Cristina B Gibson. 2017. "A Retrospective on Culture's Consequences: The 35-Year Journey." *Journal of International Business Studies*. https://doi.org/10.1057/s41267-016-0037-9.

Krabbe, Oskar, Giel Linthorst, Kornelis Blok, Wina Crijns-Graus, Detlef P. Van Vuuren, Niklas Höhne, Pedro Faria, Nate Aden, and Alberto Carrillo Pineda. 2015. "Aligning Corporate Greenhouse-Gas Emissions Targets with Climate Goals." *Nature Climate Change* 5 (12): 1057–60. https://doi.org/10.1038/nclimate2770.

Kuo, Lopin, and Bao Guang Chang. 2021. "Ambitious Corporate Climate Action: Impacts of Science-Based Target and Internal Carbon Pricing on Carbon Management Reputation-Evidence from Japan." *Sustainable Production and Consumption* 27 (July): 1830–40. https://doi.org/10.1016/j.spc.2021.04.025.

Landrum, Nancy E. 2018. "Stages of Corporate Sustainability: Integrating the Strong Sustainability Worldview." *Organization and Environment* 31 (4): 287–313. https://doi.org/10.1177/1086026617717456.

LDN Target Setting | UNCCD. n.d. Accessed November 21, 2022. https://www.unccd.int/land-and-life/land-degradation-neutrality/projects-programmes/ldn-target-setting.

Levin, Simon A. 1998. "Ecosystems and the Biosphere as Complex Adaptive Systems." *Ecosystems* 1 (5): 431–36. https://doi.org/10.1007/s100219900037.

Levin, Simon, Tasos Xepapadeas, Anne Sophie Crépin, Jon Norberg, Aart De Zeeuw, Carl Folke, Terry Hughes, et al. 2013. "Social-Ecological Systems as Complex Adaptive Systems: Modeling and Policy Implications." *Environment and Development Economics* 18 (2): 111–32. https://doi.org/10.1017/S1355770X12000460.

Martin, Maria A., Olga Alcaraz Sendra, Ana Bastos, Nico Bauer, Christoph Bertram, Thorsten Blenckner, Kathryn Bowen, et al. 2021. "Ten New Insights in Climate Science 2021: A Horizon Scan." *Global Sustainability*. Cambridge University Press. https://doi.org/10.1017/sus.2021.25.

Mirvis, Philip, and Bradley Googins. 2006. "Stages of Corporate Citizenship." *IEEE Engineering Management Review* 34 (3): 145–62. https://doi.org/10.1109/EMR.2006.261390.

Nations, United. 2018. "The Paris Agreement | UNFCCC." *United Nations Framework Convention on Climate Change*. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

Naturvårdsverket. 2017. "Environmental Objectives." 2017. https://www.naturvardsverket.se/en/environmental-work/environmental-objectives/.

Österblom, Henrik, Carl Folke, Juan Rocha, Jan Bebbington, Robert Blasiak, Jean Baptiste Jouffray, Elizabeth R. Selig, et al. 2022. "Scientific Mobilization of Keystone Actors for Biosphere Stewardship." *Scientific Reports* 12 (1): 1–17. https://doi.org/10.1038/s41598-022-07023-8.

Österblom, Henrik, Jean Baptiste Jouffray, Carl Folke, and Johan Rockström. 2017. "Emergence of a Global Science–Business Initiative for Ocean Stewardship." *Proceedings of the National Academy of Sciences of the United States of America* 114 (34): 9038–43. https://doi.org/10.1073/pnas.1704453114.

Palm, Celinda, Sarah E. Cornell, and Tiina Häyhä. 2021. "Making Resilient Decisions for Sustainable Circularity of Fashion." *Circular Economy and Sustainability*. https://doi.org/10.1007/s43615-021-00040-1.

Persson, Linn, Bethanie M Carney Almroth, Christopher D Collins, Sarah Cornell, Cynthia A. de Wit, Miriam L Diamond, Peter Fantke, et al. 2022. "Outside the Safe Operating Space of the Planetary Boundary for Novel Entities." *Environmental Science and Technology* 56 (3): 1510–21. https://doi.org/10.1021/acs.est.1c04158.

Piper, Katherine, and James Longhurst. 2021. "Exploring Corporate Engagement with Carbon Management Techniques." *Emerald Open Research* 3: 9. https://doi.org/10.35241/emeraldopenres.14024.1.

Rammelt, Crelis F., Joyeeta Gupta, Diana Liverman, Joeri Scholtens, Daniel Ciobanu, Jesse F. Abrams, Xuemei Bai, et al. 2022. "Impacts of Meeting Minimum Access on Critical Earth Systems amidst the Great Inequality." *Nature Sustainability 2022* 10 (November): 1–10. https://doi.org/10.1038/s41893-022-00995-5.

Rockström, J., W. Steffen, K. Noone, Å. Persson, F. S. Chapin, E. F. Lambin, T. M. Lenton, et al. 2009. "A Safe Operation Space for Humanity." *Nature* 461 (September): 472–75.

Rockström, Johan, Joyeeta Gupta, Timothy M. Lenton, Dahe Qin, Steven J. Lade, Jesse F. Abrams, Lisa Jacobson, et al. 2021. "Identifying a Safe and Just Corridor for People and the Planet." *Earth's Future* 9 (4): 1–7. https://doi.org/10.1029/2020EF001866.

Rockström, Johan, and Mattias Klum. 2015. *Big World, Small Planet: Abundance within Planetary Boundaries*. *Big World, Small Planet: Abundance within Planetary Boundaries*. https://doi.org/10.5860/choice.194600.

Roome, N., and R. Cahill. 2004. "Innovation, Global Change and New Capitalism: A Fuzzy Context for Business and the Environment." *Human Ecology Review* 11(3) (3): 277–79.

Roome, Nigel. 2012. "A Cybernetic Model of Corporate Responsibility-Sensing Changes in Business and Society." *International Journal of Technology Management* 60 (1–2): 4–22. https://doi.org/10.1504/IJTM.2012.049103.

Running, Katrina. 2012. "Examining Environmental Concern in Developed , Transitioning and Developing Countries A Cross-Country Test of the Objective Problems and the Sub- Jective Values Explanations." *World Values Research* 5 (1): 1–25. https://scholar.google.com/scholar?hl=sv&as_sdt=0%2C5&q=Running%2C+K.+%282012%29.+"Examining+Environmental+Concern+in+Developed%2C+Transitioning+and++Developing+Countries"+World+Values+Research+5%281%29%3A1-25.&btnG=.

Ryberg, Morten W., Troels K. Bjerre, Per Henrik Nielsen, and Michael Hauschild. 2020. "Absolute Environmental Sustainability Assessment of a Danish Utility Company Relative to the Planetary Boundaries." *Journal of Industrial Ecology*, 1–13. https://doi.org/10.1111/jiec.13075.

Ryberg, Morten W., Mikołaj Owsianiak, Julie Clavreul, Carina Mueller, Sarah Sim, Henry King, and Michael Z. Hauschild. 2018. "How to Bring Absolute Sustainability into Decision-Making: An Industry Case Study Using a Planetary Boundary-Based Methodology." *Science of the Total Environment* 634: 1406–16. https://doi.org/10.1016/j.scitotenv.2018.04.075.

Schill, Caroline, John M. Anderies, Therese Lindahl, Carl Folke, Stephen Polasky, Juan Camilo Cárdenas, Anne Sophie Crépin, Marco A. Janssen, Jon Norberg, and Maja Schlüter. 2019. "A More Dynamic Understanding of Human Behaviour for the Anthropocene." *Nature Sustainability* 2 (12): 1075–82. https://doi.org/10.1038/s41893-019-0419-7.

Schwartz, Shalom H. 2006. "A Theory of Cultural Value Orientations: Explication and Applications." *Comparative Sociology* 5 (2–3): 137–82. https://doi.org/10.1163/156913306778667357.

Senge, Peter, Bryan Smith, Nina Kruschwitz, Joel Laur, and Sara Schley. n.d. "The Necessary Revolution: HOW INDIVIDUALS AND ORGANIZATIONS ARE WORKING TOGETHER TO CREATE A SUSTAINABLE WORLD."

Steffen, Will, Paul Jozef Crutzen, and John Mcneill. 2008. "The Anthropocene : Are Humans Now Overwhelming the Great Forces of Nature The Anthropocene : Are Humans Now Overwhelming the Great Forces of Nature ? Will Steffen ; Paul J Crutzen ; John R McNeill." *AMBIO A Journal of the Human Environment* · 36 (8): 614–21. https://doi.org/10.1579/0044-7447(2007)36.

Steffen, Will, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, et al. 2015. "Planetary Boundaries: Guiding Human Development on a Changing Planet." *Science* 347 (6223). https://doi.org/10.1126/science.1259855.

Swedish EPA. 2019. "Sweden's Climate Act and Climate Policy Framework." *Swedishepa.Se*. https://www.naturvardsverket.se/en/topics/climate-transition/sveriges-klimatarbete/swedens-climate-act-and-climate-policy-framework/.

Tell, Joan, Daniel J Caldwell, Andreas Häner, Jutta Hellstern, Birgit Hoeger, Romain Journel, Frank Mastrocco, et al. 2019. "Science-Based Targets for Antibiotics in Receiving Waters from Pharmaceutical Manufacturing Operations." *Integrated Environmental Assessment and Management* 15 (3): 312–19. https://doi.org/10.1002/ieam.4141.

Vargas-Gonzalez, Marcial, François Witte, Patricia Martz, Laurent Gilbert, Sébastien Humbert, Olivier Jolliet, Rosalie van Zelm, and Jacques L'Haridon. 2019. "Operational Life Cycle Impact Assessment Weighting Factors Based on Planetary Boundaries: Applied to Cosmetic Products." *Ecological Indicators* 107 (July): 105498. https://doi.org/10.1016/j.ecolind.2019.105498.

Veldman, Jeroen, and Andreas Jansson. 2020. "Planetary Boundaries and Corporate Reporting: The Role of the Conceptual Basis of the Corporation." *Accounting, Economics and Law: A Convivium* 10 (2): 1–18. https://doi.org/10.1515/ael-2018-0037.

Walenta, Jayme. 2020. "Climate Risk Assessments and Science-Based Targets: A Review of Emerging Private Sector Climate Action Tools." *Wiley Interdisciplinary Reviews: Climate Change* 11 (2). https://doi.org/10.1002/WCC.628.

Wang-Erlandsson, Lan, Arne Tobian, Ruud J. van der Ent, Ingo Fetzer, Sofie te Wierik, Miina Porkka, Arie Staal, et al. 2022. "A Planetary Boundary for Green Water." *Nature Reviews Earth & Environment 2022 3:6* 3 (6): 380–92. https://doi.org/10.1038/s43017-022-00287-8.

Wetering, Rogier van de, Patrick Mikalef, and Remko Helms. 2017. "Driving Organizational Sustainability-Oriented Innovation Capabilities: A Complex Adaptive Systems Perspective." *Current Opinion in Environmental Sustainability*. https://doi.org/10.1016/j.cosust.2017.08.006.

Zee, Han van der. 2008. "Time to Transform." *View - The Business Transformation Edition*, 2008. https://www.wbcsd.org/Overview/About-us/Vision-2050-Time-to-Transform/News/Time-to-Transform-Leading-multinational-companies-set-urgent-action-agenda-for-all-people-to-live-well-within-planetary-boundaries.

Zipper, Samuel C., Fernando Jaramillo, Lan Wang-Erlandsson, Sarah E. Cornell, Tom Gleeson, Miina Porkka, Tiina Häyhä, et al. 2020. "Integrating the Water Planetary Boundary With Water Management From Local to Global Scales." *Earth's Future* 8 (2). https://doi.org/10.1029/2019EF001377.

Österblom, Henrik, Carl Folke, Juan Rocha, Jan Bebbington, Robert Blasiak, Jean Baptiste Jouffray, Elizabeth R. Selig, et al. 2022. "Scientific Mobilization of Keystone Actors for Biosphere Stewardship." *Scientific Reports* 12 (1): 1–17. https://doi.org/10.1038/s41598-022-07023-8.

Österblom, Henrik, Jean Baptiste Jouffray, Carl Folke, and Johan Rockström. 2017. "Emergence of a Global Science–Business Initiative for Ocean Stewardship." *Proceedings of the National Academy of Sciences of the United States of America* 114 (34): 9038–43. https://doi.org/10.1073/pnas.1704453114.

Figures

Figure 1. Planetary boundaries illustration (2022). Credit: "Azote for Stockholm Resilience Centre, based on analysis in Wang-Erlandsson et al 2022".

Figure 2. The Inglehart-Welzel World Cultural Map – World Values Survey 7 (2022). *https://www.worldvaluessurvey.org*

APPENDIX 1. Literature about culture and values

In this appendix I summarize the work of Hofstede and colleagues, Inglehart and colleagues, Schwartz and Basáñez.

Culture and personal values – national level

Hofstede and Inglehart have received over 200,000 citations on Google Scholar making them two of the world's most frequently quoted social scientists in the field of culture and personal values. Hofstede dominates in cross-cultural psychology and international management, while Inglehart prevails in sociology and political science (Beugelsdijk and Welzel 2018). Their respective bodies of work are to a large extent based on empirical research from the bottom up; for Hofstede initially based on data from surveys within IBM and later from the World Values Survey, a database that is used extensively by many scientists including Inglehart.

In contrast to Hofstede and Inglehart, Schwartz work began with theory and is situated within social psychology. His theory differs from the previous mentioned in the sense that his value orientations are related to each other in an integrated system (see e.g., Schwartz 2006). In addition to these strands of research, Basáñez (2016) has proposed three key axes that led to the discovery of three hyper cultures – Honour, Achievement, and Joy - that he argues are related to the main stages of development of human societies.

Hofstede and colleagues

About forty years ago, Hofstede identified four dimensions of work-related values that differentiated national cultures within a multinational corporation (IBM): High-Low power-distance, Individualism-Collectivism, Masculinity-Femininity, Strong-Weak Uncertainty avoidance (Hofstede 1980; Kirkman, Lowe, and Gibson 2017). However, in another cross-cultural study (Ng et al. 1982; in Hofstede 1991) results were different. Bond investigated this further (Hofstede and Bond 1988) and found that the Uncertainty avoidance dimension was missing is the Chinese Values Survey. Instead, Bond found another dimension that refers to Long- versus Short-term

orientation. Later Hofstede added a sixth dimension found by Minkov (Hofstede and Minkov 2010; Hoftede 2011) that he labelled Indulgence-Restraint. Hofstede's current framework consists of these six dimensions and country scores can be downloaded from his website (www.geerthofstede.com).

Books

Hofstede, G. 1980. *Culture's consequences: International differences in work related values*. Beverly Hills, CA: SAGE.

Hofstede, G. 1991. *Cultures and organizations: Software of the mind.* New York, NY: McGraw-Hill.

Hofstede, G. 2001. *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations.* Thousand Oaks, CA: SAGE

Inglehart and colleagues

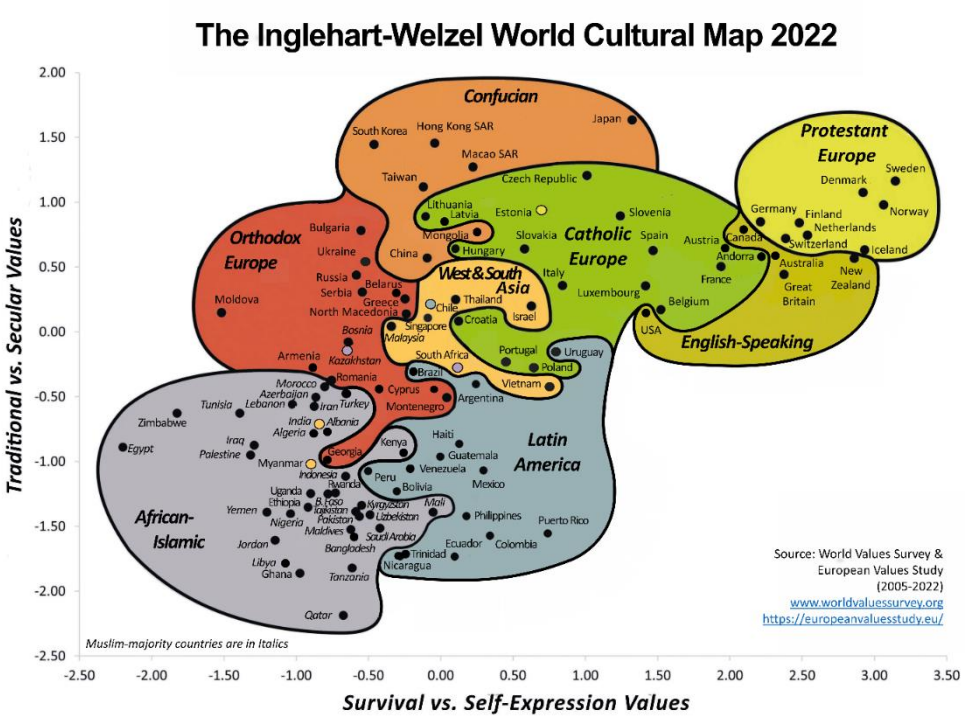
Inglehart (Inglehart 1997) was the first to document a generational shift in values among people in Western democracies, from materialist values and a priority on existential security, toward postmaterialist values and a priority on freedom to express oneself. Inglehart and his co-authors (Inglehart & Norris, 2003; Inglehart and Welzel 2005) later demonstrated a universal principle of the human mind that people prioritize security first because security is necessary to survive, but when people feel safe they begin to prioritize freedom. Hence, socioeconomic transformations that provide increasing existential security nurture a generational shift in priorities from Survival to Self-expression values. This forms the basis for one of the dimensions (Survival-Self-expression) in the Inglehart-Welzel World Cultural Map (www.worldvaluessurvey.org). According to Inglehart and Welzel the other major dimension that distinguishes societies based on WVS data is Traditional-Secular-rational values that is related to modernization of societies. See explanation below the map!

Books

Inglehart, R. 1997. *Modernization and postmodernization: Changing values and political styles in advanced industrial society*. Princeton University Press

Inglehart, R., & Norris, P. 2003. *Rising Tide.* Cambridge University Press
Welzel, C. (2013). *Freedom rising*. Cambridge University Press.

Figure 2.



Inglehart-Welzel World Cultural Map - World Values Survey (2022). https://www.worldvaluessurvey.org

Explanation to the map: "The global cultural map (below) shows how scores of societies are located on these two dimensions. Moving upward on this map reflects the shift from Traditional values to Secular-rational and moving rightward reflects the shift from Survival values to Self-expression values. A somewhat simplified analysis is that following an increase in standards of living, and a transit from development country via industrialization to post-industrial knowledge society, a country tends to move diagonally in the direction from lower-left corner (poor) to upper-right corner (rich), indicating a transit in both dimensions. However, the attitudes among the population are also highly correlated with the philosophical, political and religious ideas that have been dominating in the country. Secular-rational values and materialism were formulated by philosophers and the left-wing politics side in the French revolution and can consequently be observed especially in countries with a long history of social democratic or socialistic policy, and in countries where a large portion of the population have studied philosophy and science at universities. Survival values are characteristic for eastern-world countries and self-expression values for western-world countries. In a liberal post-industrial economy, an increasing share of

the population has grown up taking survival and freedom of thought for granted, resulting in that self-expression is highly valued." Cited from WVS Database (worldvaluessurvey.org)

Schwartz framework

According to Schwartz, value orientations evolve as societies confront basic issues or problems in regulating human activity. There are three main issues all humans confront; first, the relation or the boundaries between the person and the group, second, whether societies are more hierarchical or egalitarian, third, how people manage their relations to the natural and social world (Schwartz 2006).
The three value dimensions that Schwarz tested were: 1. Embeddedness vs. Intellectual or Affective Autonomy, 2. Hierarchy vs. Egalitarianism, 3. Mastery (for example having ambitions and being daring) vs. Harmony (for example unity with nature and world at peace). Analyses of data demonstrate the validity of the cultural orientations and showed that these dimensions form an integrated circular structure according to Schwarz. The first two dimensions was found to be correlated with the level of socio-economic development where Autonomy and Egalitarianism were related to high level of development and vice versa. The Harmony/Mastery dimension showed a different pattern and correlated the least strongly with indicators of socio-economic development. The aspects of culture that this dimension captures may be especially distinctive according to Schwartz since it added an element to understanding attitudes towards unselfishness and competition.

Basáñez world of three hyper cultures

Basáñez (2016) work is also based on the World Values Survey. He argues that we can describe cultural differences by three hyper cultures - Honour, Achievement, and Joy - based on legal systems, and that all cultures can be explained by a combination of these three values. He tracks the cultural development from honour in tribal societies, to achievement beginning with the industrial revolution, to joy by the end of World War in postmaterialist countries. Basáñez concludes that material conditions (Marx idea of historic materialism) can explain about a third of the factors driving development, and belief systems (Weber's idea of culture and ideas as the engine of

change) can explain another third of change. He also finds that the contradictions between these two strands of thought, and the ambivalence between capitalism and communism, can be regarded as false contradiction and that they are both true. However, Basáñez argues, a third driver is missing: the *interaction* between these two factors and that the interaction between material conditions on one hand, and ideas on the other, translates into innovation as the source of novelty in technology and institutions. Basáñez claims that he got this idea from biology where the effect of gene-environment interaction, was discovered in the second half of the twentieth century.

Book Basáñez, M. 2016. *A world of three cultures: honor, achievement and joy*. Oxford University Press.

Beugelsdijk and Welzel - Synthesizing Hofstede and Inglehart

By synthesizing the Hofstede and Inglehart strands of research, Beugelsdijk and Welzel (2018) argue that Hofstede's six dimensions can be reduced to three (Collectivism-Individualism, Duty-Joy and Distrust-Trust). They then used these three dimensions to test Inglehart's theory of generational values change by comparing results of five birth cohorts (born 1900-1999) using data from the World Values Survey.

Their main findings can be summarized as:

> A. Societies have become more individualistic and more joyous. They have also become somewhat more distrusting.
>
> B. Cultural differences can be explained by three factors 1. Economic development 2. Generational effects 3. Country effects due to geographic location and political history. The first two account factors for about half of the variation of cultural differences while the other half can be related to geography and history[3].

[3] Welzel argues that the Cool Water condition is a root cause of the emancipatory dynamic that Western civilization has taken by providing the conditions for a reduction in female fertility. The Cool

C. National differences are quite persistent over time and relative country rankings tend to be rather stable.

Table 1. Overview of Hofstede, Inglehart, Schwartz and Basáñez

Dimensions	**Economic**	**Political**	**Social**
Hofstede (1980)	Masculinity vs Femininity	Power Distance	Individualism vs. Collectivism
Hofstede	Uncertainty avoidance - Long vs Short term - Indulgence vs. Restraint		
Basáñez (1986)	Hard work; Prize vs Punishment	Autonomy vs. Obedience	Trust vs. Distrust
Schwartz (1994)	Harmony vs. Mastery	Egalitarianism vs Hierarchy	Autonomy vs. Embeddedness
Inglehart (1997)	Survival vs. Self-expression	Secular vs Traditional	Survival vs. Self-expression

Table 1. Basáñez (2016), p 70 (adapted to include Hofstede's 5th and 6th dimensions)

The values dimensions might seem confusing due to different labels and are sometimes overlapping. However, this field of work seems to be gravitating towards three value dimensions that can help us navigate the social world in a similar way that longitude, latitude and hight over or below sea level help navigating the physical world. Scholars also tend to agree that cultural differences can be explained by country unique conditions such as geography and history.

In addition to this, socio-economic development can also explain a large portion of the variation of cultural differences, and the change seems to be related to generational effects (Inglehart, 1997). With socio-economic development values

Water condition captures the unique climate of North-western Europe and its offshoots in North America, Australia, and New Zealand according to Welzel. (Welzel 2013)

change show a similar pattern in the direction of the top right corner on the Inglehart-Welzel World Cultural Map (www.worldvaluessurvey.org).
However, during the development process countries can take different pathways, and when socio-economic conditions deteriorate over a long period of time values tend to go in the opposite direction.

The values dimensions and the environment

The objective of Hofstede (see e.g. Hofstede, 1997) has been to help people to cope with global threats and to solve problems, including biological and environmental ones, by better understanding differences in how other people around the globe think, feel, and act, and to show that "there is a structure in this variety which can serve as a basis of mutual understanding" (Hofstede, 1997, p 3), i.e. the value dimensions.
In Hofstede's framework, environmental protection is related to the Masculinity-Femininity dimension where one key difference is whether preservation of the environment or economic growth should have the highest priority. With socio-economic development, countries tend to emphasize masculinity less and femininity more. Men tend to emphasize masculinity values less with age so that when they are over 55 years of age, they tend to be equal to those of women (Hofstede, 1997).

Hofstede argues that a shift from a short-term to a long-term orientation is highly desirable, both from an economic point of view and to deal with an increasing world population in a world of limited resources, with reference to 'Limits to growth'. Finally, he notes that the establishment of democracy requires a certain level of economic development and that achieving democracy in all countries requires a new way of handling ecosystems by "sustaining the rich countries quality of life but drastically reducing its ecological cost" and that the concept of economic growth needs to be replaced and that another measure for "the survival power of economic/ecological systems will have to be found" (Hofstede, 1997. P 244).

In the framework of Inglehart & Welzel (2005), a central component of the 'survival-self-expression' dimension involves the polarization between materialist and postmaterialist values. Environmental protection is one aspect of postmaterialist values in addition to women's and other human rights movements (children, gays and

lesbians, ethnic minorities etc.). Postmaterialist values have become more widespread since the 1970's with socio-economic development. However, it is argued that this long-term trend could be reversed "if socioeconomic conditions changed so profoundly that new generations experienced existential insecurity throughout their formative years" (Inglehart & Welzel, 2005. P. 104).

Inglehart and Welzel (2005) illustrate the interplay between changing values, change in legislation and change in behaviours related to that legislation with two examples: divorce and environmentalism. In both cases the change in legislation was followed by abrupt breakthroughs in behaviour such as filing for divorce or voting for a green party. However, these abrupt changes were a result of a gradual intergenerational rise of mass support for these policies. How these changes play out in politics depends partly on the political system.

Running (2012) investigated if concerns about environmental problems is a result of the objective deterioration of environmental conditions or subjective values among environmentally oriented individuals using the World Values Survey and the Climate Risk Index and found that a country's recent experience with climate-related disasters has little to no effect on concern for global warming. However, the subjective values explanation receives more support, particularly in countries at the most advance stage of economic development.

APPENDIX 2. List of company documents

COOP Sverige

Om Coop - Coop

Hållbarhet | Coop

Coops hållbarhetsdeklaration - Coop

Rules for Coop's Sustainability Declaration - Coop

Hållbarhetsredovisning 2020. Brev (coop.se)

Hållbarhetsredovisning 2021 (coop.se)

Filippa K

Mission Sustainability | Filippa K (filippa-k.com)

filippa-k-sustainability-report_2020-1.pdf

Filippa_K_Sustainability_Report_2021.pdf (filippa-k.com)

H&M Group

Sustainability - H&M Group (hmgroup.com)

H&M Group Sustainability Performance Report 2020 - H&M Group (hmgroup.com)

HM-Group-Sustainability-Disclosure-2021.pdf (hmgroup.com)

Houdini Sportswear

Miljömässig hållbarhet i alla led | Houdini Sportswear

Our Sustainability Work | Houdini Sportswear

Houdini Planetary Boundaries Assessment 2018:

Planetary Boundaries Assessment | Houdini official webstore (houdinisportswear.com)

IKEA/Ingka Group

Sustainability strategy Creating a positive impact through sustainability (ikea.com)

Sustainability report 2020 - IKEA

Sustainability Report FY21 and Climate Report (ikea.com)

Welcome to Ingka Group | Ingka Group

Ingka-Group-Annual-Summary-Sustainability-Report-FY20.pdf

In review: Ingka Group 2021 | Ingka Group

Ragn-Sells Recycling

Ragn-Sells Group (ragnsells.com)

Sustainability Report 2020

Sustainability Report 2021 Download Sustainability report (ragnsells.com)

Saltå Kvarn

Hållbarhet - Saltå Kvarn (saltakvarn.se)

Sustainability report 2020

Sustainability report 2021:

salta-kvarn-hallbarhetsredovisning-2021.pdf (triggerfish.cloud)

White Arkitekter

Sustainability - White Arkitekter

Annual and Sustainability Report 2020

Annual and Sustainability Report 2021 | White Arkitekter

APPENDIX 3. Interview guide - English version

Interview guide

0. **Information about the purpose of the interview + Q & A (5 min)**

1. **Background information about the interview person (5 min)**

   Major events in professional work life since 2015?

   - Change of position, employer, major projects…

   Follow up questions:
   - If change: why did you change to this job/this company?
   - If no change: why did you stay in this job/this company?

2. **The previous interview was based on the first article about 'Planetary Boundaries' (PBs) (Rockström et al. 2009) *See link below!* (5 min)**

   - What developments of the scientific framework for planetary boundaries (PBs) are you aware of since that 2009 article?

   - Are you aware of any attempts to operationalize the PBs framework for practical applications? (e.g., geographic, for specific PBs, for different systems/business sectors (e.g. energy, food, transport etc).

   - Are you aware of any companies that have included the PBs in developing sustainability or corporate strategies since 2015?

   Planetary boundaries - Stockholm Resilience Centre

3. **About developing sustainability and corporate strategies for your company (10 min)**

   - Talking about your company; are the processes of developing sustainability and corporate strategies separate or integrated?

   - Do you use any frameworks for developing sustainability strategies? Which ones?

   - How are you setting overarching goals and targets? (e.g., materiality in dialogues with stakeholders, follow international or national agreements, science-based goals and targets, other…?)

- What time horizons do you have for overarching goals and targets? Have times horizons changed in any way since 2015? More long-term or more short-term?

  Follow up question: Are corporate and sustainability goals and targets separate or coordinated in some way?

4. **About the relevance of the 'Planetary Boundaries' processes for your company (5 min)**

   Which of the 'PBs' are relevant for you organization?

- Climate change
- Biodiversity
- Nutrients overload (nitrogen, phosphorous)
- Land use (deforestation)
- Fresh water use
- Aerosols (air pollution)
- 'Novel entities' (chemicals, plastics, nanoparticles, other...? etc)

  Are any of those more important than others?
  Are there any other environmental issues that are important for your company to deal with?

5. **Has the awareness of the 'Planetary boundaries' or the Agenda 2030 notion of 'development within the limits of the planet' had any impact on *corporate* strategies in any respect?**

6. **About setting overarching goals and targets for environmental issues. (10 min)**

- How do you set goals and targets for the environmental issues most relevant to your company?
- Do you set goals and targets for your value chain? Upstream? Downstream? How far do you go in the supply chain in terms of 'scopes'?
- Are you setting 'science-based' targets for any of them? (regardless of if you use the Science-Based Targets framework or not).
- Are you aware of other companies that are setting science-based targets for environmental issues?

7. **What are the motivations for setting science-based targets for environmental issues?**

   I have listed some suggestions below – you can pick the ones you think are the most important as a starter for the conversation

- Profit motives (short/long term)
- Owners' requirements or priorities
- Top management priorities or interests
- Customer's requirements/'to get the business'
- Expectations from stakeholders (consumers, employees…)
- Changing values in society
- Follow 'best practice' in business/our industry
- To be a leader in this field
- Contribute to developing standards or best practice in business
- New legislation, regulation, standards (or anticipation of that)
- Motive related to the company's identity, brand, core values etc.
- Innovation, creativity, employee engagement
- Avoid accusation of 'greenwashing' or 'cherry picking'
- Trustworthiness of our strategies
- To be strategic, focus on what is important
- To focus on actions and follow them up
- Others are doing it so we have to do it too (e.g. competitors, customers/clients)
- Ethical considerations (the right thing to do because…)

8. **On balance – are the drivers for setting science-based targets mostly external or mostly internal?**

9. **Are there some specific values or beliefs that you think can explain your company's approach to sustainability?**

10. **Is there anything more you would like to say about this topic? (10 min)**

11. **Information about what will happen to the interview results (5 min)**

APPENDIX 4. Summary of results

Background questions

1. Background information about the interview person

The educational/professional backgrounds of the interviewees are engineering, biology, teacher (geography and biology), development geography, textiles with materials focus, purchasing and logistics. A large majority have a university degree. About half of the interviewees have worked with sustainability "all their career", while the rest have shifted from other kinds of work into sustainability over the years. The latter have learned sustainability on the job, have experienced a professional development within the field such as changing jobs at the same employer or to a new one. Most of the interviewees have a long work background in sustainability - from at least a few years up to over ten years or more.

The reasons for doing this work at the current employers is very similar among the interviewees. The most important reasons seem to be that they feel they can make a difference, there are always new things to do, they can develop themselves and have support from the employer to do so, curiosity and novelty, that there has been a huge development of the field and it continues to develop all the time. The interviewees are involved in many interesting development projects, collaborations with research, other organizations such as the WWF and the UN in addition to working with customers and in the industry. One of the most attractive things about the work seems to be the challenges, that it is an important work, but at the same time difficult.

2. The previous interview was based on the first article about 'Planetary Boundaries' (PBs) (Rockström et al 2009)

What developments of the scientific framework for planetary boundaries (PBs) are you aware of since that 2009 article

The awareness of development of the science around the PB's since 2015 is in general quite low, and it is unclear to some interviewees if and how some developments are related to the PB's field of research. Two interviewees have been more directly involved in projects related to the PB's and seem to be somewhat more

knowledgeable about updates of specific PBs and that five, six of the PBs have been crossed now, and that researchers have looked much more on the synergy effects of the PBs and how "everything is connected" in the PBs framework, in addition to focus on certain areas such as biodiversity, climate, and nutrients. Three interviewees mention biodiversity, and one water and nutrients, besides climate.

Are you aware of any attempts to operationalize the PBs framework for practical applications? (e.g., geographic, for specific PBs, for different systems/business sectors (e.g. food, transport etc)

Interviewees are to some extent aware of operationalization efforts with industry focus; in food (the Swedish 'Sustainable Food Chain' initiative), and fashion ('Fashion Pact' initiated by French president during their EU presidency) sectors. One respondent is unsure if it is related to the PBs but mentions the EAT Forum and that they tested AlbaEco's 'Ecosystem Services Review'.

One interviewee discusses the development of tools that include the PBs processes such as 'Science-Based Targets for Nature', the EU 'Green Deal and the 'Task Force for Climate Disclosures/TFCD'.

One interviewee thinks that indirectly the UN Global Goals might be a kind of operationalisation of the PBs. The respondent also mentions that that the SRC did 'the cake' picture, in which one sees that the planet is the foundation for all the other SGD's.

Another interviewee says that the PB's framework was overshadowed by the UN SDG's so that (s/he) "got stuck" in them and looked more at how they did it (setting The Agenda 2030 goals and targets).

Are you aware of any companies that have included the PBs in developing sustainability or corporate strategies since 2015?

Respondents mention that their own companies (Houdini, Saltå Kvarn, COOP, Ragn-Sells) and in a few cases one other company (Houdini, COOP, Asket, Unilever and the Kering Group) have developed applications based on the PB's.

In addition, SIDA (the Swedish Development Aid Agency) was mentioned as partly used the PBs as a foundation in their work, but that when the Agenda 2030 came SIDA adopted the SDGs instead. Respondents are more aware of examples in similar contexts, primarily in their own industry and in a couple of cases the most well-known frontrunners.

3. About developing sustainability and corporate strategies for your company

Talking about your company; are the processes of developing sustainability and corporate strategies separate or integrated?

This question helps to assess the 'Stage of CSR/Corporate Sustainability (CS)' the company is at. The results show that the companies are mostly frontrunners, but some are more ahead than others.

Corporate and sustainability strategies are, more or less, integrated in all but one of the companies. It depends to some extent to how the interviewee understands the question; there is the *process* of strategizing and the *outcome* in terms of the actual strategies the company will pursue. In the process, sustainability is often an important part of assessing the business context in environmental terms and is provided as an input to overall strategizing for sustainability as well as to pure business strategies. Some companies have focus areas for their corporate strategies (e.g., four pillars) of which sustainability is one pillar. In the companies that are on 'higher stages of CSR/Corporate Sustainability' it is difficult to entangle corporate and sustainability strategies as products and services are in themselves 'sustainable' or the company plans to make them (even) more sustainable.

Do you use any frameworks for developing sustainability strategies? Which ones?

The frameworks the companies are using are primarily: the Global Goals, i.e. the Agenda 2030 SDG's, the Paris Agreement for Climate, Materiality analysis of impacts, 'Willy Pedersen' for corporate strategy and the PB's, the Global Goals for Nature)referring to the upcoming Kunming conference in 2022), Science-Based Targets for Climate and Nature, local insights from the Swedish market, 'leaning towards' SBT's and customers insights, the PB's and Stetind declaration for 2066 and

'1,5 goal' for climate in addition to sustainability initiatives such as 'We don't have time' and 'Race to Zero'.

It seems that before 2015 the companies used the PB's but after that the Agenda 2030 and the Paris Agreement took over as an overarching framework. The Science Based Targets Initiative came a few years later and provided a framework for business to work on climate and some companies joined the initiative, while some use the methodology only.

Currently, some of the companies "are waiting" for Global Goals for Nature and the Science Based Targets for Nature. In addition to these main frameworks the companies use a variety or other frameworks, declarations, or methodologies. The frameworks the companies are using seems to depend on the 'Stage of CSR/CS'.

How are you setting goals and targets? (e.g., materiality in dialogues with stakeholders, follow international or national agreements, science-based goals and targets, other…?)

How companies are setting goals and targets is also an indicator of the 'Stage of CSR/CS' they are at. One company has the basics in place as they have conducted a materiality analysis, set their first baseline for carbon measurements, and started dialogues with their suppliers. They are also relying quite heavily on consultants which can be an indication of a lack of knowledge and experience in this field. Another company is well into conventional methods of materiality analysis, stakeholder dialogues and GRI reporting (Reference) but is also doing more in-depth sector reviews.

However, a majority of the companies are using a mix of the suggested methods and are shifting from a stakeholder focus (listening to their opinions and priorities) and moving towards more science-based goals and targets for environmental issues while relying on the SDGs for social issues.

What time horizons do you have for overarching goals and targets? Have times horizons changed in any way since 2015? More long-term or more short-term?

The most important reference year is 2030 for overarching goals (Agenda 2030) that all interviewees mention. In addition, many of the companies have business plans, including sustainability plans, for four or five years. All companies have a budget cycle on a yearly basis and targets and action plans related to that.

Time horizons is also an indication of the 'Stage of CSR/CS' the companies are at. Companies at higher 'Stage of CSR/CS' have more long-term visions and overarching goals, but also intermediate check points and, if possible, measurable targets and actions plans on a yearly basis. The interviewees' answers indicate that the time horizons have become more long-term, that new areas are emerging, and that when it is not possible to set measurable goal, they set qualitative goals or have a goal to find methods how to measure impacts.

The progress towards the more long-term goals is followed up yearly and sometimes even on a quarterly basis. The COOP 'Sustainability Declaration' provide the opportunity to follow up progress in real time.

4. About the relevance of the 'Planetary Boundaries' processes for your company

Which of the 'PBs' are relevant for you organization?

Climate change, Biodiversity, Nutrients overload (nitrogen, phosphorous). Land use (deforestation), Fresh water use, Aerosols (air pollution), 'Novel entities' (chemicals, plastics, nanoparticles, other...? etc)

Are any of those more important than others?

Are there any other environmental issues that are important for your company to deal with?

The main reason for the question was to direct the interviewees attention back to the PBs but now with a focus of how relevant the PBs are for their own company. I also wanted to get some background information on my part for the remainder of the interview. I skipped listing ocean acidification and the ozone layer and explained the reason why to the interviewees: ocean acidification is caused by carbon emissions and if we deal with carbon emissions to reduced climate change that will be beneficial

for ocean acidification and the ozone layer is recovering so that is not in general top priority.

5. Has the awareness of 'Planetary boundaries' of the Agenda 2030's notion of development 'within the limits of the planet' had any impact on *corporate* strategies in any respect?

All respondents answered yes to this question that either the PB's or Agenda 2030 notion of the importance or recognizing 'boundaries' or 'limits' of the planet has had an impact on strategies overall. It is primarily used as a 'reason why' for sustainability work, materiality analysis and what to focus on by sustainability professionals in different settings. From there the focus areas are broken down into more specific issues. Climate is possible to measure and to set goals inside the boundary according to the interview persons and they hope to be able to expand that to the other PBs as well for example with SBTs for Nature. Circular solutions are often regarded as solutions to human and companies' impact on the planet.

6. About setting overarching goals and targets for environmental issues

How do you set goals and targets for the environmental issues most relevant to your company?

The purpose of this question was to follow up the previous question about how companies are setting goals and targets for sustainability in general. Some of the respondents referred to answers they had given previously. Some additional information came out of this question, the most important being that biodiversity is very difficult to set a goal for.

Do you set goals and targets for your value chain? Upstream? Downstream? How far do you go in terms of 'scopes?

The common theme here is that the impacts are larger in other parts of the supply chain than in their own operations. The companies are working to reduce impacts in the value chain by collaborating with other companies, try to influence those to do reductions, or provide solutions that reduce emissions elsewhere. Some added that the positive impacts are not recognized in current standards.

Are you setting 'science-based' targets for any of them (regardless of if you use the Science Based Targets framework or not?

When asking about science-based targets most of the respondents think about the Science-Based Targets Initiative for Climate (SBTi) and the Science-Based Targets for Nature. However, there are also other science-based approaches such as the PB's assessment and research related to farming practices in the Baltic Regions (Reference). The answers reflect that the SBTs is an emerging set of standards and practice with great interest among the companies in the sample.

7. What are the motivations for setting science-based targets for environmental issues?

See main text for results!

8. On balance – are the drivers for setting science-based targets mostly eternal or mostly internal?

See main text for results!

9. Are there some specific values of beliefs that you think can explain your company's approach to sustainability?

See main text for results!

10. Is there anything more you would like to say about this topic?

Some of the respondents mention the PBs framework and that it is "hugely interesting" if the PBs can be operationalised as they are already using the picture as 'a reason why' for their sustainability work. Respondents add that that they struggle with explaining circularity as it is quite technical and requires a lot of knowledge. The complexity of social-ecological systems also makes it challenging to act.