

Wageningen University - Department of Social Sciences  
MSc Thesis Chair Group PAP

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# An EU SAFE AND JUST OPERATING SPACE

Operationalising the Safe and Just Operating Space  
framework for transformative change planning in the  
European Union

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**Wietse Slob**

**MSc International Development Studies**

**Sustainable Development Diplomacy specialisation**

**Supervisor: Dr. Sylvia Karlsson-Vinkhuyzen**

**Examiner: Dr. Nicolas Jager**

**PAP80336**



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## Abstract

This thesis aims to operationalise the Safe and Just Operating Space (S&JOS) framework developed by scholars for transformative change planning in the European Union (EU). The S&JOS framework has been developed to assess the sustainability of socio-ecological systems and consists of planetary boundaries (PBs) and social foundations. An extensive review of the existing discourse on S&JOS downscaling from the global to sub-global levels reveals the multifaceted nature of ongoing endeavours, characterised by diverse methodologies, varying scales, and inherent political complexities. This review underscores the potential of a more unified approach capable of guiding justice-oriented dimensions in downscaling studies. Qualitative interviews were conducted to compare the S&JOS framework with the Framework for Strategic Sustainable Development (FSSD) and assess their complementarity. The findings highlight the significance of the FSSD as a complementary tool for operationalising the S&JOS framework in the context of transformative change planning. The qualitative interviews coupled with an analysis of a selection of EU policy documents show disparities between EU policy goals and the PBs. While the prospect of implementing the S&JOS framework at the EU level holds some promise, especially in addressing social policy gaps, it also presents significant challenges, notably related to EU competences. The exploration in this thesis suggests potential directions for further research. These avenues include applying the combined S&JOS and FSSD frameworks to specific policymaking cases and further exploring the relationship between S&JOS operationalisation and transformative change planning to effectively steer and enable sustainable development in the EU.

**Key words:** Safe and Just Operating Space, Framework for Strategic Sustainable Development, European Union policymaking, transformative change

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## List of Acronyms and Abbreviations

COP	Conference of Parties
CO2	Carbon Dioxide
CSR	Corporate Social Responsibility
DG	Directorate-General
ESB	Earth System Boundary
ESG	Environmental, Social and Governance
EU	European Union
FSSD	Framework for Strategic Sustainable Development
GHG emissions	Greenhouse Gas emissions
GDP	Gross Domestic Product
HES framework	Human-Environment System framework
IPCC	Intergovernmental Panel on Climate Change
MENA	Middle East and North Africa
PB	Planetary Boundary
ppm	Parts Per Million
SET	Social-Ecological Transformation
S&JOS	Safe and Just Operating Space
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
SOS	Share of Sustainability
SPs	Sustainability Principles

## 1. Introduction

The survival of life on Earth as we know it is under threat from numerous significant crises and major challenges, commonly known as the global sustainability challenge (Robèrt et al., 2019). In response to this urgent need for action, Rockström et al. (2009ab) have conceptualised and attempted to quantify nine planetary boundaries (PBs) that refer to global indicators and their thresholds. Scientists have identified that, when a PB is crossed, there is a significant risk of unleashing unprecedented and irreversible cascading effects, which would ultimately destabilize the current balance of the entire global ecosystems. Richardson et al. (2023) claim that presently, six out of the nine global PBs have already been crossed. For instance, the PB for climate change is surpassed as greenhouse gas (GHG) emissions rise exponentially, crossing unprecedented thresholds, causing global warming and the climate crisis. This situation alone already places our current socio-ecological systems at the brink of collapse (Robèrt et al., 2019). However, other PBs, which are equally relevant have also been crossed causing disastrous effects (Steffen et al., 2015). Nonetheless, adhering to these boundaries, using them as limits to human activities, would significantly diminish the possibility of unintentionally pushing the Earth system towards a significantly less hospitable state (Steffen et al., 2015).

Since the publication of the research on PBs, the framework and its primary works have garnered some acclaim (Steffen et al., 2015; O'Neill et al., 2018). Yet, it has also received various critiques and nuanced appraisals. Some authors argue that the framework is arbitrary (Nykqvist, Persson & Persson, 2013) and oversimplifies the complexity of socio-ecological systems (Keppner et al., 2020; Jabot, 2023). Other critiques focus on the aspect that the implementation of the framework involves political decisions, making it inherently normative (Bierman, 2012; Lucas & Wilting, 2018; Jabot, 2023). When Rockström et al. (2009ab), a group of scientists, attempted to establish global quantified boundaries for governing global environmental risk through an expert-driven approach, questions about the democratic legitimacy were raised (Pickering & Persson, 2020). Another widely cited critique was published by Kate Raworth (2012), who expanded on the PBs framework by advocating for the inclusion of social boundaries alongside the environmental ones. Raworth posited that global access to the benefits of natural resources is a pressing concern and that it is possible to address current global deprivation while minimizing impact on the planetary boundaries (Cole, Bailey & New, 2014). Consequently, Raworth added social boundaries, also called social foundations, to the PBs framework and named this revamped framework the Safe and Just Operating Space for humanity (Raworth et al., 2012; Raworth, 2017; Bierman & Kim, 2020). The Safe and Just Operating Space (S&JOS) framework delineates boundaries for ecological processes and social well-being on a global scale, emphasizing the crucial interconnections between environmental sustainability and human needs (Hossain & Ifejika Speranza, 2020).

To veer away from the current unsustainable trajectory and remain within a S&JOS for humanity scholars posit that it is necessary to implement transformative changes within our economies and societies (Pereira et al., 2015). It has been argued that the root causes of unsustainability can only be addressed through transformative change (Uitto & Batra, 2022). This involves fundamental shifts in the relationships between humans and the environment. Commonly known as “social-ecological transformations” (SETs), these fundamental shifts aim to promote societal well-being in both the present and the future while safeguarding the Earth's life support systems (Pereira et al., 2015). However, when examining the central concept of S&JOS for transformative change, two main gaps appear.



First, both the PBs and the S&JOS concept were developed for the global level while major decision-making processes and governance structures also operate at the national, regional, and local levels (Dearing et al., 2014; Keppner et al., 2020; Jabot, 2023). The idea of addressing transboundary environmental issues at the local level was first introduced in the 1987 Brundtland Report (Fuhr, Hickmann & Kern, 2018). Many treaties and agreements are established at the international level, but countries are sovereign and responsible for translating global agreements, such as treaties or international agendas, into practical laws, policies, or plans and enforce them at their respective levels. In other words, there is no global government responsible for implementing international agreements. The initial PBs were designed to understand the impacts of crossing global ecosystem's boundaries, anticipating the cascading effects of environmental degradation. However, those effects often impact the sustainability of regional ecosystems long before the effects become apparent at the global level (Dearing et al., 2014). Additionally, the identification of regional boundaries becomes increasingly relevant due to the geographical heterogeneity of certain boundaries, especially when examining governance and equity implications (Dearing et al., 2014).

Therefore, in order to develop a practical approach to address sustainability at different levels, it is necessary to translate, downscale, and operationalize S&JOSs to context-specific levels (Raworth, 2012; Keppner et al., 2020; Bai et al., 2016; Ferretto et al., 2022). However, defining context-based S&JOSs and transformative sub-global pathways poses a significant scientific challenge. Conceptually, while strong reservations surrounding the downscaling of the framework were expressed, its feasibility and relevance have been the object successful studies and demonstrations (Dearing et al., 2014, Cole, Bailey & New, 2014; Fang et al., 2015; Kahiluoto et al., 2015; Fanning et al., 2022, among others).

In this thesis, I argue that it is important to understand the implications of the S&JOS at the sub-global level, taking into account the specificities of the European Union (EU) policymaking processes. The ongoing implementation of the 2019 European Green Deal (EGD) may represent a timely and innovative case of attempting to effectively operationalise at least part of the S&JOS framework. As the EU's recently adopted economic growth strategy, the EGD aims to attain climate neutrality by 2050 and sets biodiversity goals to protect and restore ecosystems, while also promoting a fair and just transition (European Commission, n.d.-c). This ambitious objective is pursued through the promotion of green technologies to stimulate the economy, the establishment of sustainable industries and transportation systems, and the reduction of pollution levels (European Commission, n.d.-c). This thesis aims to support EU practitioners in the implementation of the Green Deal by adding a layer of considerations regarding the operationalisation of the S&JOS framework in the current EU political context.

Second, while the S&JOS framework can support the definition of PBs and social foundations at global, regional and national scales, I argue that the framework might remain insufficient as a tool for transformative change planning by itself. Robèrt, Broman and Basile (2013) suggest that the PBs framework needs integration with other sustainable development efforts that support strategic actions on the ground and which account for uncertainties inherent in metrics and quantitative descriptions at the global planetary boundary scale. There are numerous tools, concepts, methods, and frameworks for sustainable development. I suggest that the Framework for Strategic Sustainable Development (FSSD) stands out as a well-structured and unifying framework that addresses most of

the main challenges of the S&JOS framework. The FSSD was initially developed in the late 1980s and has since continuously been refined. It is intended to assist decision-makers, organisations both public and private, and civil society actors in taking action to achieve both short and long-term goals based on scientifically robust set of sustainability principles (Missimer, Robèrt, & Broman, 2017; Robèrt et al., 2019). It is possible to couple the PBs framework with strategic decision-making processes guidelines that adhere to sustainability principles (SPs), with a logical and practical methodology to progress towards fulfilling these principles (Robèrt, Broman & Basile, 2013). This is how the FSSD could address the criticism that the PBs and S&JOS frameworks is being too long-term oriented (Allen, 2009; Schlesinger, 2009). The FSSD can also be instrumental for situations in which specific global sustainability metrics are not yet well developed and to account for future symptoms that cannot be anticipated (Robèrt, Broman & Basile, 2013).

Turner & Wills (2022) pose that downscaling the S&JOS is a normative and political process, influenced by subjective assessments of risk and justice. While the S&JOS framework is rooted in scientific evidence, determining its specific application and contextual translation requires subjective judgments (Kim & Kotzé, 2021; Raworth, 2012; Turner & Wills, 2022). Without being prescriptive, the FSSD supports an operational approach to facilitate sound decision-making processes including either collaborative and co-creation of transformative pathways, roadmaps, scenarios, or strategic plans towards sustainability depending on the scale and context. This is why I claim that it is worthwhile to study how the FSSD may effectively support democratic and science-based regional boundary-defining processes.

Essentially, the FSSD offers a framework for systematically working towards staying within the PBs while pursuing socioeconomic development and innovation (Robèrt, Broman & Basile, 2013). Robèrt, Broman & Basile (2013) conducted an analysis of the PBs framework to explore strategies for preventing global ecological tipping points and ensuring the long-term well-being of humanity and the planet. Yet, the analysis was done more than a decade ago, before the subsequent PB framework updates in 2015 and 2023. Therefore, it also did not encompass the S&JOS social foundations by Raworth (2012). In this thesis, I address this research gap by further building upon the analysis of the role the FSSD can play in support of the operationalisation of the PBs, extending it to the S&JOS, to include the social foundations. Focusing on how to operationalise the S&JOS at EU level, I have investigated the relationship between the S&JOS and the FSSD, as well as how the FSSD can potentially complement and support the operationalisation of S&JOSs. More specifically, I focused on climate and biodiversity in an EU Green Deal context, which also aligns and connects with the overarching objectives of the TRANSPATH project coordinated by Wageningen University & Research. TRANSPATH is a four-year study funded by Horizon Europe, the EU's main funding programme for research and innovation (Transpath, n.d.).

This thesis is organised as follows. I start with providing a comprehensive overview of the research background, including the research goals, research questions, and the research approach. Then, I present the analytical framework, the key concepts employed, and their interrelationships. After, I outline the methodology. This leads to the presentation of the results. Finally, the thesis delves into a discussion of the findings, including highlights and limitations, and offers conclusive insights and recommendations.

## 2. Research Background

### 2.1 Problem Statement

To have a practicable approach for using the S&JOS framework to inform EU policy it needs translation, operationalisation, and downscaling (Raworth, 2012; Keppner et al., 2020). In this thesis, I propose connecting the S&JOS framework to the FSSD.

### 2.2 Research Aim

The main aim of this research is to operationalise the Safe and Just Operating Space framework for transformative change planning in the European Union.

### 2.3 Research Questions

The following research questions have supported the research aim:

**Main research question:** How can the Safe and Just Operating Space framework be operationalised for transformative change in the European Union?

- **Sub-research question 1:** What guidance can be harnessed from the current scientific discourse on the central concept of Safe and Just Operating Space for its downscaling to sub global levels?
- **Sub-research question 2:** How does the Framework for Strategic Sustainable Development (FSSD) compare to the Safe and Just Operating Space (S&JOS), and in what ways can the FSSD potentially complement and support the operationalisation of the S&JOS at sub global levels?
- **Sub-research question 3:** What are the normative goals and visions linked to a Safe and Just Operating Space articulated in EU biodiversity and climate policies, and how do they compare to the EU downscaled Safe and Just Operating Space made by scientists?
- **Sub-research question 4:** How could the Safe and Just Operating Space framework be operationalised for the EU level, and what does this mean for EU policymaking?

### 2.4 Research Approach

In the subsequent sections, first the analytical framework will be outlined below, which facilitates the development and interconnection of key concepts, thereby enhancing our understanding of them. The accompanying figure (see Figure 1) furnishes a comprehensive overview of the research strategy, offering detailed insights into its components. Second, in the methods section, the research methodology will be discussed including the interactive qualitative research approach, data collection methods and data analysis.

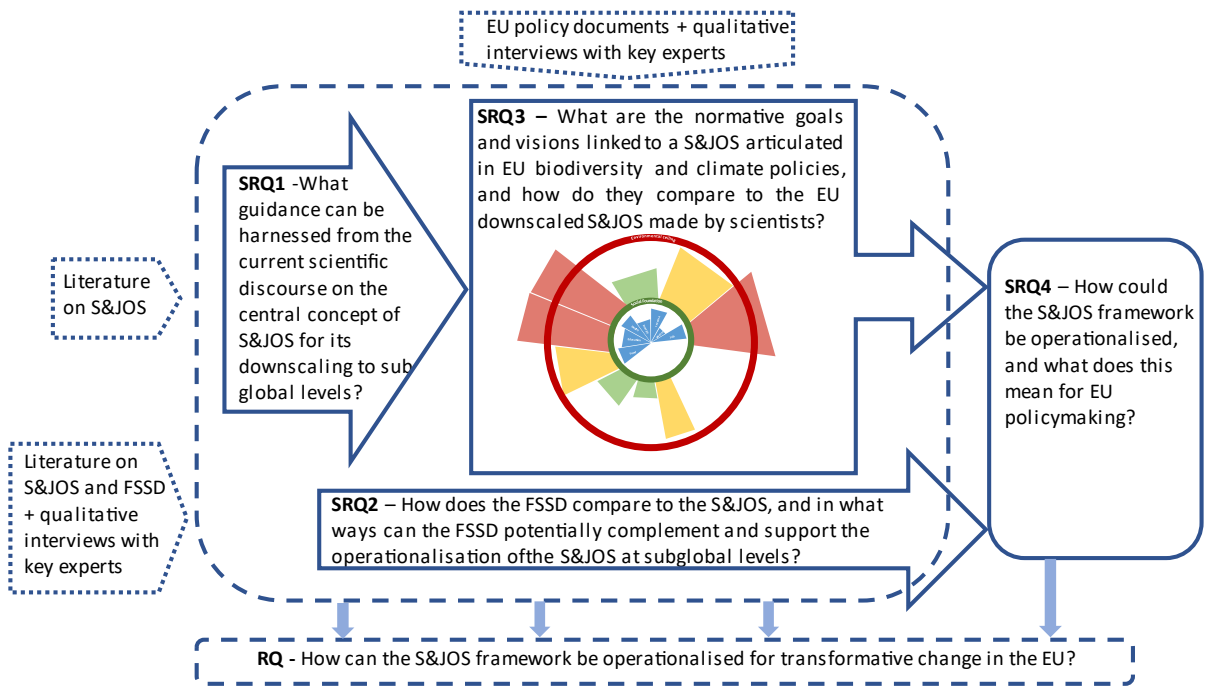


Figure 1 - Research strategy.

### 3. Analytical framework

This chapter aims to present a comprehensive overview of the analytical framework. As mentioned previously, the main objective of this research is to understand how the S&JOS can be operationalised for transformative change planning in the EU.

Firstly, the discourse surrounding the S&JOS framework is discussed, with particular emphasis on the PBs framework and its critiques and the downscaling of the S&JOS framework to sub-global levels as a means of operationalisation. By exploring this downscaling approach, one can gain a deeper understanding of how the S&JOS can be effectively operationalised in an EU policy level context.

Secondly, a comprehensive definition of transformative change will be provided. This definition will serve as a crucial pillar within the analytical framework, guiding the subsequent analysis and allowing for a clear understanding of the transformative potential and implications of the S&JOS operationalisation.

The third part of this chapter focuses on enhancing the comprehension of the FSSD. As mentioned previously, the selection of the FSSD in this study stems from its potential to address some of the challenges associated with the S&JOS and facilitate its operationalisation.

In the fourth section, attention is given to briefly outlining the EU's policy focus on climate and biodiversity. This policy focus aligns with the overarching objectives of the TRANSPATH project, providing further relevance and applicability to the analysis conducted within this thesis.

This analytical framework offers several benefits. It provides a systematic approach for evaluating and understanding the operationalisation of the S&JOS within the EU context. This analytical framework, however, also possesses certain limitations, such as potential constraints in capturing the full complexity of real-world complex systems and dynamics or accounting for all contextual nuances. These limitations are acknowledged and discussed as necessary throughout the analysis. Figure 2 below provides a visual representation of the chapter's structure with an overview of the different sections and their interconnectedness.

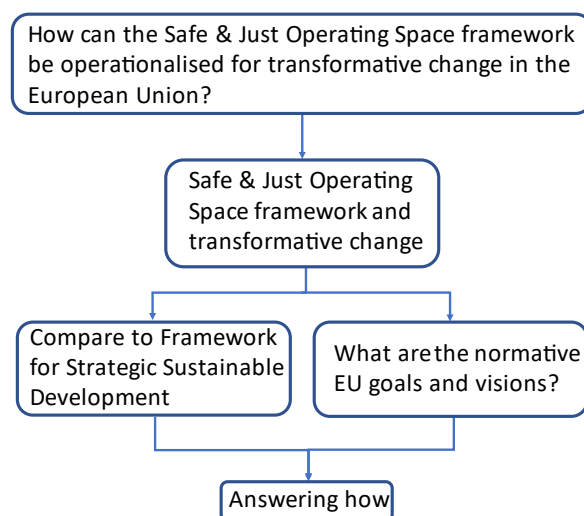


Figure 2 - Graphic overview of the analytical framework.

### 3.1 Conceptualising the Safe and Just Operating Space framework

#### *The Planetary Boundaries framework: A Safe Operating Space*

The Planetary Boundaries (PBs) framework, also called Safe Operating Space (SOS), is the result of a science-based analysis of the potential for human disturbances to disrupt the Earth System on a global level (Steffen et al., 2015). First proposed by Rockström et al. (2009ab) as a conceptual framework for estimating a safe operating space for humanity with respect to the functioning of the Earth system, it outlines nine interconnected planetary boundaries that humanity must not cross to prevent disastrous consequences (Dearing et al., 2014). The nine PBs are climate change, ocean acidification, freshwater use, land-use change, biodiversity loss, nutrient cycles (nitrogen and phosphorus), ozone depletion, atmospheric aerosol loading, and chemical pollution. Currently, six out of the nine planetary boundaries have been crossed, as calculated by Richardson et al (2023).

By combining the precautionary principle with scientific comprehension regarding the functioning of ecosystems, the framework identifies thresholds for the major human-induced disturbances (Steffen et al., 2015). Below these thresholds there is a range where the likelihood of destabilizing ecosystems remains minimal, effectively representing a safe operating space for humanity. Beyond this safe operating space, for each PB, there is a zone of uncertainty, indicating a region of escalating risk. To evaluate the present level of anthropogenic influence on ecosystems and assess the risk to their stability, a comparison is made with the suggested PB. In 2023, Rockström et al. (2023) have updated the PBs framework and quantified safe and just Earth System Boundaries (ESBs). For climate and atmospheric aerosol loading, Rockström et al. (2023) found that justice considerations constrain the ESBs more than safety considerations (see Figure 3).

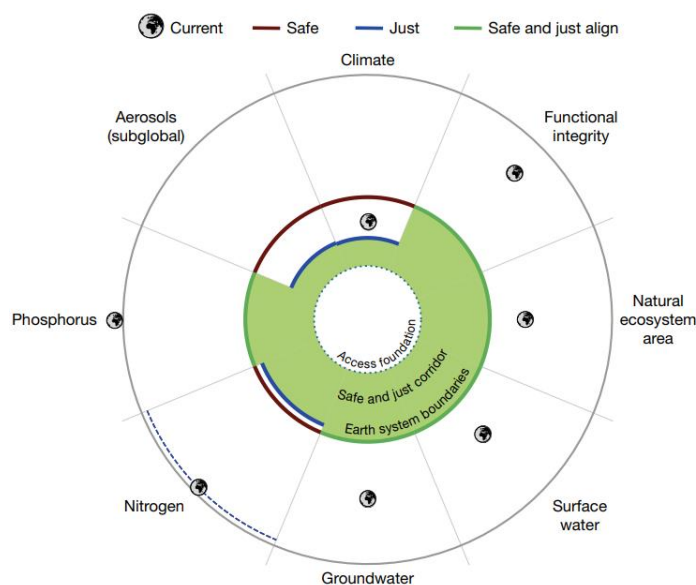


Figure 3 - Proposed safe and just Earth System Boundaries (Rockstrom et al., 2023).

Since its publication, the Planetary Boundaries framework has attracted considerable interest while also being subject to scientific scrutiny (Steffen et al., 2015). Criticisms target the framework itself and its implementation. For example, although they are presented as a scientific identification of pre-existing boundaries, separate from traditional environmental targets set by policymakers, several

authors suggest that the PBs and their operationalisation carry a normative dimension (Biermann & Kim, 2020; Lucas & Wilting, 2018; Jabot, 2023). Biermann & Kim (2020) suggest that how to respect a boundary is a political process, which relies on local social and ecological resilience. Critics express concerns against expert-driven decision-making without democratic processes and argue for stakeholder consultation and public participation (Biermann & Kim, 2020; Pickering & Persson, 2020).

Another criticism points towards the PBs framework primary concern for long-term effects which overlooks immediate environmental concerns (Biermann & Kim, 2020). In addition, some global limits proposed in the framework are considered too lenient, allowing ongoing environmental degradation. Debates persist regarding specific boundaries, such as freshwater consumption and pollution, with varying views on where the thresholds are (Biermann & Kim, 2020). The framework's reliance on extinction rates for biodiversity control is also criticised, and alternative metrics are suggested (Biermann & Kim, 2020). Even the selection of the boundaries and their values is questioned and considered arbitrary (Biermann & Kim, 2020). The 2015 update responds to some of the critics and clarifies that the planetary boundaries are not global thresholds, as not all processes have singular thresholds at that level (Steffen et al., 2015; Biermann & Kim, 2020).

Finally, Biermann & Kim (2020) point out that while the PBs originally focused on establishing global limits on Earth's subsystems, it neglects regional distribution, historical patterns, and societal issues. Blind framework implementation may hamper growth in Africa, Asia, and Latin America, ignoring global inequality and social justice, with potential political repercussions on global equity (Biermann & Kim, 2020). In fact, Steffen et al. (2015) acknowledge that the PBs framework does not address the "deeper issues of equity". Oxfam's doughnut framework, which combines planetary boundaries with social foundations, offers a critique of global inequality and suggests a safe and just operating space (Raworth, 2012). The next section will dive deeper into the approach by Raworth (2012).

#### *The social foundations: A Safe and Just Operating Space*

The PBs framework approach was expanded upon by Raworth (2012), who introduced a social foundation consisting of initially eleven, later twelve, social foundations. She suggests that these social boundaries (and their illustrative indicators), which are derived from internationally agreed minimum standards for human wellbeing as established in the 2015 Sustainable Development Goals, must all be met within the planetary boundaries (Raworth, 2012; Raworth, 2017). The twelve indicators are: food security, health, education, income and work, peace and justice, political voice, social equality, gender equality, housing, networks, energy, and water. Raworth reconceptualised the concept as a "safe and just operating space for humanity" and it is often referred to as "the Doughnut" (see Figure 4) (Raworth, 2012; Raworth, 2023). In this framework, the term "just" pertains to the "prevention of unacceptable human deprivation and extreme global inequality within the context of human rights" (Cole, Bailey & New, 2014, p. 2). In this thesis, I refer to the S&JOS as the PBs framework by Rockström et al. (2009ab) combined with the social foundations by Raworth (2012).

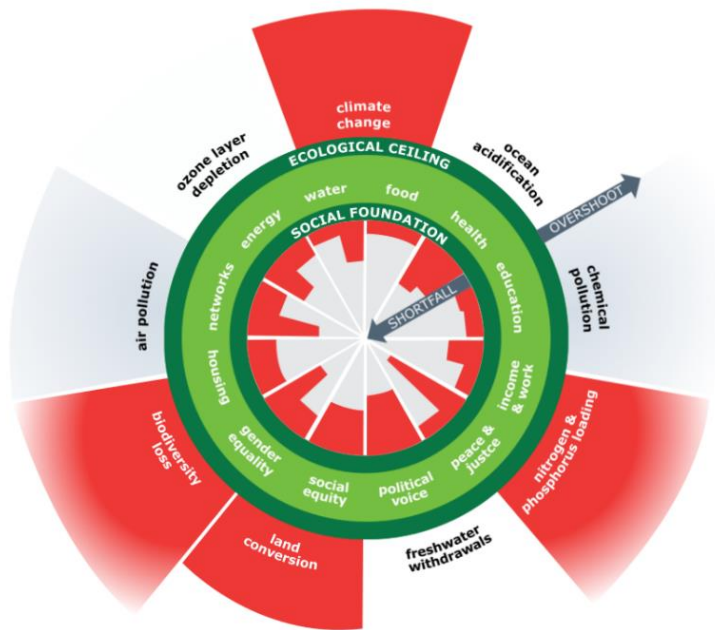


Figure 4 - A safe and just operating space (Raworth, 2023).

Raworth (2012) posits that environmental issues and social factors are intricately interconnected and mutually reinforcing. In other words, as suggested by Ferretto et al. (2022), giving precedence to social concerns should not imply a disregard for environmental considerations. As a result, the S&JOS visually represents the delicate balance between human needs and environmental sustainability, offering guidance for policymaking (Raworth, 2012).

The relationship between social foundations and PBs elucidates how environmental stress impacts poverty and social well-being, as per Ferretto et al. (2022). Adhering solely to PBs is deemed insufficient for ensuring sustainability, and it is imperative to pay heed to social foundations in order to establish a comprehensive and equitable operational framework for humanity (Ferretto et al., 2022). Nevertheless, Ferretto et al. (2022) contend that a deficiency exists in terms of indicators that bridge the gap between PBs and the social foundations within the S&JOS. Although indicators are available for most PBs and social foundations, establishing connections between these dimensions remains a challenge due to the influence of regional policies and local environmental conditions on social indicators (Ferretto et al., 2022).

#### *Downscaling the Safe and Just Operating Space framework*

The process of downscaling, which is a form of operationalising the S&JOS framework, is crucial for implementing the practical aspects of framework (Kim & Kotzé, 2021). While the 2015 update clarified that the PBs framework was not originally intended to be downscaled to smaller levels due to the inherent global nature of Earth system processes (Biermann & Kim, 2020; Steffen et al., 2015), the authors recognize the need to downscale the framework to better align with decision-making contexts and facilitate appropriate governance choices (Steffen et al., 2015). In their most recent paper, Rockström et al. (2023) identified sub global Earth system boundaries (ESBs) as the relevant scale of action and acknowledge that nations, cities, businesses, and other actors should establish and achieve science-based targets for the translation of safe and just ESBs (Rockström et al., 2023). However,



Rockström et al. (2023) emphasize that exposure of a location to transgressed boundaries does not necessarily imply responsibility for causing or addressing these environmental impacts.

When it comes to downscaling the S&JOS, meaning the PBs framework and the social foundations, there are several critiques to consider. For example, Nykvist, Persson & Persson (2013) highlight the challenges associated with downscaling, noting that it is not a straightforward process. Additionally, Jabot (2023) raises the question of operationalisation, stating that while the PBs framework is evidence-based, it is fundamentally a political concept conceived as a global framework. In this thesis, I agree with this, both for the global and any sub global scale. Determining the fair allocation of what it takes to keep within the S&JOS becomes a complex value-laden task that involves both normative and political considerations, alongside scientific analysis (Kim & Kotzé, 2021; Jabot, 2023).

While there is criticism, there are also several proponents for downscaling the S&JOS framework. For example, Cole, Bailey & New (2014) showcase the feasibility of downscaling the framework. Dearing et al. (2014) claim that the S&JOS can be adapted and implemented at regional levels, i.e., nation-states, watersheds, or even national parks. Also, non-state actors (e.g., corporations) are increasingly downscaling the framework as the pressure for Corporate Social Responsibility (CSR) and Environmental, Social, Governance (ESG) has gained increased importance (Kim & Kotzé, 2021). Overall, downscaled S&JOSs are often conducted as part of monitoring and evaluation efforts, to measure absolute progress towards social and environmental sustainability (Ali & Ryberg, 2023).

### 3.2 Transformative change

In recent years, the concept of transformative change has gained considerable attention in scientific literature (Pereira et al., 2015; Westley et al., 2011), particularly in the context of addressing complex societal challenges and fostering sustainable development. One of the definitions attributed to transformative change, as put forth by Pascual et al. (2022), emphasizes its profound nature and broad scope. According to this definition, transformative change entails “a fundamental, system-wide reorganisation across technological, economic, and social factors, including paradigms, goals and values” (Pascual et al., 2022, p. 31). This definition highlights the holistic and systemic nature of transformative change, which goes beyond mere incremental adjustments or isolated modifications, aiming for a profound and far-reaching transformation of societal systems. By understanding and exploring the concept of transformative change, researchers and policymakers can gain insights into the magnitude and complexity of the changes required to address pressing global challenges and foster sustainable development in an interconnected world (Pereira et al., 2015).

### 3.3 The Framework for Strategic Sustainable Development

The Framework for Strategic Sustainable Development (FSSD), initially developed in the 1990s and continuously adapted, is intended to assist decision-makers, organisations both public and private, and civil society organisations in achieving long-term goals based on scientifically robust sustainability principles for the entire biosphere (Missimer, Robèrt, & Broman, 2017; Robèrt et al., 2019). The framework emphasizes the importance of setting a clear vision within scientific boundary conditions for sustainability, identifying leverage points for change, and engaging stakeholders in the decision-making process (Robèrt et al., 2019). The FSSD is based on systems thinking and comprises of several elements that allow one to strategically plan towards sustainable societies. By including the FSSD in this research I aim to offer a unified and practical definition of sustainability as well as a methodological

strategy for planning for sustainability. The framework comprises of the following elements (Broman & Robèrt, 2017): a funnel metaphor, a five-level model, a principled definition of sustainability and an operational approach to facilitate collaboration and co-creation for strategic planning for transformative change, which will be elaborate on in the following paragraphs.

First, the FSSD includes a funnel metaphor facilitating an understanding of the sustainability challenge and the self-benefit of competent proactivity. The “funnel metaphor” illustrates the decline in ecological and social systems' capacity to meet human needs as the population grows. This decreasing potential is symbolized by the narrowing cross-section of the funnel. Broman & Robèrt (2017) assert that the current societal design and operation violate sustainability principles, resulting in unsustainability. Resolving these issues would shift the metaphorical funnel to a cylinder, signifying sustainability, although challenges would persist, as per Broman & Robèrt (2017).

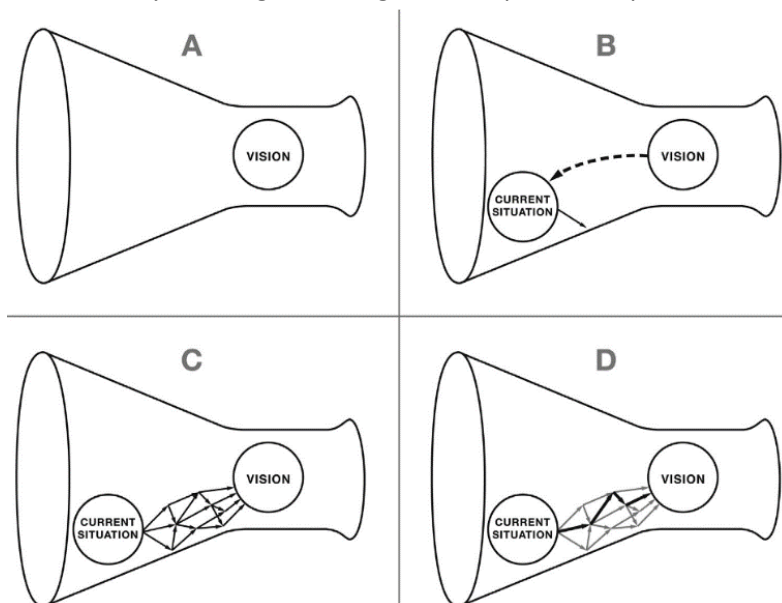


Figure 5 - The funnel metaphor (Broman & Robèrt, 2017).

Second, the FSSD is a model with five levels (see Figure 6), distinguishing and clarifying the inter-relationships between social and biophysical phenomena of fundamentally different character. At the system level, it considers principles governing the global system, resource stocks, climate regulation, biodiversity, and relationships between human practices and ecological/social impacts. The success level involves defining a vision within sustainability principles. The strategic guidelines provide a framework for transitioning towards the vision, while being flexible and non-prescriptive. The actions level involves prioritising concrete actions aligned with the vision and strategic guidelines, such as sustainability education, phasing out harmful substances, and improving working conditions. Finally, the tools level includes methods and support for decision-making, monitoring, and disclosure, such as modelling, life cycle assessment, and management systems (Broman & Robèrt, 2017).

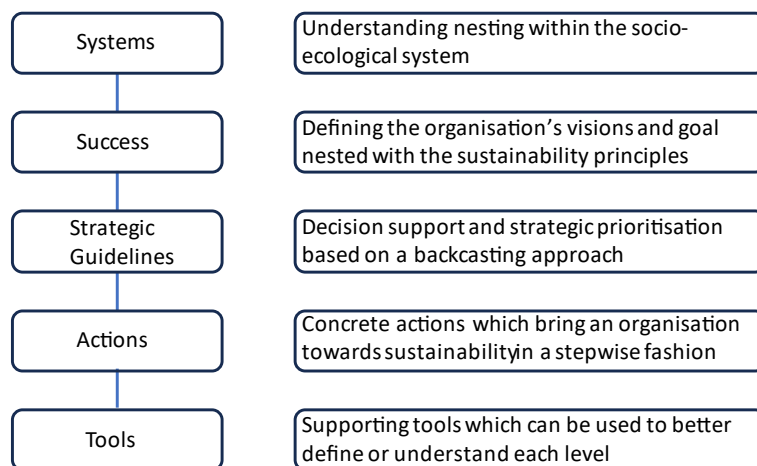


Figure 6 - The Five-level framework (based on Broman & Robèrt, 2017).

Third, a principled definition of sustainability that provides a definition of success based on boundary conditions allowing for strategic backcasting and redesign for sustainability. To effectively guide planning processes, Broman & Robèrt (2017) suggest that a generally applicable and concrete definition of sustainability is needed. Broman & Robèrt (2017) acknowledge that while a single science-based definition is considered necessary, it is important to acknowledge that sustainability is a normative concept. They suggest that in a sustainable society, “nature is not subject to systematically increasing ...:

1. ... concentrations of substances extracted from the Earth's crust. This means limited extraction and safeguarding so that concentrations of lithospheric substances do not increase systematically in the atmosphere, the oceans, the soil or other parts of nature; e.g. fossil carbon and metals;

2. ... concentrations of substances produced by society. This means conscious molecular design, limited production and safeguarding so that concentrations of societally produced molecules and nuclides do not increase systematically in the atmosphere, the oceans, the soil or other parts of nature; e.g. NOx and CFCs;

3. ... degradation by physical means. This means that the area, thickness and quality of soils, the availability of fresh water, the biodiversity, and other aspects of biological productivity and resilience, are not systematically deteriorated by mismanagement, displacement or other forms of physical manipulation; e.g. over-harvesting of forests and over-fishing;

and people are not subject to structural obstacles to ...

4. ... “health. This means that people are not exposed to social conditions that systematically undermine their possibilities to avoid injury and illness; physically, mentally or emotionally; e.g. dangerous working conditions or insufficient rest from work;

5. ... influence. This means that people are not systematically hindered from participating in shaping the social systems they are part of; e.g. by suppression of free speech or neglect of opinions;

6. ... competence. This means that people are not systematically hindered from learning and developing competence individually and together; e.g. by obstacles for education or insufficient possibilities for personal development;

7. ... impartiality. This means that people are not systematically exposed to partial treatment; e.g. by discrimination or unfair selection to job positions;

8. ... meaning-making. This means that people are not systematically hindered from creating individual meaning and cocreating common meaning; e.g. by suppression of cultural expression or obstacles to co-creation of purposeful conditions.” (Broman & Robèrt, 2017, p.23):

Finally, the FSSD is comprised of an operational approach to facilitate collaborative and co-creation of transformative pathways, roadmaps, scenarios, and strategic plans towards sustainability (Broman & Robèrt, 2017). The ABCD procedure consists of four steps, which are also shown in Figure 5. Step A involves learning about the sustainability challenge and the FSSD and agreeing on a preliminary vision of success aligned with sustainability principles. Step B focuses on analysing the current situation in relation to the vision and identifying challenges and assets that can support the transition. Step C involves brainstorming and generating ideas for closing the gap between the vision and the current reality, disregarding constraints imposed by the present conditions. Additional goals may be added or adjusted during this step. Finally, Step D applies strategic guidelines to prioritise solutions and develop a strategic plan that balances progress towards the vision, return on investment, and a flexible approach to support sustainability transition. Evaluating actions in the context of the identified gap and future steps is essential, and other strategic guidelines such as transparency and accountability may be considered (Broman & Robèrt, 2017).

### 3.4 EU Biodiversity and climate policy

To conduct a thorough analysis of the normative objectives and aspirations underlying the EU policies pertaining to climate and biodiversity, it is essential to gain deeper understanding of these policy domains. While not aimed to be exhaustive, this section aims to briefly outline the EU's policy approach in relation to biodiversity and climate change. Outlining these policy areas lays the basis for an evaluation of their conformity with scientific recommendations.

First, the EU emerged as a pioneer in global climate action following the 1990 IPCC report. Leaders committed to limit greenhouse gas emissions to 1990 levels by 2000 (Delbeke & Vis, 2020). Over the past two decades, the EU has implemented various policies driven by legislation, targets, and financial mechanisms to transition to clean energy sources, promote energy efficiency, and support green technologies (Delbeke & Vis, 2020). The EU aims to achieve net-zero emissions by 2050, and it has proposed a Fit for 55 policy package, which sets a 55% reduction target by 2030 (Delreux & Ohler, 2019; Schwarte, 2021).

Second, through legislative measures like the Birds and Habitats Directives and the EU Biodiversity Strategy for 2030, the EU strives to halt biodiversity decline, restore ecosystems, and ensure sustainable use of natural resources (Ferranti et al., 2019; Hermoso et al., 2022). By endorsing protected areas, promoting sustainable practices in agriculture and forestry, and integrating biodiversity considerations across sectors, the EU aims to safeguard the natural heritage of its member

states (European Commission, n.d.-b). Additionally, the EU engages in international collaboration, forging partnerships with global organisations and fulfilling biodiversity-related commitments under multilateral agreements (Groen, 2019).

## 4. Methodology

### 4.1 Maxwell’s interactive approach to qualitative research design

The research design of this thesis follows Maxwell's (2008) assertion that qualitative research design should be considered a reflexive process that operates throughout all stages of the project. This approach emphasizes the interconnectedness of answering research questions, identifying limitations, and gathering and analysing data. To facilitate the integration of research findings and allow for iteration and flexibility, an interactive model is proposed as a beneficial strategy. The interactive model comprises five key components: goals/aim, conceptual framework, research questions, methods, and validity (Maxwell, 2008). Furthermore, ethical considerations are recommended by Maxwell (2008) to be an integral part of every aspect of the design. While other factors such as available resources, research setting, and perceived problems exist, it is important to note that they contribute to the research environment rather than the actual study design itself (Maxwell, 2008).

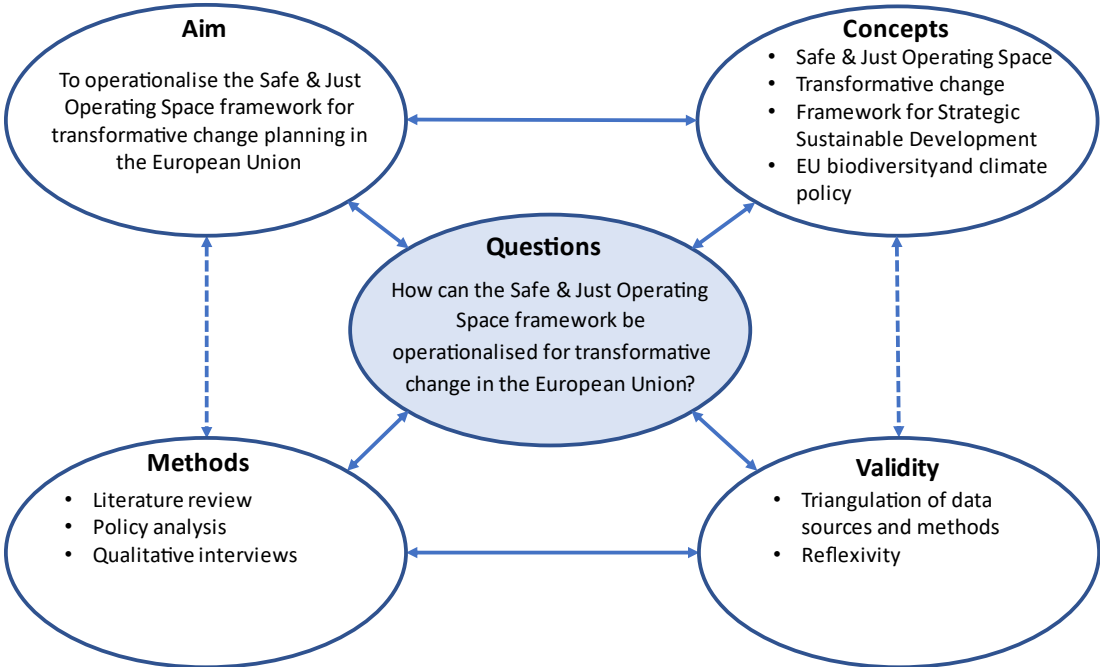


Figure 7 - An interactive research design (Maxwell, 2008).

### 4.2 Data Collection

#### Sub-research question 1

To answer the question: ‘What is the current scientific discourse on the central concept of the Safe and Just Operating Space, specifically regarding its downscaling to sub global levels?’, a literature review was conducted on the central concept of S&JOS and its downscaling studies. The objective of the literature review was not to encompass all published articles, but rather to identify various themes that can inform the research question.

The aim of the literature review was to examine key studies and contributions in the scientific discourse surrounding the S&JOS framework. It investigated the state of the art of the operationalisation of the framework by scholars, particularly its application at sub-global levels

through downscaling. Through an exploration of the existing literature, I aimed to critically assess and consolidate the key debates, insights, and knowledge gaps. The literature was found using the search terms that are displayed in the table below.

**Table 1 - Key terms used in the literature review.**

Key term	Combined with term on the left	Combined with 'AND' +
Planetary Boundaries	Framework	Operationalisation / Operationalization
Safe and Just Operating Space	Model	Downscaling / Downscale / Downscaled
Safe and Just Space	Concept	
Doughnut/Donut		

The primary data sources were collected through desk research, utilizing Google Scholar, Scopus, and the WUR Library. Additionally, a snowball sampling method was employed to identify key publications in the research field and obtain relevant articles pertaining to the topic (Lecy & Beatty, 2012). These steps contributed to the inclusion of significant publications in the research field. Notably, review articles (also known as meta-analyses) were utilized to provide a comprehensive overview of relevant literature.

*Sub-research question 2*

In order to address the question: ‘How does the Framework for Strategic Sustainable Development (FSSD) compare to the Safe and Just Operating Space (S&JOS), and in what ways can the FSSD potentially complement and support the operationalisation of the S&JOS at sub-global levels?’, a literature review was conducted. The focus of the literature review was on exploring the existing literature on the FSSD and its potential relationships with the S&JOS framework, combining keywords such as ‘Framework for Strategic Sustainable Development’ and ‘Safe & Just Operating Space’. It is noteworthy that the literature review was not meant to be exhaustive, but rather to support the qualitative interviews by providing background.

To further enhance the understanding of both the S&JOS framework and the FSSD framework, as well as their interconnections, qualitative semi-structured interviews were conducted with a select group of key scholars and experts who possess familiarity with both frameworks. The sample size for these interviews consisted of seven participants (N=7). These results from the interviews provided valuable insights and perspectives that shed light on the comparative analysis of the two frameworks and the potential ways in which the FSSD can complement and support the operationalisation of S&JOS at sub-global levels. It is worth noting that, in addition to the seven planned interviews, an interview with a member of the Doughnut Economics Action Lab (DEAL) was scheduled at a later stage. The purpose of this interview was to deepen the understanding operationalising the S&JOS framework and enquire about the identified shortcomings of the S&JOS framework by some of the original seven respondents.

*Sub-research question 3*

To address the question: ‘What are the normative goals and visions linked to a Safe and Just Operating Space articulated in EU biodiversity and climate policies, and how do they compare to the downscaled boundaries to EU made by scientists?’, a policy document analysis was conducted.

The document analysis primarily relies on materials obtained from EU institutions such as the European Commission, the European Parliament, and the European Council, as well as potentially other relevant EU-related organisations. Data sources include EUR-Lex and organisation-specific Press Release Websites.

In addition to the document analysis, qualitative semi-structured elite interviews were conducted with eight (N=8) EU experts from institutions like the European Commission, the European Environmental Agency, the Belgian Federal Climate Department and the Brussels School of Governance. These interviews aimed to identify the normative boundaries of safe and just biodiversity and climate policies within the EU context. Semi-structured qualitative interviews are well-suited for data collection as they allow for depth and coverage aligned with a predefined set of questions. The term 'elite' in this context refers to individuals who exercise a significant share of authority or influence within a larger group, as defined by Scally et al. (2021). The interviewees were contacted via email and phone, and interviews were conducted either in-person or online using Teams software. Interview duration lasted from approximately 30-60 minutes. The fieldwork took place in Brussels, Belgium, in early July 2023.

In this thesis, the respondents are referred to by their last name, to enhance readability. Two respondents wished to remain anonymous and will be referred to as Respondent #2 and Respondent #3. In annex 1 (Table 4), a full overview can be found of all respondents and their affiliations.

#### *Sub-research question 4*

The results obtained from addressing SRQ1-3 provided valuable insights to help answer the question: 'How could the Safe and Just Operating Space framework be operationalized, and what does this mean for EU policymaking?' Notably, the interviews with key scholars and experts (N=7, same interviews as in SRQ2), who possess knowledge of both the Safe and Just Operating Space (S&JOS) framework and the Framework for Strategic Sustainable Development (FSSD), also contributed to a deeper understanding of the practical implementation of the S&JOS framework and its implications for EU policymaking.

### 4.3 Data Analysis

Using Atlas.ti software, data was analysed thematically. The analysed documents and the transcripts of the interviews were coded. The research findings were organized into clusters that highlight recurrent themes for each research topic (Linneberg & Korsgaard, 2019). Coding is considered an appropriate strategy for processing the collected data as it enables one to organise and interpret the obtained data into relevant results. In addition, it permits a methodical and reflective approach to process data (Williams & Moser, 2019).

The 'blended approach' was applied, which allowed for a combination of the inductive and deductive coding (Linneberg & Korsgaard, 2019). This is because several codes, or 'labels', will be created concurrently with the development of the interview questions. The analytical frameworks served as the foundation for the development of the codes. This allowed one to focus on the topics that are acknowledged to be crucial in the literature. As part of the blended approach's inductive component, coded labels were added at a later stage.



#### 4.4 Limitations

There are several key limitations that are worth discussing. First, an important limitation is the small sample size due to time and resources constraints. This raises concerns about generalizing the findings to larger populations or different contexts. The limited sample size restricts the ability to draw conclusions beyond the specific participants and settings involved and may not fully encompass the range of experiences within a larger population (Queirós, Faria & Almeida, 2017). Therefore, caution will be exercised when interpreting the findings. This research aims to gain a deeper understanding of S&JOS for EU decision making, rather than achieve generalizability. To address this limitation, the research will emphasize the context-specific nature of the findings.

Second, an additional limitation to consider was the potential scheduling conflict due to the timing of interviews coinciding with the EU summer recess. Many EU officials take time off or have limited availability during this period, which posed a risk to the research process. Crucial interviewees may have not been readily available, hindering the acquisition of necessary insights and perspectives. The limited availability of key stakeholders can significantly impact data collection. This risk was mitigated by proactively engaging potential interviewees in advance, discussing the study's objectives and timeline to identify mutually convenient time slots. Flexibility and open communication with interviewees helped navigate any scheduling challenges that arise.

Third, despite employing reflexivity, elimination subjectivity and bias completely remains difficult. While I do not necessarily consider this as a key limitation, I do acknowledge that my personal beliefs, experiences, and perspectives can considerably influence various stages of the research process, including data collection, analysis, and interpretation. Therefore, I have used reflexivity, during the research design phase and throughout the whole thesis project, to self-consciously critique, appraise, and evaluate how my subjectivity and context influence the research processes (Olmos-Vega, Stalmeijer & Kahlke et al., 2023).

#### 4.5 Ethical considerations

This study does not contain social experiments. Yet, interviews were conducted and prior to the interview, informed consent was asked, orally at the start of an interview. Interviewees were also asked if they want to remain anonymous.

# 5. Results

## 5.1 Results 1 - Scientific discourse on downscaling the Safe and Just Operating Space

The results are presented in four chapters. They are followed by the discussions and conclusion. This first chapter unpacks the results on the question: What guidance can be harnessed from the current scientific discourse on the central concept of Safe and Just Operating Space for its downscaling to sub global levels? It begins with the literature review, followed by a brief overview outlining the evolution of the S&JOS framework. Then, I synthesize studies dedicated to downscaling of the framework, ultimately culminating in a summary that addresses the research question.

### 5.1.1 Literature review

The search terms for research question 1 are outlined in section 4.1. The databases WUR library, Scopus and Google Scholar, yielded similar findings, although some disparities were identified. To consolidate the outcomes, I aggregated the results from all databases, culminating in a total of 162 publications. Employing a discerning approach, I sifted through titles, abstracts, and conclusions, handpicking 61 publications from this initial pool for in-depth review. My criteria for selection were primarily centered on synthesis papers and studies focused on downscaling the SOS or S&JOS to sub-global levels. The timeframe of interest encompassed papers published from 2009 onwards, coinciding with the initial release of the PBs framework. Non-English literature was excluded from consideration. Furthermore, I drew upon other pertinent publications, both citing and cited by the selected works, with particular emphasis on extensively referenced studies. This additional set of sources played a crucial role in clarifying, expanding upon, and strengthening the literature review.

In Figure 8 below, an overview can be found of the diverse array of literature incorporated into the literature review. Notably, a significant portion (N=30) of the literature pertains to the Safe Operating Space. The category 'Other' encompasses articles that, while relevant, do not neatly fit into a specific category.

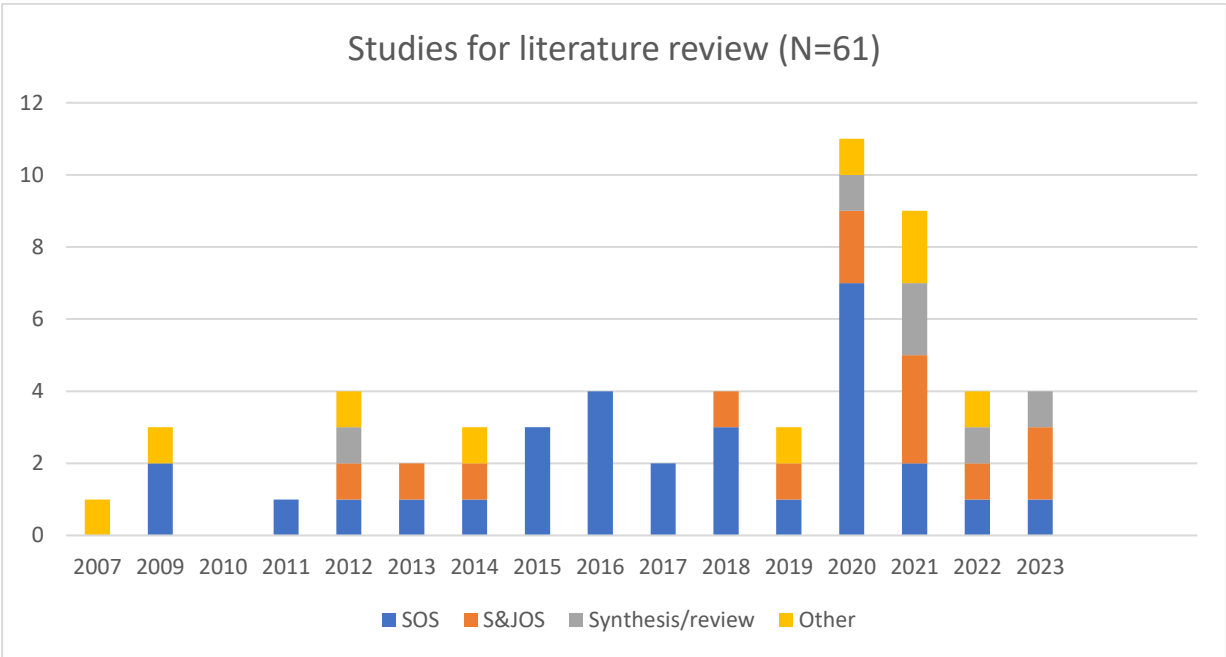


Figure 8 - Number of studies considered in the literature review.

For the review of operationalisation attempts, this analysis draws upon 33 empirical studies among the original 61 publications intended for review (please refer to Figure 9 below). These studies are specifically dedicated to operationalisation of the PBs/SOS, and the S&JOS, or present a conceptual framework to support their operationalisation at various scales. More studies were identified, but for practical reasons and time constraints I selected a sample of studies based on several factors.

First and foremost, I looked at relevance, intuitively selecting most relevant studies that aligned best with the research focus of this thesis. For instance, I prioritised studies with a focus on the EU or Europe. Second, I looked at number of citations, which provided an indication of credibility and significance in the field. Understandably, there are more downscaling studies that relate only to the PBs than the S&JOS. My intention was not to artificially create a balance between PB downscaling studies and S&JOS downscaling studies, so the current selection of downscaling studies aims to reflect the reality of the current downscaling literature landscape.

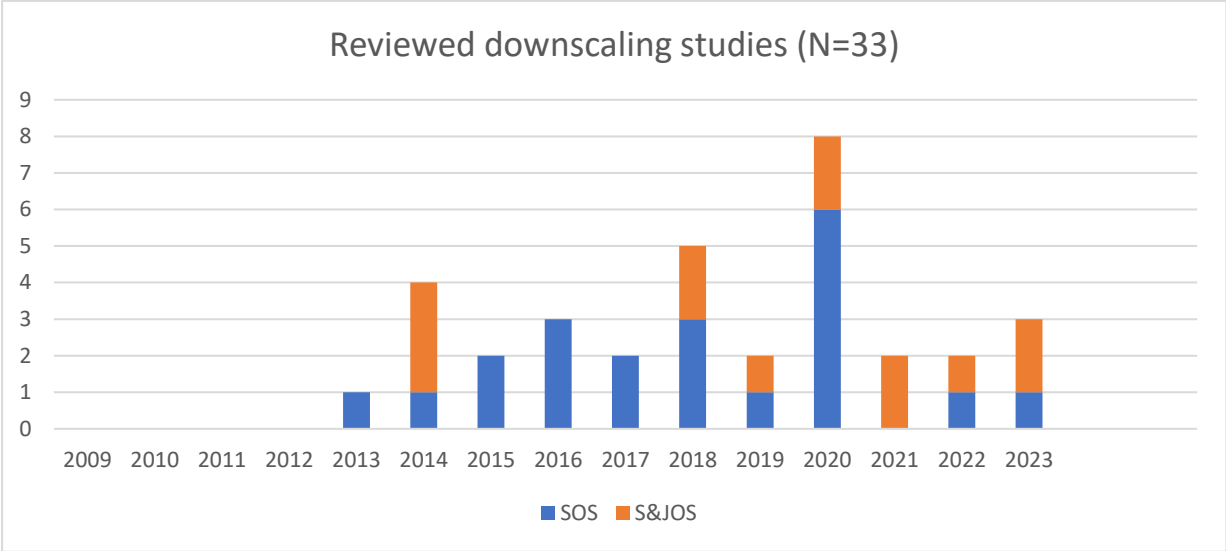


Figure 9 - Number of downscaling studies reviewed, by year of publication.

5.1.2 Evolution of the Safe and Just Operating Space for humanity

As mentioned in section 3.1, the S&JOS framework combines the PBs framework (or so-called SOS), introduced by Rockström et al. (2009ab), with Raworth's (2012) concept of social foundations. The PBs seek to identify and safeguard critical processes that regulate the Earth's ability to sustain Holocene-like conditions (Raworth, 2017). By integrating the social boundaries, the S&JOS framework intends to assess the sustainability of social-ecological systems (Han, Yu & Qiu, 2023). The following paragraphs offer a summary of the evolution of the PBs – S&JOS, followed by an exploration of downscaling in the reviewed literature.

The PBs framework was first published in 2009. Then, it underwent updates in 2015 and 2023 to further expand on the nine critical Earth-system boundaries identified (Steffen et al., 2015; Rockström et al., 2023; Richardson et al., 2023). These boundaries, it is suggested, are pivotal to sustaining the stability characteristic of the Earth-system with the Holocene epoch as a baseline (Steffen, Rockström & Constanza, 2011, p. 61). Rockström et al. (2009b, p24) define the Earth System as “the integrated biophysical and socioeconomic processes and interactions (cycles) among the atmosphere,

hydrosphere, cryosphere, biosphere, geosphere, and anthroposphere (human enterprise) in both spatial —from local to global — and temporal scales, which determine the environmental state of the planet within its current position in the universe.” and underscore that humans and their activities are an integral part of the Earth System.

Yet, the PBs are not the first scientific attempt to define biophysical boundaries for human development (Galaz et al., 2012). Initiatives such as the 1972 Limits to Growth report and the "Tolerable Windows Approach" developed by the German Advisory Council on Global Climate Change during the 1990s, are also characterised by normative specification of non-tolerable risks and establish biophysical boundaries to guide humanity in preventing human-induced catastrophe (Rockström et al., 2009b; Biermann, 2012; Biermann & Kim, 2020; Galaz et al., 2012). Similar terminology describing the same idea is 'planetary guard rails' or 'earth system targets' (Biermann & Kim, 2020).

In 2015, six years after the original Rockström et al. (2009a) publication, the PBs were updated. The new publication included adjusted boundaries and addressed some of the criticisms to the 2009 article (Biermann & Kim, 2020). The scientists also stressed that PBs research is a work-in-progress (Biermann & Kim, 2020), and introduced a 'zone of uncertainty' to account for the gaps in understanding some Earth System dynamics (Steffen & Morgan, 2021; Steffen et al., 2015). The 'safe' side, as indicated by present scientific understanding, indicates that the likelihood of significantly undermining the Earth's resilience is very low (Steffen et al., 2015). Progressing beyond the 'danger' end of the zone of uncertainty means that, according to the current scientific knowledge, a significantly greater chance of crossing the thresholds that will shift the Earth's systems balance. Such shift has the potential to bring about severe consequences for human societies (Steffen et al., 2015).

Considerable discourse has been ignited by the PBs framework, with criticisms centred on the establishment of thresholds and the interconnection of global and regional scales (Tan et al., 2022; Lewis, 2012), the political nature of boundary identification, the framework's focus on long-term goals, and its neglect of regional disparities and social issues, especially in the Global South (Biermann & Kim, 2020). In section 3.1, I provided a more detailed presentation of the critiques to the PBs framework.

The 2023 revision replaces the term PBs with "Earth system boundaries", identifying global and sub-global Earth System Boundaries (ESBs) across various likelihood levels to tackle risks and uncertainties (Rockström et al., 2023). Rockström et al. (2023) argue that the assessment builds upon the PBs framework, the S&JOS and the Sustainable Development Goals from the 2030 Agenda adopted by all the United Nation's member-states in 2015. Firstly, Rockström et al. (2023) acknowledges that the PBs focus on safe environmental limits but ignore the social goals from the 2030 Agenda and the social foundations. As a result, they suggest considering both biophysical and sociopolitical factors in assessing human-environment interactions (Rockström et al., 2023). Additionally, they establish both global and sub-global ESBs in various domains, in contrast to PBs that primarily focus on the global level (Rockström et al., 2023). This can help regional assessment for domains such as the biosphere and freshwater (Rockstrom et al. 2023). Thirdly, they set boundaries at multiple likelihood levels for Earth system states (Rockström et al., 2023). Fourthly, Rockström et al. (2023) clarifies that Earth system tipping points are important for the ESBs, but they are not the only evidence that informed the boundaries (Rockström et al., 2023).

Raworth (2012) expanded on the initial planetary boundaries approach, adding social boundaries, also referred to as social foundations. The social foundations represent twelve basic human needs, forming an inner boundary, below which are dimensions of human deprivation. It aligns with government priorities set at the Rio+20 Conference and by 2030 Agenda for Sustainable Development held by the United Nations (Ribeiro & Picanco-Rodrigues, 2023). When combining the PBs with the social foundations, Raworth (2012, 2017) coined the term S&JOS. The S&JOS is designed to be able to assess the sustainability of social-ecological systems (Han, Yu & Qiu, 2023), but has also been influential in policy development.

### 5.1.3 Downscaling of the S&JOS framework

Now that the evolution of the S&JOS framework has been presented, the subsequent sections lay out a comprehensive analysis of the existing literature concerning the operationalisation of the S&JOS framework. In recent years, the downscaling of the S&JOS framework has gained significant attention in recent literature (Han, Yu & Qiu, 2023; Turner & Wills, 2022; Ferretto et al., 2022; Hossain & Ifejika Speranza, 2020; Hjalsted et al., 2021, among others). Several researchers have attempted to downscale the PBs to specific national or regional contexts (Nykvist, Persson & Persson, 2013; Hoff, Nykvist & Carson, 2014; Cole, Bailey & New, 2014, among others) and the S&JOS to specific contexts (Han, Yu & Qiu, 2023; Cooper & Dearing, 2019).

No common definition of downscaling was found in the literature, but in the context of PB-downscaling, Ryberg et al. (2020, p.2) defines downscaling as “a method for making the “conceptual” PB-framework operational and allow decision-makers in e.g., industries and governments to apply “PB-thinking” as part of their strategic planning.” Dearing et al. (2014) propose that upon sub-global downscaling, the S&JOS framework can serve three main functions: (1) enhancing policy impact at regional scales, (2) contribute to the dissemination and comprehension of complexity thinking across governance and policy-making domains and (3) function as a potent metaphor and communication tool, facilitating discussions about regional equity and sustainability. As stated by Turner & Wills (2022), research focused on downscaling the S&JOS has primarily concentrated on interpreting and measuring key parameters across different scales, originating with a focus on the PBs.

Apart from the different functions described by Dearing et al. (2014), it is good to elaborate on the underlying rationale behind S&JOS downscaling. As articulated by Hossain & Ifejika Speranza (2020), numerous Earth system processes are governed from regional scale issues. Consequently, policies, laws, and regulations are subject to varying interpretations and applications at regional scales (Hossain & Ifejika Speranza, 2020; O’Riordan & Lenton, 2013). An additional rationale for the S&JOS operationalisation at a sub-global level is that consequences of ecosystem degradation are felt most significantly within the confines of national or regional economies long before encountering the global limits of resource pressure (O’Riordan & Lenton, 2013). Furthermore, current natural resource management predominantly occurs at smaller scales as an integral component of national and regional development strategies (O’Riordan & Lenton, 2013). O’Riordan & Lenton (2013, p. 304) argue that therefore “analytical tools that map resources and their boundaries at these scales of governance are more likely to have relevance and traction.” Moreover, Kim & Kotzé (2021) argue that downscaling the S&JOS to regional and localised scales, better shows the impact of global environmental changes on different social groups.

Regarding EU-level downscaling, Nilsson and Persson (2012) propose that scaling down PBs to the EU level would not be a feasible strategy, although no direct reference to S&JOS has been made (as it precedes Raworth's work). They stress the need for closer scrutiny and expansion of the scientific foundational principles and precise threshold values encountered. This scrutiny is vital to attain the requisite level of scientific certainty and, consequently, political legitimacy necessary for states and other stakeholders to come to a consensus on sharing responsibilities (Nilsson and Persson, 2012).

As mentioned in section 3.1, there are some criticisms to downscaling. While the original intent of the PBs framework did not encompass downscaling, Rockström, Steffen, and Constanza (2011, p.62) emphasize that "in no way does this mean that local or regional environmental issues, which have largely been the focus of policy and management for decades, have become less important." Nevertheless, according to late co-author Will Steffen, downscaling can be seen as a potential misuse of the framework, as boundary processes may not scale linearly, posing challenges in determining safe operating limits or aligning supply chains (Steffen & Morgan, 2021). Similarly, downscaling the social foundations, grounded in human needs, presents a challenge in the process of translating the model across different spatial scales (Turner & Wills, 2022).

#### 5.1.4 Synthesis of downscaling studies

Numerous studies have made efforts to operationalise the S&JOS framework, employing diverse approaches and spanning various spatial scales. These studies exhibit variations in their approaches. The following paragraphs offer a concise and non-exhaustive overview, including on different scales of downscaling, the approaches to downscaling, the difference sharing approaches, allocation principles and justice, and the choice of indicators.

##### *Downscaling at different scales*

In the context of spatial scales, downscaling occurs primarily at regional, national, and local levels. While downscaling efforts have expanded to include non-state entities like corporations (Kim & Kotzé, 2021), this review excludes examining corporate-level downscaling as it is outside the research scope. For a comprehensive view of various downscaling studies, refer to Annex 2 (Table 5).

First, Hossain & Ifejika Speranza (2020) delineate the regional scale as a range spanning from  $10^4$  km<sup>2</sup> to  $10^7$  km<sup>2</sup>, encompassing sub-national units such as watersheds, river basins, national administrative divisions, wetlands, coastal regions, or agro-ecological zones. In the literature, authors do mix up scales and it can be observed that urban/city administrations can be seen as a separate scale of downscaling due to their inherent distinctiveness and unique attributes.

There are several noteworthy downscaling studies targeting regional level, including in the EU and Europe. For example, Hoff, Nykvist & Carson (2014) operationalise the PBs framework to the European context, adopting an equitable per-capita allocation (per year) approach of the total allowable resource use (e.g. emissions), and compare this to several PBs. They find that for all assessed boundaries, the European's total per-capita footprint exceeds both the global average and the allowable per-capita footprint if the PBs were equally allocated among the global population (with a population of 7 billion at the time) (Hoff, Nykvist & Carson, 2014).

There are various other examples, including Hoff et al. (2018) work to operationalise the PBs for Europe within the realm of policy. They underscore the necessity for an iterative discourse between scientists and policymakers. Weidner & Guillén-Gosálbez (2023) run a PBs assessment of deep decarbonisation options for building heating in the EU. EEA & FOEN (2020) assesses Europe's environmental footprint in relation to the PBs, finding that Europe exceeds its limits for the nitrogen, phosphorus and land systems boundaries and did not overshoot the freshwater boundary. The Zoe Institute (2021) worked on downscaling of the S&JOS to the context of the EU, offering a visionary proposition of a "beyond GDP dashboard" designed to track progress towards the 2030 Green Deal objectives. This approach underscores the importance of maintaining a coherent narrative for policymakers, particularly during periods of profound systemic transformation.

Secondly, the results show that most of the downscaling studies have primarily concentrated on the national level (Nykvist, Persson & Persson, 2013; Dao, Peduzzi & Friot, 2018; Häyhä et al., 2016; O'Neill et al., 2018; Parsonsová, 2021, among others). Nykvist, Persson & Persson (2013) can be considered pioneers for their exploration of the relationship between the S&JOS and Sweden's national environmental objectives. In a similar vein, Parsonsová's (2021) review of the downscaling of the SOS to the national level highlights advancements in the development of national indicators. However, the review underscores the imperative for the formulation of a comprehensive downscaling methodology, the establishment of principles centred on justice and equity in resource allocation, and the seamless integration of the S&JOS framework into national policies. O'Neill et al. (2018) have developed indicators to measure the S&JOS and quantified resource use associated with meeting basic human needs and compared this to downscaled PBs for 150 countries. By comparing per capita resource consumption across seven distinct biophysical categories for each nation against the global PBs expressed in per capita equivalences, O'Neill et al. (2018) find that none of countries meet the fundamental needs of their citizens and adhere to sustainable global levels of resource use. As pointed out by Hickel (2019), the study underscores that meeting basic needs of the global population would lead to transgression several environmental thresholds, based on the inherent interconnection between resource exploitation and human well-being (Hickel, 2019).

Thirdly, at the local level, several notable downscaling studies have been undertaken. Hoornweg et al. (2016) present an urban monitoring and communications tool, accompanied by a proposed methodology for the downscaling of PBs from the city's perspective. This approach was applied in cities such as Toronto, Shanghai, São Paulo, Mumbai, and Dakar. In a similar vein, Hachaichi & Baouni (2020) conduct a pioneering study that downscales the PBs framework to the city scale, yielding valuable insights into the Middle East and North Africa (MENA) region. This geographical area, as asserted by the authors, has been significantly underexplored within the scientific discourse. Furthermore, Pasgaard & Dawson (2019) contribute a noteworthy instance of local-level downscaling, utilizing the S&JOS framework to evaluate the interplay between nature conservation and development at the village level in Laos. Of particular significance is their emphasis on the limitations in the conceptualisation of justice as targeting the attainment of a minimal level of well-being (Pasgaard & Dawson, 2019).

#### *Various approaches to downscaling*

Downscaling to sub-global levels can serve various objectives. Addressing footprints, Hoekstra & Wiedmann (2014) advocate for harmonizing environmental footprints and the PB framework.

Expanding on this, Fang et al. (2015) conducted an extensive exploration of the relationship between footprints and boundary indicators, presenting a novel approach for evaluating environmental sustainability known as the footprint-boundary assessment.

Wiedman & Allen (2021) introduced the concept of consumption-based footprint accounting, contending that footprints acquire heightened policy relevance when they can gauge the sustainability of consumption behaviours. This involves comparing consumption with S&JOS thresholds and social foundations. Bjørn et al. (2019) propose that a consumption-based footprint approach could effectively attribute breaches of specific planetary boundaries in certain areas to the usage of goods and services within cities or regions. Parsonsová (2021) notes that data availability issues often hinder consumption-based data at the national level, underscoring the enduring significance of territorial indicators in national PB assessments. An alternative approach to assessing performance is the production-based (territorial) method, as highlighted by Nykvist, Persson & Persson (2013). Furthermore, the life cycle assessment (LCA) offers another avenue to translate the planetary boundaries (PBs) concept into information for product-related decisions. For example, Bjørn et al. (2019) utilize LCA as a tool for this purpose. Additional approaches centre on crafting national 'barometers' or 'portraits' to guide priority areas for action (Cole, Bailey & New, 2014), focus on regional dynamics specific to particular places (Dearing et al., 2014).

#### *Differences in sharing approaches*

Beyond variations in scale and underlying purposes for operationalisation, diverse approaches to sharing approaches of S&JOSs emerge in the review of downscaling studies. Sharing approaches refer to the way of allocating a global or regional shares of a S&JOS in proportion to a quantity such as population, land area, emissions, GDP, etc. along with a specific sustainability perspective based on production, consumption or life cycle. In simple terms, sharing refers to distributing the available resources for a PB or social foundation. Within the assessed literature, three primary sharing strategies have been identified: top-down, bottom-up, and hybrid approaches (Xue & Bakshi, 2022; Fang et al., 2015; O'Neill et al., 2018).

A top-down approach entails establishing boundary thresholds at the global level and subsequently adapting them to the desired sub-global scale, often based on a per capita basis (Häyhä et al., 2016; Xue & Bakshi, 2022). While this technique is relatively effective for the climate change boundary, it encounters difficulties when addressing more regional or localized boundaries, such as those related to biodiversity (Xue & Bakshi, 2022). Xue and Bakshi (2022) posit that this implies 'sharing' nature's capacity among different locations, potentially undermining ecosystem conservation and restoration efforts, while also posing geographical feasibility challenges.

In contrast, a bottom-up approach hinges on customized and typically regional datasets to delineate sub-global boundary thresholds (Xue & Bakshi, 2022). This strategy might be better suited for defining boundaries related to biosphere integrity and social dimensions, given their strong reliance on contextual factors (Xue & Bakshi, 2022).

Lastly, a hybrid approach integrates boundary thresholds at sub-global scales and establishes connections between both local and global information. This simultaneous consideration serves to



protect both global and sub-global S&JOSs, which can then be downscaled to local levels (Xue & Bakshi, 2022).

#### *Allocation principles & justice theory*

Amidst the varied sharing approaches, a range of allocation principles can be employed. Hjalsted et al. (2021, p.10) describe an allocation principle as “a principle by which decisions about how to allocate a given resource between individuals can be made.” The allocation process is normative in nature as it outlines the recommended approach for dividing resources, as asserted by Ryberg et al. (2018). For instance, in the context of climate change, the use of various allocation principles based on differing ethical and normative criteria can yield distinct results in terms of emission reduction responsibilities for countries or regions Hoff et al. (2018). As such, downscaling the S&JOS hinges on divergent viewpoints concerning what constitutes an equitable assignment of responsibility for staying within the social and ecological boundaries, including aspects like emissions, as highlighted by Hoff et al. (2018).

In other words, allocation principles refer to distribution of something (e.g., resources or environmental limits) to be shared. According to Hjalsted et al. (2021), distributive justice concerns the just distribution of goods among agents and has various dimensions. Hjalsted et al. (2021) describe five dimensions of distributive justice, namely: (1) pattern of distribution (e.g., equality), (2) currency (e.g., Gt Co2-eq per year for climate change), (3) target (e.g. European citizens), (4) scope (e.g. regional), and (5) time span (e.g., one generation). There are more allocation principles in the literature than described here, and I do not aim to list them exhaustively. In the following paragraphs I describe some examples of allocation principles.

One frequently discussed principle is the equal per capita allocation (Hjalsted et al., 2021). It allows exploration of the universal quality of life attainable if resources were evenly distributed (O’Neill et al., 2018), and it is often referred to as the egalitarian principle as a principle of distributive justice (Hjalsted et al., 2021). Per capita allocation has been widely recognized as the prevailing sharing principle in the application of distributive justice theory to the S&JOS (Ryberg et al., 2020). In this review, most downscaling studies use per capita allocation.

Another downscaling allocation principles integrates the concept of burden-sharing (Turner and Wills, 2022). Burden-sharing strategies aim for equitable distribution of responsibility (O’Neill et al., 2018; Hickel, 2020), tracking national trajectories over time (Fanning et al., 2022), and assessing cities’ contributions to global boundary trends (Hoornweg et al., 2016). The linked distributive justice principle is prioritisation, describing that “a benefit has greater moral value the worse the situation of the individual to whom it accrues.” (Hjalsted et al., 2021, p.12).

The grandfathering allocation principle bases future emission rights on past emissions and impacts. It is often employed in policymaking due to its pragmatic nature (Hjalsted et al., 2021). However, it tends to favour established large entities and economies, impeding new entrants and smaller economies from market participation or growth, without considering ethical or sustainability practices (Hjalsted et al., 2021). Moreover, the principle’s sensitivity to the chosen reference year for the status quo poses a challenge within a sustainability framework (Hjalsted et al., 2021).

The ability to pay allocation principle based on a country's GDP per capita is proposed as a form of prioritarianism (Hjalsted et al., 2021). This principle prioritises allocating a larger share of the SOS to low GDP nations over high GDP nations, thereby favouring economically disadvantaged and less developed countries (Hjalsted et al., 2021). However, countries with higher GDP, despite contributing larger environmental footprints, receive a smaller SOS share, potentially hindering their efforts to reduce impacts and stay within their allocated share (Hjalsted et al., 2021). As with all allocation principles, the ability to pay principle is influenced by the chosen reference year (Hjalsted et al., 2021).

### *Choice of indicators*

Disparities among various downscaling studies highlight indicator selection discrepancies. However, due to time limitations of the research, a closer comparison based on indicator use is not pursued here. Instead, a concise introduction and overview of potential indicators is presented.

Indicators serve as communication tools, simplifying complex realities and aiding the evaluation of economic, social, and environmental performance for sustainability within socio-ecological systems (Hossain & Ifejika Speranza, 2020). The Zoe Institute (2021) emphasize that each indicator choice has strengths and weaknesses, and numerous feasible indicators exist to encompass diverse subjects.

Indicators serve the purpose of simplifying complex realities and allow for measuring performance (Hossain & Ifejika Speranza, 2020). Critiques have been directed at the indicator selection for the original PBs proposed by Rockström et al. (2009a). According to some authors such as Rockström et al. (2009ab), using the Holocene as a baseline to define the PBs may be relevant for climate, but many indicators are not representative for human development. For example, the land use indicator, scrutinized for its inability to differentiate between various agricultural land conversions and their varying levels of harm (Nykvist, Persson & Persson, 2013). Another example is the species richness as an indicator, which is being debated (Hossain, Ifejika Speranza, 2020). Additionally, limited attention is given to social indicators during S&JOS operationalisation (Hossain & Ifejika Speranza, 2020). Hossain & Ifejika Speranza (2020) outline challenges including initial indicator choice, social dimension oversight, contextualization, and determining indicator types and spatial contexts. They identify three key tasks in selecting regional-scale S&JOS indicators: (1) Identifying indicators representing S&JOS at this level; (2) translating global planetary boundaries to regional scale through adaptable global indicators; and (3) establishing indicators connecting sub-national, national, and global S&JOS (Hossain & Ifejika Speranza, 2020).

Indicators can be single-issue (e.g., one indicator for Nitrogen) or multiple-issue, referring to a set of indicators (Hossain & Ifejika Speranza, 2020; Rockström et al., 2009b). Another distinction relates to identifying slow (e.g., climate change) and fast variables (e.g., food provision) (Hossain & Ifejika Speranza, 2020). Furthermore, indicator spatial context adds complexity, as an indicator can have diverse implications in varying settings (Moldan & Dahl, 2007; Hossain & Ifejika Speranza, 2020). Teah et al. (2016) suggest that, in many cases, a situational trade-off is likely between an unavailable ideal indicator (e.g., accurate approximation of reality) and an alternative proxy of that reality (e.g., less accurate, low resolution), particularly in developing countries as a result of unavailable data or due to limited monitoring capabilities.

### 5.1.5 Downscaling - key themes identified

Several key themes can be observed in the discourse on downscaling the S&JOS to sub-global levels, thereby contributing to answering the research question. A synthesis can be found below. First of all, the S&JOS can be seen as a political construct. Steffen, Rockström, and Constanza (2011) highlight the significance of normative judgment in quantifying PBs. According to Steffen, Rockström and Constanza (2011), while scientific insights provide a foundation, the core of this quantification hinges on human perceptions of risk. Also, within the context of the S&JOS, the integration of safeguards rooted in empirical scientific knowledge are notably influenced by subjective assessments of risk and justice, as underscored in research by Kim and Kotzé (2021), Raworth (2012), and Turner and Wills (2022). In this context, Wiedmann and Allen (2021) argue that the process of downscaling the S&JOS is susceptible to a range of socio-economic, ethical, and political considerations, which involves normative choices that influence the overall approach. While some papers acknowledge and highlight this (Cole, Bailey & New, 2014; Ferretto et al., 2022), there are many studies that omit the normative implications, mostly with the PBs downscaling (Hoorweg et al., 2016; Hachaichi & Bauouni, 2020; Hossain et al., 2017; Persson et al., 2022) and to a much lesser extent with S&JOS downscaling studies (Han, Yu & Qiu, 2023; Dearing et al., 2014).

Secondly, there are several justice dimensions in defining S&JOS boundaries. Various downscaling studies have addressed the justice dimensions in downscaling PBs and social foundations to sub-global levels (Rockström et al., 2023; Hjalsted et al., 2021; Kim & Kotzé, 2021; Hossain and Ifejika Speranza, 2020, among others). While one can argue for an observed trend in incorporation of justice elements in S&JOS operationalisation, Gupta et al. (2021) suggest that there remains a gap in social science research, specifically the lack of comprehensive analyses regarding the justice dimensions inherent in setting targets for PBs. Echoing this sentiment, Kim and Kotzé (2021) argue that a unified conceptual framework for downscaling is conspicuously absent. They propose integrating the politics of downscaling within this conceptual framework and emphasize the inclusion of numerous ethical considerations (Kim and Kotzé, 2021). For instance, Hossain and Ifejika Speranza (2020) advocate for an approach that transcends geographical boundaries and extends beyond a mere place-based territorial perspective.

To illustrate matters of justice and equity within the context of climate change, the direct translation of global boundaries onto individual nations is suggested to undermine the accountability of those responsible for pollution (Hossain and Ifejika Speranza, 2020). Hossain and Ifejika Speranza (2020) argue that this approach also disregards the entitlement of inhabitants in developing countries to sustainable development, particularly when their contributions to pollution have been minimal compared to their counterparts in developed nations, yet they face more severe consequences of climate change. Steffen et al. (2015) acknowledge that the PBs framework does not address the 'deeper issues of equity'. This is considered a significant limitation of the framework when determining a 'fair share' of responsibility in safeguarding the boundaries (Kim & Kotzé, 2021).

Thirdly, when exploring the dimension of justice in setting boundaries and thresholds, allocation principles that lay out how to allocate given resources emerge as pivotal. As described previously in section 5.1.4, a range of allocation principles can be employed, and many downscaling efforts adopt a per capita boundary approach (O'Neill et al., 2018, Hoff, Nykvist & Carson (2014); Nykvist, Persson & Persson (2013), among others). However, O'Neill et al. (2018) suggest that a per capita approach might

not be the most suitable means of resource management. They advocate for a deeper comprehension of equity and responsibility to be incorporated (O'Neill et al., 2018). Furthermore, they acknowledge that a more profound understanding of equity may necessitate a concept of shared responsibility between producers and consumers (O'Neill et al., 2018).

The equal per capita approach does not account for a 'just' distribution. For instance, it fails to consider scenarios where one individual requires more daily calories than another, possibly due to work demands or gender differences (Hjalsted et al., 2021). Another critique is that this approach only accounts for individuals alive at the time of allocation, disregarding the fact that portions of S&JOS may have already been allocated to individuals who are no longer living – a factor overlooked by this principle (Hjalsted et al., 2021).

Fourthly, there is a need to democratize the S&JOS. Much of the downscaling work has been focused on utilising the SOS or S&JOS for sustainability assessment (Han, Yu & Qiu, 2023). Additionally, many downscaling efforts are led by experts and possess a highly technical nature (Turner & Wills, 2022). In fact, the initial development of the PBs framework and the S&JOS framework was predominantly led by the scientific community, prompting concerns about democratic legitimacy (Pickering & Persson, 2020). However, the potential for downscaling the S&JOS to serve as a deliberative and reflexive exercise for other stakeholders such as citizens, decision-makers and private actors remains underexplored within the literature.

Moving towards a S&JOS necessitates actions both at the global and local scales (Raworth, 2012). An essential challenge facing the S&JOS framework is the definition of context-based S&JOSs, requiring translation, operationalisation, or downscaling to render it practicable for diverse contexts (Keppner et al., 2020). While the original boundaries for the SOS and S&JOS were established by the scientific community, the identification of S&JOSs involves ethical and political decisions. Consequently, operationalising the S&JOS for decision-making at sub-global scales should involve at least engaging relevant actors (Häyhä et al., 2016; Hossain & Ifejika Speranza, 2020). Hossain & Ifejika Speranza (2020) argue that regional-scale S&JOS necessitates a transdisciplinary approach aimed at negotiating and integrating various actor visions.

As previously mentioned, Furthermore, global inequalities and differing perspectives on sustainable development have constrained the political utility of the Planetary Boundaries framework (Kim & Kotzé, 2021). Häyhä et al., (2016) emphasize that iterative dialogue and continuous collaboration between scientists and policymakers are indispensable due to the evolving scientific understanding of global systemic risks in conjunction with increasing human pressures on ecosystem resilience at a planetary level. Häyhä et al. (2016) argue the collaborative approaches between scientists and policymakers ensure legitimacy and a robust scientific foundation.

The process of operationalizing S&JOS at sub global levels underscores that designing S&JOS is not solely a scientific endeavour but also an ethical and political choice, necessitating the participation of relevant stakeholders (Häyhä et al., 2016; Hossain and Ifejika Speranza, 2020). Pasgaard & Dawson (2019) stress the significance of understanding for whom and by whom the S&JOS is designed, identifying those willing to accept it, and acknowledging those who possess the authority to make

decisions and ensure the effective implementation of the S&JOS (Pasgaard & Dawson, 2019; Hossain and Ifejika Speranza, 2020).

Within the literature, several suggestions for designing S&JOSs have been put forth. One approach is a transdisciplinary method aimed at negotiating and integrating the diverse perspectives of different stakeholders (Hossain and Ifejika Speranza, 2020). To facilitate this process, Hossain and Ifejika Speranza (2020) propose the establishment of social learning spaces and deliberative processes, enabling actors to confront their varying mental models of change and encourage contemplation about their own actions and their potential repercussions.

#### 5.1.6 Identified knowledge gaps

Knowledge gaps are part of the scientific discourse, and identifying some of these gaps can therefore inform answering the research question. The following paragraphs outlays some of these research gaps, as identified in the reviewed literature.

As pointed out by Han, Yu & Qui (2023), only a limited number of studies have directly addressed the complexities of spatial heterogeneity and temporal dynamics in relation to environmental performance and human well-being. Prior investigations into sustainability using the S&JOS framework can be categorized into static sustainability assessments of social-ecological systems confined to specific time frames or analyses of temporal fluctuations in overall regional summaries. There are limited studies that have directly addressed spatial heterogeneity and temporal dynamics in environmental performance and human well-being (Han, Yu & Qui, 2023). Also, Lucas & Wilting (2018) underscore the need for upcoming analyses to give greater attention to the spatial and temporal characteristics. According to Lucas & Wilting (2018), it is evident that local conditions and temporal variabilities exert a pivotal influence on determining the extent of sustainable resource utilization and acceptable emission levels (Lucas & Wilting, 2018).

Secondly, much downscaling studies have focused on the national or region scales there is a need for a scalable and transferable method for measuring sustainability of S&JOSs at local scales. According to Han, Yu & Qui (2023), as sustainable is typically pursued by governments, corporations, communities, and key stakeholders at various levels (e.g., national, regional, and local), policy-oriented S&JOS downscaling needs to be able to address sustainability issues across scales and socio-ecological contexts.

Thirdly, Han, Yu & Qiu (2023) argue that what remains less addressed in sustainability assessments based on the S&JOS is the consideration of both biophysical processes as well as social well-being. They suggest this is crucial as there are complex relationships, such as synergies and trade-offs, between different policy goals or SDGs (Han, Yu & Qiu, 2023).

#### *Summary*

The S&JOS can be seen as an integration of PBs framework with the concept of social foundations introduced by Raworth (2012). This framework is intended to assess the sustainability of social-ecological systems. The PBs framework defines critical Earth-system boundaries essential for maintaining a stable Earth system, while the S&JOS adds a social dimension to this assessment. The

PBs framework has undergone updates in 2015 and 2023, identifying nine critical Earth-system boundaries.

The S&JOS framework has garnered attention in recent literature, particularly concerning its downscaling to specific national or regional contexts. Downscaling involves making the conceptual framework operational at smaller scales. Researchers have explored various approaches to downscaling, including top-down, bottom-up, and hybrid methods. Allocation principles, such as per capita allocation, burden-sharing, and the ability to pay, are employed to distribute available resources or responsibility for staying within environmental limits. Indicator selection is pivotal in downscaling studies, encompassing single-issue and multiple-issue indicators, as well as considerations for slow and fast variables and spatial contexts. Downscaling the S&JOS framework aids in assessing regional and local impacts of global environmental changes.

The discourse on downscaling the S&JOS to sub-global levels reveals several key themes. Firstly, the S&JOS is regarded as a political construct, with normative judgments playing a pivotal role in quantifying PBs and social foundations. The integration of safeguards is influenced by subjective assessments of risk and justice. Secondly, justice dimensions in defining S&JOS boundaries are explored, highlighting the challenges of setting targets for PBs and the need for a unified conceptual framework. There is concern that the direct translation of global boundaries onto individual nations undermines responsibility and equitable development. Thirdly, allocation principles for resources are discussed, with criticisms of the per capita approach and calls for a deeper understanding of equity and shared responsibility. Lastly, democratizing the S&JOS and involving diverse stakeholders in its operationalisation are emphasized, recognizing the ethical and political nature of the process. Knowledge gaps include the need for more consideration of spatial heterogeneity, temporal dynamics, and the integration of biophysical processes and social well-being in S&JOS operationalisation, particularly at local scales.

## 5.2 Results 2 – How complementary are the Framework for Strategic Sustainable Development and the Safe and Just Operating Space?

The following chapter addresses the results related to the research question: How does the Framework for Strategic Sustainable Development (FSSD) compare to the Safe and Just Operating Space (S&JOS), and in what ways can the FSSD potentially complement and support the operationalisation of the S&JOS at sub-global levels? First, the results of the literature review are presented. Following that, the interview results are outlined. It includes the comparison between the S&JOS and the FSSD, their complementarity, as well as the respondents’ view on how the FSSD can support EU policymaking and transformative change. Finally, the chapter lays out a summary that addresses the research question.

### 5.2.1 Literature review

For the literature review, I employed the search terms 'Framework for Strategic Sustainable Development' along with the inclusion of 'Planetary Boundaries' and 'Safe and Just Operating Space.' However, the yielded results were notably limited in number and in scope. There were no papers that compare the FSSD and the S&JOS. However, one study by Robèrt, Broman, and Basile (2013) comprises of an examination of the PBs from the standpoint of the FSSD. In analysing the PBs through the FSSD, the authors identify at least three fundamental challenges and suggest how the FSSD can improve and inform the PBs framework. A summary of the challenges and FSSD improvements is presented in Table 2 below.

<b>Table 2 - Fundamental challenges with PBs from an FSSD perspective (Robèrt, Broman, and Basile, 2013).</b>	
<b>PB fundamental challenges</b>	<b>FSSD improvements</b>
<ul style="list-style-type: none"> <li>▪ The PBs does not contemplate the underlying mechanisms that move humanity towards critical planetary boundaries, hindering proactive and preventive actions. Understanding such mechanisms can help with early corrective actions to avoid problems before they arise.</li> </ul>	<ul style="list-style-type: none"> <li>▪ The FSSD seeks to identify mechanisms that move humanity towards critical planetary boundaries as sustainability principles, offering a comprehensive systems-based strategy for early corrective and mitigating measures.</li> </ul>
<ul style="list-style-type: none"> <li>▪ PBs involve uncertainties and identifying all critical boundaries is challenging.</li> </ul>	<ul style="list-style-type: none"> <li>▪ The FSSD offers a principle-based practical approach that doesn't rely on precise knowledge of PBs or tipping points, enabling robust action strategies despite inherent uncertainty.</li> </ul>
<ul style="list-style-type: none"> <li>▪ On the condition that underlying basic mechanisms are known (as mentioned above), not having an organisational and sectoral dimension in a sustainability framework could slow down proactive sustainability efforts that require cooperation and feedback loops.</li> </ul>	<ul style="list-style-type: none"> <li>▪ The FSSD bridges the gap of individual decisions to the global sustainability challenges by combining boundary metrics with explicit mechanisms, fostering cooperation across various scales and disciplines to strategically address global sustainability challenges posed by the PBs.</li> </ul>

In terms of literature that is solely focused on the FSSD, the literature search located 12 studies. Some papers were written by the original authors of the FSSD themselves and others by scholars who applied the FSSD in various contexts. In their 2017 work, Broman & Robèrt provide a thorough overview of the latest iteration of updates incorporated to the FSSD. They detail its development method, discuss its rationale and benefits, and validate the advantages with practical examples.

Noteworthy is that there exists a limited body of scientific literature that offers critiques of FSSD, unlike the comprehensive scrutiny observed in the case of the PBs and the S&JOS frameworks. Upham (2000a) has highlighted concerns regarding the clarity, comprehensiveness, and scientific basis of the FSSD. He suggests that the framework might be susceptible to ambiguity, subjective value judgments, and potentially could advocate actions that lack scientific support. In a separate work, Upham (2000b) presents concerns related to implicit reasoning and value judgments, along with unstated assumptions. Furthermore, the rhetorical utilization of risk assessment and the FSSD's primary focus on persuasion, rather than being entirely grounded in science, are also raised as concerns in Upham's work. However, this criticism seems to be outdated with the FSSD having evolved significantly since 2000.

Indeed, despite the limited scientific articles that scrutinize the FSSD in the literature, it has evolved significantly over the past three decades, and incorporated feedback and criticisms through peer discussions, as described in Broman & Robèrt (2017). Broman & Robèrt (2017) point to that what constitutes the FSSD today is the result of several iterations since the 1990s, including Robèrt (1994), Holmberg (1995), Broman, Holmberg & Robèrt (2000), Robèrt (2000), Robèrt et al., (2002), Ny et al., (2006), Missimer, Robèrt & Broman (2017ab). The most recent and major change focused on improving the framework's part on social sustainability. Missimer (2015) posited that the social sustainability definition within the FSSD at the time was deficient both in theory and practical application. As a result, Missimer worked on refining the FSSD's social dimension to support tangible planning and decision-making more effectively for strategic sustainable development (Missimer, 2015).

### 5.2.2 Interviews with FSSD scholars and experts

As outlined in section 4.1.1, I aimed to triangulate different methods to answer the same research question. Therefore, interviews were conducted with seven respondents: four sustainability research scholars, two university lecturers in strategic sustainable development, and one NGO member in landscape restoration. Five out of seven respondents reported to currently use the FSSD in their jobs. Respondents had varying levels of familiarity with the S&JOS framework.

The subsequent sections will outline the main similarities and differences between the FSSD and the S&JOS, how the FSSD complements the S&JOS, its application in EU policymaking, its relation to transformative change, and provide a summary of the answer to the research question.

#### *Comparing the FSSD and the S&JOS*

To understand if and how the FSSD complements the operationalisation of S&JOSs at sub-global levels, a comprehensive comparison between the two was undertaken. The main similarities and differences as highlighted by respondents are summarised in Table 3 and will be elaborated in subsequent sections.



**Table 3 - Main similarities and differences between the Framework for Strategic Development and the Safe and Just Operating Space framework.**

<b>Similarities</b>	
<ul style="list-style-type: none"> <li>▪ Both frameworks are rooted in a science-based perspective</li> <li>▪ Both frameworks aim to define a safe and just operating space</li> <li>▪ Both frameworks strive to establish a baseline for sustainability, but do not necessarily aim for something beyond sustainability</li> <li>▪ Both frameworks are designed to be universally applicable, transcending cultural and temporal boundaries</li> <li>▪ In both frameworks, ethical perspectives are likely to have influenced the development</li> </ul>	
<b>Differences</b>	
<b>FSSD</b>	<b>S&amp;JOS</b>
<ul style="list-style-type: none"> <li>▪ Abstract and principle-based starting point</li> </ul>	<ul style="list-style-type: none"> <li>▪ Concrete and salient priority issue starting point</li> </ul>
<ul style="list-style-type: none"> <li>▪ Looks at root causes of sustainability problems</li> </ul>	<ul style="list-style-type: none"> <li>▪ Aims to establish absolute limits in terms of outcomes, does not address root causes</li> </ul>
<ul style="list-style-type: none"> <li>▪ Offers procedural approach for organisational planning</li> </ul>	<ul style="list-style-type: none"> <li>▪ Does not offer a procedural approach, less actionable for organisations at sub-global levels</li> </ul>
<ul style="list-style-type: none"> <li>▪ Takes a precautionary approach</li> </ul>	<ul style="list-style-type: none"> <li>▪ Focuses on defining specific limits (e.g., from a toxicology perspective)</li> </ul>
<ul style="list-style-type: none"> <li>▪ Social principles define social sustainability based on the adaptive capacity of social systems</li> </ul>	<ul style="list-style-type: none"> <li>▪ Social foundations align with the 2030 Sustainable Development Goals (SDGs) and do not define social sustainability</li> </ul>

*Similarities and differences*

The S&JOS and the FSSD share several similarities in their approaches and objectives. Both frameworks aim to define a safe and just operating space for humanity (Broman) and are rooted in a science-based perspective (Daly). They are also designed to be universally applicable, transcending cultural and temporal boundaries (Daly). Daly mentioned that while not formally ethical documents, it is likely that the researchers' ethical perspectives influenced the development of both frameworks. Furthermore, Ploeg noted that the FSSD's ecological sustainability aligns well with the planetary boundaries (Ploeg). It is noteworthy that Daly emphasized that both frameworks strive to establish a sustainability baseline rather than aiming for something beyond sustainability.

While some similarities were discussed, most respondents primarily focused on differences in approaches and characteristics between the two frameworks. Firstly, Daly stresses the distinctness of S&JOS and FSSD as separate frameworks with differing orientations (Daly). Moore explains that the FSSD has an abstract and principle-based starting point, contrasting with the concrete priority issues in the PBs (Moore). While the PBs mainly aim to define limits from a toxicology perspective (Daly), the FSSD adopts a precautionary approach rooted in the system's adaptive capacity (Daly, Johnson). Three

respondents stressed that the FSSD's broader view can capture aspects potentially overlooked by the S&JOS framework (Moore, Daly, Johnson). For example, while the PB for novel entities (e.g., plastics) remains undefined, a violation of the FSSD's second sustainability principle encompasses all the different combinations of how humanity is polluting the Earth without having to anticipate or identify and list them (Daly). Therefore, Daly argues that the only solution would be to stop systematically increasing the emission of any substance that accumulate and cannot break down in nature. Johnson expressed a similar sentiment:

*"The FSSD is less likely to overlook things because it does not wait for evidence."*

Secondly, Broman highlights another distinction, noting that PBs and the S&JOS establish absolute limits (e.g., for climate change), yet fail to address the underlying causes of approaching or surpassing these limits. Conversely, the FSSD enables an analysis of the fundamental drivers behind problems (Broman). Broman argues that this omission in the S&JOS framework poses a challenge for organisations seeking to understand how they can effectively contribute to sustainability in their operations (Broman).

It is good to point out that in an interview with Grcheva an employee from Doughnut Economics Action Lab (DEAL), of which Kate Raworth is the cofounder and conceptual lead, I mentioned the criticism of absent underlying causes by the S&JOS framework. Grcheva pointed out the difference of looking at the Doughnut in a simplified way, compared to looking at Doughnut economics as a whole. Grcheva described that just looking at the framework refers to an "outcome-based" way of using the Doughnut, with the indicators and how to downscale those. However, Doughnut Economics, according to Grcheva, contains a more elaborate methodology. She mentioned that in this underlying methodology is what addresses the core practices: mindsets. Grcheva mentioned the following:

*"Doughnut Economics does identify the core problems, but it does not offer the solutions. The solutions will inevitably have to be place-based. And that is what practitioners are doing. They are the ones to experiment."*

Thirdly, Moore highlights FSSD's organisational planning focus, while pointing out that the S&JOS relies on global data, making it less user-friendly for organisations. Unlike the S&JOS, the FSSD lacks quantified boundaries but offers SMART actions for system-level compliance (Broman). The FSSD's systems-based approach is applicable at various scales, while downscaling S&JOS to sub-global levels poses challenges (Baumgartner). Three respondents consider that the S&JOS is less actionable for entities compared to the FSSD (Broman, Moore, Baumgartner).

Finally, the FSSD's social sustainability principles focus on social systems' adaptive capacity, while the social foundations of the S&JOS align with the SDGs as global goals (Johnson, Daly). Johnson highlighted that the FSSD's social principles, describing structural obstacles, are more academically oriented, while the social foundations serve as a practical starting point (Johnson). However, respondents mainly focused on the ecological differences and referred much less to the social side. Johnson also noted that comparing with the social foundations was harder than the ecological side (Johnson). These differences underscore the contrasting features and scopes of the two frameworks.

*How can the FSSD complement and support the S&JOS framework for organisations?*

All seven respondents affirmed the FSSD's potential to complement and support S&JOS (Broman, Moore, Daly, Ploeg, Baumgartner, Johnson, Sroufe). However, one respondent noted that complementarity depends on the context, as both frameworks serve distinct purposes (Daly). While S&JOS might suit novices, FSSD's sustainability principles hold greater value for designers or when evaluating new ideas (Daly). The following paragraphs presents FSSD's complementary role in relation to S&JOS.

First of all, three respondents indicate the FSSD's complementary role with the S&JOS through its sustainability principles, addressing gaps when specific boundaries are unknown, employing the precautionary principle (Daly, Ploeg, Broman, Sroufe). These principles offer a broader perspective (Ploeg) and explain why certain global limits are approached (Broman), fostering root cause focus for core issue resolution (Broman). For climate change for example, the FSSD's sustainability principles elucidate rising fossil carbon emissions' impact on reaching the limit (Broman). Moore notes the challenge of quantifying all PBs, highlighting preventive measures' significance, while Baumgartner asserts FSSD's value in evaluating system alignment and progress toward sustainability principles. Ploeg concisely phrases it as follows:

*“The FSSD has a principle-based approach, and because the principles are science-based and not worldview-based or philosophy-based, they can guide us through the safe and just operating space framework to make sure that anything that we learn about the framework reduces the risk of us making mistakes along the way.”*

As illustrated in the previous section, a violation of the FSSD's sustainability principle two (meaning to systematically increase concentrations of substances produced by society), suggests the importance of the precaution for more proactive and safe sustainability approaches. Baumgartner also emphasizes the importance of the FSSD's third sustainability principle, being able to address ecosystem functionality and restoration, integrating biodiversity concerns into decision-making (Baumgartner). On the social side, the FSSD's five social sustainability principles, per Daly, offer a distinct perspective, identifying issues that may be overlooked by the SDGs or the social foundations (Daly).

Secondly, respondents proposes that FSSD's procedural support can complement the S&JOS (Moore, Broman, Sroufe). While the S&JOS has global orientation, posing challenges for context-specific application (Moore), the FSSD can guide systemic and strategic action within limits (Broman). This enables organisations to align their actions with the global scale (Broman). Per Broman states that organisations' operational success and adherence to strategic guidelines hinges on the FSSD's five-level model. Clear guidance on smart actions is needed to translate limits into practical steps (Broman). Hence, strategic guidelines and actionable approaches from the FSSD are essential for success (Broman). These points are exemplified by Broman's statement:

*“Neither the planetary boundaries nor the SDGs come with procedural support for how to work with them in organisations. They are just presented as global overall boundaries or goals. The SDGs come with some procedural support, but it is vague. So, it does not help organisations much to come up with smart actions in their daily operations. Therefore many organisations do not know what to do, so, they tend to pick one or a few of those goals and disregard the others, which is completely against the intention with the SDGs.”*

Thirdly, Broman suggests that the FSSD can aid pinpointing the 'smart zone' for sustainable development (Broman), guiding effective regulatory navigation for organisations without financial strain (Broman).

Moreover, FSSD not only aids organisations but also propels positive societal transformation (Broman). Successful, strategic sustainability pursuits serve as role models, sparking adoption and accelerating change (Broman). Conversely, lacking strategy and financial struggle impede societal progress and sustainability goals (Broman).

Finally, when asked specifically about whether the FSSD could help make boundary-defining processes more democratic yet science-based, Broman provided the following response:

*“There is no contradiction between having a science-based, principled, and explicit definition of sustainability on the one hand and democracy or inclusive leadership on the other. On the contrary, such a definition is helpful for avoiding misunderstandings based on unclarity of basic scientific knowledge and true differences in views and values become clearer if they are not muddled with such misunderstandings. This is beneficial for democracy and inclusive leadership by giving us more time for discussions about things that we actually disagree about based on different views and values.”*

#### *Challenges identified with integrating the FSSD and the S&JOS*

While numerous avenues were identified for potential FSSD complementarity with S&JOS, respondents also highlighted key challenges in the integration of the two frameworks. One key challenge, according to Ploeg, is the relative inaccessibility of both frameworks (Ploeg). For instance, comprehending the three ecological sustainability principles requires a basic understanding of thermodynamics, knowledge not everyone holds (Ploeg). Thus, there is a certain level of difficulty in grasping the language and concepts within both the S&JOS and the FSSD (Ploeg).

Considering S&JOS operationalisation, Broman posed that another key challenge is whether the top leadership is involved and committed and whether there is an infrastructure within the organisation that can facilitate the necessary dialogues. Lastly, in the context of integrating both frameworks, Johnson argued that the social side of things are subtle and more complex (Johnson). He suggests that it is more challenging to identify what is unsustainable in the social context than with environmental matters (Johnson).

#### *FSSD and EU policymaking*

Respondents also address the FSSD's possible specific role in supporting the EU policymaking. Broman notes that the FSSD's potential in guiding and informing policies ranges across levels, while Moore proposes that combining the FSSD and the S&JOS may address silos within governments and promote strategic thinking for cross-boundary challenges. Baumgartner advocates a combination of both frameworks for effective policymaking to surmount policy isolation and contradictions, fostering balanced strategies. Daly advises using the FSSD and the S&JOS as robust policy. She suggests integrating FSSD's ABCD approach with the EU planning models for flexibility (Daly).

Johnson urges that a precautionary, principled approach with ecological sustainability and systemic thinking can address structural obstacles and promote fairness in EU policymaking. Ploeg also

emphasizes that both the FSSD and the S&JOS can consider unintended consequences in policymaking. Additionally, he suggests that stakeholders can infuse sustainability visions with high-level values in S&JOS operationalisation processes. Ploeg illustrates that sustainability principle eight, 'meaning-making' (referring to that people are not systematically facing structural obstacles that hinder their ability to create individual meaning and collectively cocreate common meaning), plays a crucial role in the S&JOS operationalisation process and underlines that active involvement empowers individuals with agency and intrinsic motivation to pursue aspirational approaches beyond sustainability (Ploeg).

### *The FSSD & transformative change*

When asked about how the FSSD complements and supports the S&JOS framework for transformative change, several key themes were recurrent in the data. Ploeg emphasizes again how S&JOS addresses specific indicators relevant to the current context, while the FSSD delves into the root causes of sustainability issues. Thus, embracing the eight sustainability principles drives transformative change, argues Ploeg.

Daly suggests that, during the S&JOS operationalisation, the inner perspective of the convener and the small conversations between powerful individuals play a crucial role in driving change, highlighting the need to intentionally create spaces that promote connection, trust, and meaningful dialogue, which are not explicitly addressed in existing frameworks but are essential components of the transformative process (Daly).

Broman suggests a procedural support system for sustainability initiatives at the organisational level, motivating others to adopt strategic sustainability approaches, fostering a positive cycle of societal change and increasing the likelihood of success before critical tipping points are reached. Failing to execute sustainability efforts can hinder the whole organisation's progress. If sustainability efforts are not strategically executed and lead to financial setbacks, they can impede the wider societal progress and reduce the probability of attaining sustainability goals before reaching critical thresholds (Broman).

Furthermore, Baumgartner recommends combining backcasting with sustainability visions and strategic thinking for transformative potential at the corporate level. Embracing an inclusive stakeholders approach, innovation, and radical openness to new ideas becomes the starting point for driving meaningful transformation (Baumgartner).

Finally, Johnson advocates for setting aggressive targets to ensure progress and compensate for accumulated debt in the system. Soft targets have hindered sustainable development progress (Johnson).

### *Summary*

In summary, the FSSD and the S&JOS share similarities in their science-based approach, the pursuit of a safe and just operating space, and consideration of ethical perspectives. However, they differ in their starting points, with the FSSD focusing on root causes and offering actionable guidance, while the S&JOS defines specific limits without addressing underlying causes of sustainability problems. The FSSD can complement the S&JOS by providing sustainability principles, procedural support, and a broader perspective, but challenges such as accessibility, the technicality of the frameworks, and addressing social complexity must be navigated.

Furthermore, the FSSD can play a central role in EU policymaking by offering a principled and science-based approach that can bridge policy silos. It could also contribute to transformative change by emphasizing root cause analysis, collaboration, and inclusion, thereby accelerating progress toward sustainability goals. Despite limited direct literature comparing the two frameworks, the experts interviewed recognize the potential synergy between the FSSD and the S&JOS and suggest that their integration can enhance sustainability efforts at sub-global levels and in policy-making contexts.

### 5.3 Results 3 – An EU Safe and Just Operating Space: policy goals and scientific insights

This chapter presents the results regarding the research question: What are the normative goals and visions linked to a Safe and Just Operating Space articulated in EU biodiversity and climate policies, and how do they compare to the EU downscaled Safe and Just Operating Space made by scientists? For the climate change and biodiversity boundaries, the findings have been categorized into four sections. First, an analysis of policy documents; second, insights from interviews with EU officials; third, the boundaries or thresholds as discussed or proposed by scientists; and four, based on the analysed climate and biodiversity documents, an analysis of human rights and social justice. Finally, an integrated summary is provided answering the question.

#### 5.3.1 Climate change policy document analysis

In a EUR-Lex analysis for both the climate change boundary as well as the biodiversity boundary (see section 5.3.4), an in-text ‘exact word phrase’ was conducted using the search terms ‘planetary boundary’ and the plural ‘planetary boundaries’. Consolidated versions and corrigenda were excluded ex-ante in the search query. The search term ‘planetary boundary’ resulted in 12 EU official documents while the plural ‘planetary boundaries’ resulted in 216 documents. Combining the two search queries and omitting overlapping and inaccessible documents resulted in 198 documents for analysis. The PBs were mentioned a total of 497 times. It's noteworthy that references to scientific studies are also counted in this category. Most documents date after 2019, coinciding with documents accompanying Green Deal legislation (e.g., European Climate Law, Soil Health Law etc.), as can be seen in Figure 10 below.

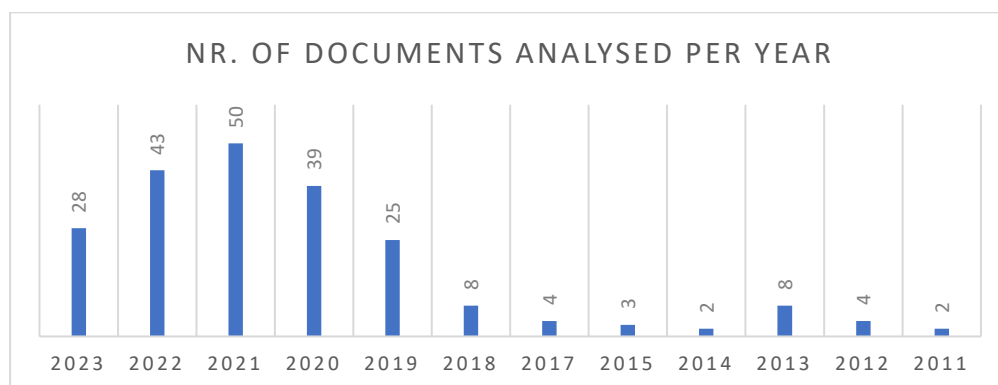


Figure 10 - Number of documents analysed per year.

In 26 documents, there was a specific reference to the climate change boundary. Occasionally, original works like Rockström et al. (2009ab) or studies that use the PBs framework are cited. Interestingly, in most cases, which account for 128 out of the 198 documents, the PBs receive only a single mention, typically serving as a reminder of the importance of respecting these boundaries in relation to sustainable growth and competitiveness. In 28 documents, the PBs are mentioned twice and in 15 documents three times. The documents with the most mentions of the PBs are related to the 7<sup>th</sup> Environment Action Program (EAP), and to some extent the 8<sup>th</sup> EAP. The PB for climate change was often mentioned in the context of the European Climate Law, for example (European Commission, 2020a, p. 10):

*“To maximise prosperity within the planetary boundaries and to increase resilience and reduce vulnerability of society to climate change.”*

Finally, the most prevalent document types have been summarised in Figure 11, which includes Commission Staff Documents, Opinions from the European Environmental and Social Committee (EESC), European Parliament Resolutions, and Communications, often originating from the Commission.

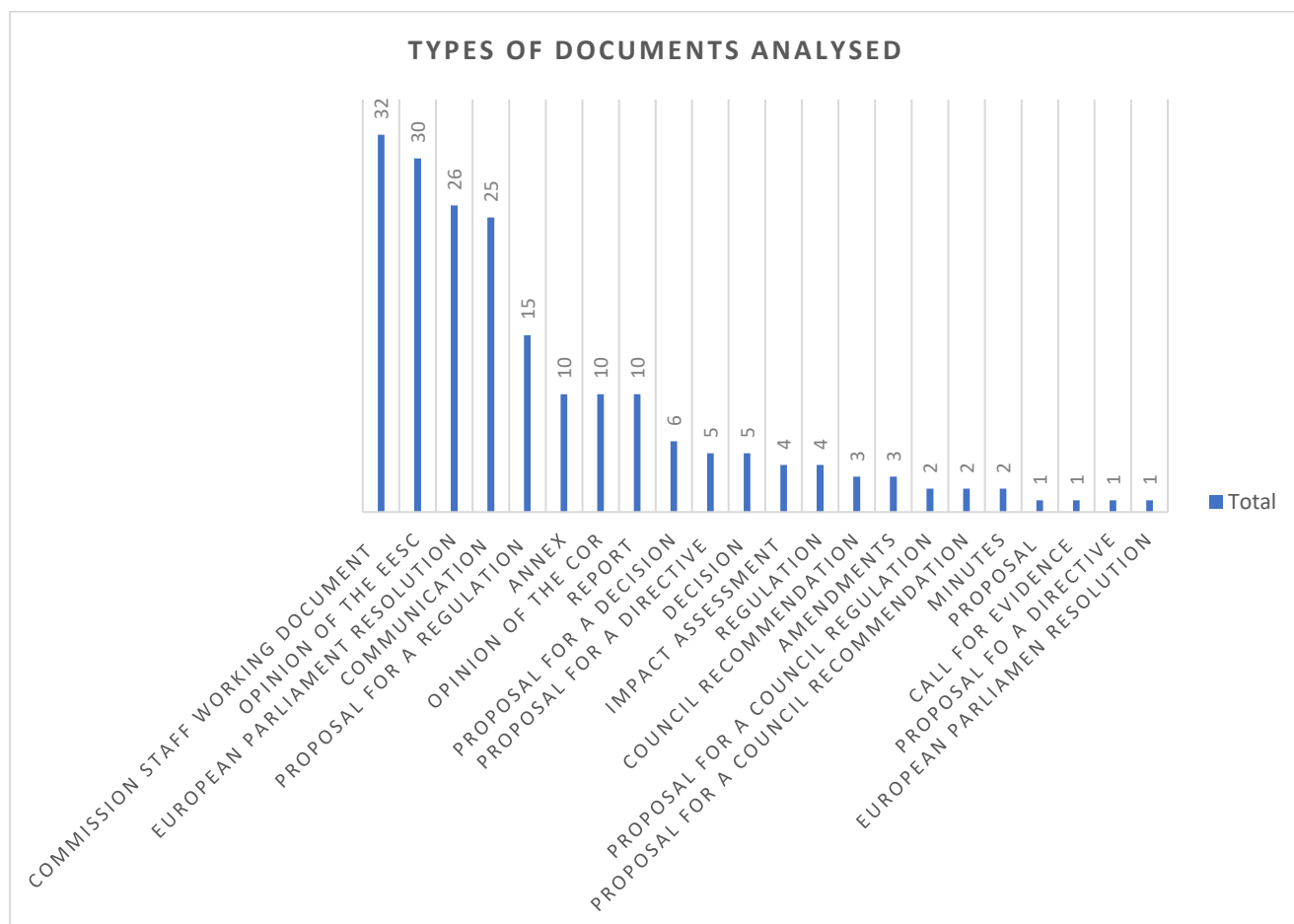


Figure 11 – Number of documents analysed per type.

In addition to the EUR-lex document analysis, several other documents complemented the analysis to identify the stated policy goals and visions related to climate change. In the documents, I looked for the specific terms ‘planetary boundary’, ‘planetary boundaries’ in relation to climate change or any stated goal related to climate change. Noteworthy is that the PB for climate change only relates to climate change mitigation and does not include climate adaptation or climate resilience goals. Therefore, climate adaptation and resilience goals are not considered.

The results of the policy document analysis show that international processes at the UNFCCC level influence EU climate policy (European Union, 2023a). The EU, through the Paris Agreement, is committed to limiting the global temperature increase to well below 2 degrees Celsius and aiming for 1.5 degrees Celsius above pre-industrial levels (European Union, 2023a). Under the Glasgow Climate Pact, adopted on 13 November 2021, the Conference of Parties (COP) recognized the importance of



limiting temperature increase to 1.5 degrees Celsius and the EU pledged to strengthen the 2030 targets by the end of 2022 (European Union, 2023a).

The EU's overarching climate policy goal is to achieve "no net emissions of greenhouse gases by 2050" (European Union, 2023a, p.1). The EU has also committed to reducing economy-wide greenhouse gas emissions by at least 55% compared to 1990 levels by 2030, as outlined in Regulation (EU) 2021/1111 (European Union, 2023a; European Council, n.d.). Swift emission reductions and enhancement of carbon sinks are laid down in Regulation (EU) 2021/1119 (European Union, 2022).

The 8th Environment Action Programme (EAP) describes the goal "to accelerate the green transition to a climate-neutral, sustainable, non-toxic, resource-efficient, renewable energy-based, resilient, and competitive circular economy in a just, equitable and inclusive way, and to protect, restore and improve the state of the environment by, inter alia, halting and reversing biodiversity loss. It supports and strengthens an integrated policy and implementation approach, building upon the European Green Deal." (European Union, 2022, p.8). The long-term policy objective mentioned, emphasizes the idea that people should thrive within the boundaries of the planet in a well-being economy (European Union, 2022, p.8). It was found that the PBs were posed to be central in the design of the European Union's 7<sup>th</sup> Environment Action Programme (EAP), which sets out the EU ambition of 'Living well, within the limits of our planet' (Hoff et al., 2017). However, it has not been specified how exactly they planned to do this and have not been systematically integrated into EU policymaking (Hoff et al., 2017)

### 5.3.2 Interviews with EU experts

EU experts were interviewed to gather their perspectives on the main political goals and visions regarding EU climate policy. While not specifically relating to climate, Lung points out that the PBs are mostly related to EU vision documents:

*"The planetary boundaries and the idea of a safe operating space we see mostly fitting into the context of overarching strategies, such as the eight EAP for example."*

However, Lung points out that while most people may agree with this vision, the practical implications for Member States in terms of staying within planetary limits are far less defined.

Respondent #2, an EU expert in the Belgian Federal Agency who chose to remain anonymous, emphasizes that the EU's primary climate goal is evidently laid out in the European Climate Law, which sets a 2050 target for climate neutrality (Respondent #2). Moore specifies the core climate and energy policy goals, which form the foundation of the policy framework, referring to a 55% greenhouse gas reduction by 2030, renewable energy targets, and attainment of energy efficiency.

Tulkens highlights that the European Commission's primary climate policy goals revolve around the European Green Deal, suggesting the importance of monitoring of Green Deal progress. Respondent #2 also mentions the Green Deal, referring to it as a growth strategy to enhance competitiveness of the economy and strengthen the industrial base. According to Respondent #2, while there are economic implications of EU climate policy, he also stresses that EU climate policy is prioritising social inclusion, with a specific focus on supporting vulnerable groups.

Finally, climate neutrality's go hand in hand with negative emissions to counter overshoot, according to Respondent #2. According to Respondent #2, this dual goal integrates both, crucial for long-term

carbon removal implications (Respondent #2). Notably, he admits that his view is influenced by the nature of his work. Conversely, Respondent #3, an EU Official in DG Climate Action, does not consider negative emissions as a core objective but suggests that ensuring effective sinks is one approach to reducing net emissions (Respondent #3).

It is noteworthy that when asked if the EU climate policy goals are directly related to environmental and social boundaries suggested or discussed by scientists, respondents did not directly relate to the PBs when identifying the main policy climate policy goals and visions. Both Respondent #3 and Respondent #2 mention that the EU climate policy goals are indirectly related, referring to the 1,5 degrees Celsius Paris Agreement goal. Tulkens answer positively and highlights that in DG Research they often consult with scientists, research organisations, including the European Environmental Agency, to ensure that key research gaps are addressed and that those are relevant for the implementation of policies. Tulkens also mentioned the following:

*"I would say that the existence of a safe operating space was implicitly acknowledged through the [EU's] decision to become climate neutral. Otherwise, it would mean that the decision would have been somewhat irrational as Heads of States have the responsibility to take decisions that can be implemented. Whether those decisions are safe and just is a qualification that is left to policy analysts."*

According to Arnold, the planetary boundaries are everywhere in the narrative, but maybe not directly linked in the programmes and policies, suggesting that a lot of progress needs to be made on this. Moore is not sure to what extent the concept of the PBs informs EU policy. He interestingly points out the interplay between EU policymakers and scientists, mentioning that that scientists are often asked to describe what is safe while they respond that they cannot:

*"In the IPCC negotiations they don't ask scientists what they want to do. The politicians and decision makers tell them what they want to do, and the scientists tell them what the impacts are and how to get there. Obviously, the people who wrote the planetary boundaries differ on that."*

### 5.3.3 Comparison with downscaled climate boundary as suggested or discussed by scientists

In this section, the EU stated policy goals and visions as found in the policy document analysis and the interviews will be compared with the downscaled climate boundaries as suggested or discussed by scientists.

To start with, it is good to mention that there are two variables that characterise the planetary boundary for climate change. First, there is the total CO<sub>2</sub> in the atmosphere which, for the PB for climate change, is currently set at 350 parts per million (ppm), or 350-450 including the zone of uncertainty (Ferretto et al., 2022). The second variable is the observed top-of-energy imbalance Hoff et al. (2018). A positive imbalance implies that there is more incoming energy into the Earth than is radiated back to space Hoff et al. (2018). However, the global temperature or the greenhouse gas concentrations are not very suitable as a metric for sub-global S&JOS planning. As they do not directly relate to controllable factors through policies, Hoff et al. (2018) define the climate change PB as a stock boundary, with confined budget for the total amount of greenhouse gas emissions (Hoff et al., 2018). Another important point is that the climate change planetary boundary of 350-ppm is stricter than the Paris Agreement's goal

of limiting global warming to below 2°C, though it might align with a more ambitious aim of capping warming at 1.5°C (Hoff et al., 2018).

There are a handful of studies that have downscaled the PB for climate change to EU level. Nykvist et al. (2013) did not specifically downscale to EU level, but pioneered the climate downscaling and divided the global carbon budget equally per capita worldwide for the next 100 years, allocating emission to countries (also considering historic emissions) and dividing them over the population of that country. They propose an annual CO<sub>2</sub> emissions cap of 2 tons per capita for a world with 8 billion people and 1.5 tonnes CO<sub>2</sub>/y for a population of 10 billion people (Nykvist, Persson & Persson, 2013). According to Hoff, Nykvist & Carson (2014), the EU had already surpassed the 2 tons per capita limit with an average of 5.3 tons per capita (Hoff, Nykvist & Carson (2014)). This indicates that the EU does not operate within the per capita boundary for climate change.

Hoff et al. (2018) define the climate change PB as a stock boundary, with confined budget for the total amount of greenhouse gas emissions. Hoff et al. (2018) also utilized an equal-per-capita approach, yielding an EU CO<sub>2</sub> budget of 40-70 Gton. However, they emphasize differing equity principles result in diverse reduction pathways and targets, projecting that the EU's greenhouse gas reduction should be between 35% and 76% by 2030 (Häyhä et al., 2016). Along similar lines, the Zoe Institute (2021) underscore multiple studies indicating the EU's equitable share under the Paris Agreement should entail a 60-65% reduction by 2030, instead of the current 55% by 2030 reduction target.

The European Scientific Advisory Board on Climate Change (2023) does not specifically refer to the PB for climate change but created scenario pathways for climate neutrality in the EU and aligning with the Paris Agreement objectives. The board's recommendation consists of keeping EU greenhouse gas emissions budget between 11-14 Gt Co<sub>2</sub>e between 2030 and 2050. This implies a 90-95% reduction by 2040 and considers multiple dimensions of fairness and feasibility (European Scientific Advisory Board on Climate Change, 2023). The current EU 2040 target is not identified yet, so no comparison can be made.

While not falling within the scope of the research question, it is good to mention that think tanks and policy action groups have also suggested EU boundaries for climate change. For example, according to CAN Europe (2022), taking a per-capita share of the 1.5 degrees Celsius global carbon budget results in 20.28 GtCo<sub>2</sub> for the EU. Taking the EGD Fit for 55 package proposals and the net-zero by 2050 objective, the EU carbon budget from 2021-2050 accounts for 49.13 GtCO<sub>2</sub>. According to CAN Europe (2022), this means the EU's policies are unaligned with the 1,5-degree Celsius goal and that while the EU represents only 5% of the global population, they plan to use 10% of the available global carbon budget to limit global warming to 1.5 Degrees Celsius (CAN Europe, 2022).

#### 5.3.4 Biodiversity policy analysis

As discussed in Section 5.3.1, the EUR-lex analysis encompassed a total of 198 documents. Within this data set, planetary boundaries were found to be mentioned in direct connection with biodiversity in 19 of the 198 documents, which is slightly fewer compared to the 26 mentions related to climate change. Remarkably, biodiversity was frequently cited in conjunction with the food system. For instance (European Commission, 2020b, p.19):

*“It will monitor the transition to a sustainable food system so that it operates within planetary boundaries, including progress on the targets and overall reduction of the environmental and climate footprint of the EU food system.”*

In many of the references, the planetary boundaries are referred to regarding biodiversity decline. For example, in a European Parliament Resolution from 2021 the following was mentioned (European Union, 2021a, p.6):

“[The European Parliament] Is alarmed by the fact that the loss of biodiversity and ecosystem services is undermining progress in approximately 80 % of the assessed targets for the SDGs; calls for the EU to continue its efforts to reduce its biodiversity footprint worldwide and to bring it into line with planetary boundaries.”

On top of the EUR-lex document analysis, various other documents were analysed looking for stated biodiversity goals and visions. Documents were found through desk research, and aiming to cover topics that were missed in the EUR-lex analysis. It was found that internationally, the Kunming-Montreal Global Biodiversity Framework encompasses four overarching goals set to be accomplished by 2050 (European Commission, 2022). These objectives revolve around enhancing ecosystem and species health, with a particular emphasis on curbing human-induced species extinctions. Moreover, the framework underscores the imperative of promoting the sustainable utilization of biodiversity, ensuring equitable distribution of associated benefits, and bolstering efforts pertaining to implementation and financial support (European Commission, 2022).

At the European Union (EU) level, the EU Biodiversity Strategy 2030, adopted in 2020, is intended to serve as a comprehensive blueprint for safeguarding natural ecosystems and reversing the deterioration they have undergone. This strategy is underpinned by the overarching ambition of rejuvenating Europe's biodiversity by 2030. Within its framework, specific actions and commitments have been delineated to facilitate the attainment of this goal (European Commission, n.d.-a).

Noteworthy is that there is also a strong link between climate and biodiversity. In a resolution on the climate and environment emergency, the European Parliament stressed the importance of immediate action, urging the Commission to ensure that all relevant legislative and budgetary proposals align with the 1.5-degree Celsius objective and that they are not contributing to biodiversity loss (European Union, 2020a). In the Decision (EU) 2022/591 of the European Parliament and of the Council of 6 April on a General Union EAP to 2030, specific mention is made to ensuring effective climate and biodiversity mainstreaming and consistency between climate and biodiversity funding (European Union, 2022).

### 5.3.5 Biodiversity interviews

Interviews were also conducted to gain insights into perspectives on the primary political goals and visions regarding biodiversity. The following paragraphs provides an overview of the results. To begin with, Claeys identifies the four fundamental pillars within the biodiversity approach: protecting biodiversity, restoring biodiversity, mainstreaming biodiversity into other policies, and undertaking global action (Claeys). This approach has yielded favourable outcomes, particularly on the international stage, where a robust consensus has proven effective (Claeys). The EU's restoration proposed law strives to regenerate 20% of its maritime and terrestrial areas through dedicated restoration missions. By 2050, all ecosystems necessitating legal restoration should be quantifiable (Claeys). However, in the context of nature restoration legislation, the consideration of fairness aspects is not as prevalent

(Claeys). It predominantly relies on actions pursued by individual Member States, wherein national measures linked to socioeconomic advancement wield significant influence, overseen by a dedicated commission (Claeys).

Moreover, Arnold highlights that the Green Deal introduced a holistic framework addressing interconnected challenges like biodiversity, emphasizing the need to consider multiple factors and avoid a sole focus on carbon accounting (Arnold). Some industries prioritise CO2 reduction as the primary KPI, but other vital issues should not be overlooked, Arnold argues.

Additionally, Tulkens emphasized the European Commission's top priority: serving the policy goals of the Green Deal, including biodiversity (Tulkens). However, monitoring progress, especially for biodiversity, remains a complex challenge (Tulkens).

Lastly, when posed with the question of the principal policy goals for biodiversity, Hahn accentuates the difficulty of harmonizing with PBs, given the absence of specific biodiversity targets and the uncertainties surrounding their comprehension and quantification (Hahn). Consequently, the focus revolves around the concept of PBs, despite grappling with the challenge of not fully understanding or quantifying them (Hahn).

#### 5.3.6 Downscaled biodiversity boundary as suggested or discussed by scientists

In the following paragraphs, I aim to draw a comparison to the policy goals and visions identified from the policy document analysis and the interviews and the downscaled boundary as suggested or discussed by scientists. Worth mentioning is that the biosphere boundary can be measured in two ways: via genetic diversity, and biodiversity intactness at global and biome level (Häyhä et al., 2016). Both measures are transgressed globally (Häyhä et al., 2016).

Significant uncertainty surrounds quantifying this boundary, and researchers are actively seeking improved control variables while cautioning against downscaling without better ecosystem understanding, as noted by prior national efforts. European data on territorial biodiversity performance underscores the issue's gravity, with a biodiversity intactness study indicating Europe's biosphere integrity boundary has been breached. Häyhä et al. (2016) stress the necessity of comprehending and measuring Europe's global biosphere impact due to consumption, proposing a consumption-based biodiversity footprint, with initial findings highlighting Europe's substantial externalization of biodiversity threats.

Häyhä et al. (2016) argue that merely quantifying and downscaling the planetary boundary is inadequate for the global biosphere integrity boundary, which defines limits for processes with shifts in planetary ecosystem behaviour, involving all organisms coevolving with the environment. The intricate impacts of human actions across space, time, and trophic levels complicate predicting local disruptions' effects on global functionality in our rapidly changing environment, further complicating biosphere integrity boundary implementation. Biosphere integrity boundary is not quantified for Europe as the authors point to that no global limit has yet been published at that time (EEA & FOEN, 2020).

#### 5.3.7 Human rights and social justice policy analysis

Apart from the climate and biodiversity PB analysis, I looked at how human rights and social justice are linked in the policy documents for climate and biodiversity. Therefore, the existing EUR-Lex search was

elaborated using the original 'planetary boundaries' search terms but adding AND 'human rights'. As the term 'human rights' did not provide any useful direct links to the PBs, I used the terms 'equity' and 'justice'. Arguably, there are more combinations possible to account for human rights and social justice (e.g., equitable, SDGs etc.), however given the scope of this thesis and due to time constraints, this was the chosen selection for analysis.

To start with, the search term 'planetary boundaries' + AND + 'equity' provided 78 documents. After excluding overlapping and inaccessible documents, 73 documents remained, in which the term 'equity' was mentioned 125 times. Out of the 73 documents, 31 documents had references that were unrelated (e.g., equity in investment) and therefore these mentions do not comprise of the 125 mentions reported. A total of 38 documents had mention of 'equity'. Often, this was a referral to the Paris Agreement or the SDGs. In four documents the planetary boundaries were directly linked to the term 'equity'. In the analysis, I observed that the planetary boundaries are often combined with terms like 'wellbeing' and 'inclusion'.

*"At the start of the UN Decade for Action, the SDGs have kept the EU focused on a sustainable growth path compatible with planetary boundaries, on wellbeing, inclusion and equity."* (European Union, 2021b, p.19)

*"The EESC points to the Commission working document on Delivering on the UN's Sustainable Development Goals, which notes: '... the SDGs will keep the EU focused on a sustainable growth path compatible with planetary boundaries, on wellbeing, inclusion and equity.'" (European Union, 2021c, p. 3)*

*"... ensuring sustainable management of natural resources; while promoting equality, equity and justice; and peace and security. In addition, whilst the challenge of addressing planetary environmental boundaries ..."* (European Commission, 2013, p8)

*"Sustainable Development is about the future of people; the economy should, within the planetary boundaries, work for society to deliver prosperity and equity, now and for future generations."* (European Economic and Social Committee, 2019, p.3)

The search term 'planetary boundaries' + AND + 'justice' resulted in 116 documents, with 357 mentions of the term 'justice'. However, none of those mentions were directly related to the planetary boundaries. The three most common links to justice were access to justice (35 documents) in relation to the Aarhus Convention, climate justice (9 documents) and intergenerational justice (4 documents). While the term justice was not directly found in relation to the planetary boundaries, the following reference is worth noting:

*"Moving towards a wellbeing economy means combining the idea of prosperity with the possibility of social progress within planetary boundaries. It involves defining more clearly what we want from progress and articulating the foundations for an economy founded on sustainability. The starting point is a meaningful and viable vision of prosperity for people and for the planet."* (European Union, 2020b, p.1)

Complementary to the EUR-lex analysis, several additional policy documents were analysed to extract the stated policy objectives in relation to human rights and social justice. It was found that the Fit for 55 package aims to ensure a just and socially fair transition (European Council, n.d.). The primary objective is to contribute to a socially fair transition towards climate neutrality (European Union, 2023b). The Just Transition Fund has been established with the goal of enabling regions and individuals to address the impacts of the transition towards the EU's 2030 and 2050 climate and energy targets, aligning with the Paris Agreement (European Union, 2021d).

Regulation (EU) 2018/1999 outlines the specific objective of a resilient Energy Union, which is to provide EU consumers, including households, with secure, sustainable, competitive, and affordable energy (European Union, 2018). Additionally, one of the main goals is to ensure predictable governance of the Energy Union and Climate Action to achieve the 2030 and 2050 targets in line with the Paris Agreement (European Union, 2018).

#### 5.3.8 Human rights interviews

Engaging individuals with a human rights background within EU institutions presented challenges, as they were hard to locate and those approached who are explicitly working with human rights in the European Commission failed to recognize the direct link between human rights and climate and biodiversity issues. Consequently, human rights and social justice inquiries were directed towards EU officials specialized in climate and/or biodiversity, revealing that many of these officials possessed comprehensive insights into the interconnectedness of human rights and social justice with biodiversity and climate policies. Respondents mentioned both human rights issues but also social justice elements.

Regarding social justice matter, Respondent #3 underscores the EU's initiatives in the Social Fund and the Just Transition Fund, aiming to ensure that carbon pricing benefits individuals with fewer financial resources and lower emissions, enabling their participation in the Just Transition and access to better job opportunities. According to Respondent #3, climate change presents various challenges that demand practical actions to safeguard human rights, necessitating judicial measures when necessary.

According to Respondent #3, however, human rights concerns seem less prioritised and often become theoretical debates (Respondent #3). While discussions on climate-related human rights are essential, practical actions matter most (Respondent #3). When our rights are at stake, taking judicial action becomes necessary to prompt governments to take more substantial actions (Respondent #3). Respondent #3 poses that the real question is how to reduce emissions rapidly, sustainably, and equitably within the means of the European society.

Respondent #3 argues that achieving a fast transition may lead to financial support for various industries, but it could also result in job losses (Respondent #3). This becomes a political question about how society wants to proceed. According to Respondent #3, it is not as simple as blaming the government for not doing enough and thinking that suing them on human rights grounds will automatically solve the problem. Decisions on the speed of change and societal transformation can only be made by parliaments (Respondent #3). Respondent #3 argues that many people want change, but the pace and approach must be collectively determined, recognizing the challenges faced by some vulnerable groups.

Respondent #2 is uncertain whether human rights are specifically referenced in the European Climate Law, but according to him the European Climate Law likely contributes to safeguarding them. The SDGs explicitly focus on human rights, and the EU's implementation also supports them, as per Respondent #2. The European Green Deal supports the right to a healthy environment and a private life, impacting various sectors like housing, employment, and social life (Respondent #2). The 'leave no one behind' principle improves citizens' situations concerning climate policy, albeit indirectly (Respondent #2).

Regarding human rights and biodiversity, Hahn suggests that the first dimension is access to healthy ecosystems and the unequal suffering caused by ecosystem damage (Hahn). For instance, access to green areas differs in cities, with poorer areas having less biodiversity (Hahn). The second aspect, according to Hahn, relating to aspects of justice, concerns who bears the cost of pollution, leading to an environmental footprint inequality (Hahn). Since society pays instead of the polluters, it disproportionately affects poor people who pollute significantly less (Hahn). The third aspect concerns the fair sharing of business opportunities, particularly the types of jobs affected (Hahn). The DG Environment review of existing laws revealed few solutions addressing fairness, with the Water Directive being one notable exception, says Hahn (Hahn). While it is not mandatory in EU law, a court case against Ireland led to changes when the EU stated that water cannot be provided for free, resulting in social unrest in Ireland (Hahn). According to Hahn, water is the only ecosystem covered in the social pillar of rights, guaranteeing access to healthy drinking water in the communication (Hahn). No other ecosystem is covered by either fundamental rights or the European Pillar of Social Rights (Hahn). Regarding air quality, it serves as the only indicator linking the region's richness and air quality, with Environment Agency studies exploring the connection between air quality, chemicals, noise, and poverty (Hahn). However, the overall knowledge base on this topic remains weak (Hahn).

Claeys states that the nature restoration law typically lacks explicit links to fairness aspects, as it primarily relies on Member States' actions related to social and economic development (Claeys). There is a commission overseeing this matter, as per Claeys.

The Taxonomy Regulation includes various criteria, with a focus on social minimum safeguards, ensuring activities do not infringe human rights and are legal (Claeys). Additionally, an activity must substantially contribute to one environmental objective without significantly harming the other five (Claeys). This framework sets the sustainability framing in the taxonomy regulation, influencing other regulations like the carbon removal certification framework, although they may not explicitly mention the taxonomy regulation to avoid complete linkage (Claeys).

According to Claeys, the only specific regulation human rights he is aware of in EU law is Article 18 of the Taxonomy Regulation, which addresses minimum safeguards (Claeys). Economic activities claiming sustainability must align with the OECD guidelines for multinational enterprises and the United Nations guiding principles on business and human rights (Claeys). This includes adherence to the principles and rights outlined in the eight intergovernmental conventions identified in the declaration of the International Labour Organisation on fundamental principles and rights of work and the international bill of human rights (Claeys).

According to Moore, from a social and economic perspective, the EU has recently emphasized the concept of a just transition, focusing on regions, cities, and industries severely impacted or made unfeasible by achieving climate neutrality, such as coal regions (Moore). The introduction of social climate funds tied to ETS2 aims to compensate affected groups as decided by Member States (Moore).



Moore points out that interestingly, there was limited discussion at the EU level for ETS1, despite its impacts on electricity prices and other aspects (Moore). However, ETS2 has sparked more debate due to its broader reach into transportation and buildings (Moore). Concerns exist on two fronts: the genuine worry about people's well-being and the political concern that visible negative impacts could affect policy acceptance (Moore). Moore argues that the ETS2 brings carbon pricing closer to the general public, increasing visibility at the ground level, leading to both real social and economic concerns and political considerations, especially with upcoming government elections.

According to Arnold, trade policy and communication on trade for all have aimed to consider the social and environmental impacts of trade relations and globalized value chains (Arnold). However, despite these principles, practical challenges persist (Arnold). For instance, clothes produced in textile factories that may have unsafe conditions are still found on European high streets (Arnold). Similarly, there are concerns about child slavery in lithium extractions for the green transition (Arnold).

### *Summary*

This chapter explores the alignment between EU biodiversity and climate policies and the PBs as suggested or discussed by scientists. The analysis reveals that EU climate policy reflects its commitment to international climate agreements, particularly its aim for achieving net-zero emissions by 2050 and a 55% reduction in greenhouse gas emissions by 2030. However, scientists' suggestions regarding per capita emission limits indicate that the EU may have already exceeded its fair share of emissions.

In the EUR-Lex analysis, the PBs are consistently mentioned in EU documents, such as the 7th and 8th Environment Action Programme (EAP). Biodiversity is often linked to the food system and mentioned less frequently than climate change in direct connection with PBs. Respondents emphasize a strong link between climate and biodiversity, but comparing biodiversity policy goals with the biodiversity PB as suggested by scientists proves challenging due to quantification issues.

Human rights were analysed within the selection of policy documents for climate and biodiversity. While the term 'human rights' did not result any direct connections, the terms 'equity' and 'justice' were indirectly related to the PBs. Most references primarily revolve around the Paris Agreement, SDGs, or unrelated issues. Respondent interviews underscore the importance of taking practical actions to safeguard human rights and social justice in climate and biodiversity policy.

## 5.4 Results 4 – Operationalising the Safe and Just Operating Space framework for EU level

The following chapter represents the results pertaining to the research question: ‘How can the S&JOS framework be operationalised for the EU level, and what implications does this hold for EU policymaking?’ The first two sections cover the results on the potential usefulness of operationalising the S&JOS at the EU level and the ways to enhance the alignment of policy goals with downscaled boundaries. Subsequently, the final two sections present the results on the ‘how’ part of operationalising the S&JOS to the EU level and the connection to pathways for transformative change.

### 5.4.1 Do respondents consider EU operationalisation of the S&JOS framework useful?

Inquiring with the EU expert respondents about the EU-level usefulness of downscaling the S&JOS, three out of seven respondents responded positively (Respondent #2, Arnold, Lung). One respondent mentioned being less familiar with the S&JOS yet believed in finding a way to downscale the framework to EU level (Hahn). Another respondent pointed out the EU's existing downscaled climate boundaries, referring to the EU climate budget in relation to the Paris Agreement (Respondent #3). One respondent held a positive view, but underlined challenges related to Member State competences and governance levels (Tulkens). Another challenge mentioned relates to science-based targets, as he pointed out that absolute thresholds are contested as people would question where these targets come from (Lung). Finally, one respondent did not answer the question.

Moore points out the presence of current EU policies and initiatives that tackle ecological and social boundaries, as initiated by Directorate-General (DG) Climate Action and DG Environment. However, he argues that the existence of departmental silos represents a coordination challenge (Moore). Nevertheless, Moore argues that the implementation of the S&JOS framework at the EU level has the potential to enhance collaboration and holistic strategies in tackling interconnected ecological and social challenges. Similarly, Grcheva draws attention to potential of the S&JOS framework to address silos:

*“It allows places to break out of silos and to have those holistic cross-departmental intersectoral conversations which are the starting point to doing a lot more work.”*

Finally, Respondent #2 suggests that the S&JOS framework can bridge the gap in the European Green Deal policy coherence of the social dimension, which is currently lacking according to him:

*“A more holistic framework, whether through the S&JOS or SDGs, would be valuable for EU policy, enhancing the focus on social aspects in addition to the environmental ones.”*

### 5.4.2 How to enhance the alignment of policy goals with downscaled boundaries?

The analysis in chapter 5.3 shows that EU policy goals and visions do not fully align with the downscaled boundaries as suggested or discussed by scientists. Respondents were asked to identify potential measures for aligning EU policy goals with downscaled boundaries as suggested or discussed by scientists.

To start with, Respondent #2 identifies an opportunity in aligning climate and environmental ambitions with economic and fiscal measures:

*"While we are ambitious about climate and environmental policies, success depends on aligning them with strong economic and fiscal measures. These policies act as levers in society, facilitating a just transition and ensuring no one is left behind."*

Respondent #2 also suggests that the European Semester, the EU's framework for the coordination and surveillance of economic and social policies, can act as an effective policy coordination tool, but again stressed that its implementation is complicated by the EU's lack of fiscal policy competences. Respondent #2 therefore argues that fiscal policies must incentivize sustainable alternatives for a successful transition.

Arnold also highlights the challenge of aligning EU policy with downscaled boundaries and proposes that participatory democracy, citizens' assemblies, and policy labs have the potential to generate more innovative ideas than traditional party programs:

*"Sometimes you get more far-reaching ideas coming out of citizens assemblies or policy labs than from what you get in political party programmes. So maybe we need to explore those new forms of democracy much more."*

Additionally, he contends that a major obstacle lies in reaching a democratic consensus on the acceptable extent of planetary destruction (Arnold). This, he argues, is currently overlooked in party agendas (Arnold).

#### 5.4.3 Factors influencing goal formulation in EU climate policies

Respondents have also identified the key drivers influencing the formulation of goals and visions in EU climate policies, which will be presented in the following paragraphs. Firstly, respondents consider science and international processes to be of importance. Respondent #3 argues that EU climate policy is rooted in science and international processes and agreements. He claims that the IPCC's integration into the scientific process significantly guides EU policy decisions. Moore emphasizes the EU's active involvement in international negotiations, demonstrating ambition both within the EU and globally, with goals aligned with international timetables (Moore).

Arnold points out that the European Climate Law includes a provision for a scientific advisory body responsible for providing recommendations on the 2040 target, influencing policy objectives. Recent discussions within this body propose ambitious targets ranging from minus 90 to minus 95 percent, generating debates on extreme measures and potential populist sentiments, according to Arnold.

Secondly, respondents highlight the influence of economic growth and competitiveness as a key driver influencing climate policy goal formulation. Respondent #2 underlines the EGD as an economic growth strategy. He continues to argue that the Emissions Trading System (ETS) plays a critical role in achieving emission reductions while prioritising economic efficiency (Respondent #2). Also, economic growth and overall efficiency improvements act as key driving forces in shaping climate policy, says Respondent #2. Respondent #3 underscores that considerations of competitiveness and economic opportunities are key drivers, even amid substantial investment costs. Lobbying efforts from various stakeholders also influence EU climate policy development (Respondent #2).

Thirdly, Respondent #3 points to the influence of China and globalisation as key drivers. He argues for the need for transformative change driven by challenges like China's industrial dominance and

Europe's shift towards high-value, highly skilled jobs have raised concerns about preserving middle-skilled and low-skilled employment. However, Respondent #3 advocates for embracing transformative approaches to address multiple challenges simultaneously, a viewpoint he suggests is gaining traction among high-level leaders, including Prime Ministers, as a means of adapting to globalisation and creating opportunities amidst various challenges.

#### 5.4.4. Factors influencing goal formulation in EU biodiversity policies

Respondents were also asked about the factors influencing policy goal formulation for biodiversity. First, in line with the argument posed by Respondent #3 concerning climate change, Claeys emphasized the significance of scientific input and international progress for EU policy goals related to biodiversity (Claeys). According to Claeys, biodiversity is a complex issue encompassing impacts on societies, ecosystems, well-being, security, sustainability, and various political sectors. Respondent #3 asserts that scientific input should not be confined to climate alone but should extend to all aspects addressed by DG Environment. Nonetheless, he argues that the incorporation of scientific input in non-climate areas, such as biodiversity, seems to be less stringent compared to climate-related matters (Respondent #3).

Hahn underscores that international processes play a role in setting targets for biodiversity, yet unlike climate change, which has well-defined official targets aligning political and scientific perspectives, biodiversity lacks such clarity (Hahn). She notes that efforts are being made through the recent global biodiversity framework indicators [within the Kunming-Montreal Global Biodiversity Framework] but argues that progress in this realm remains limited (Hahn).

Secondly, EU politics is suggested to play an important role. In addition to scientific input, respondents highlight the contributions of the European Parliament and the Office of the President of the European Commission (Claeys, Hahn). Claeys suggests that there is a political consensus within EU society and practices to address both biodiversity and climate change (Claeys).

#### 5.4.5 How could the S&JOS be operationalised to EU level?

Then, respondents were asked how to best operationalise the S&JOS to EU level, several key themes present itself. A first theme relates to quantification when operationalising the S&JOS at the EU level. Respondent #3 emphasizes the significance of quantification in addressing climate change through the assessment of present resource allocation vis-à-vis future needs. Comprehending the balance between present undertakings and their repercussions on succeeding generations can lead to more well-informed decisions according to Respondent #3. In addition, he suggests that employing a budgetary methodology aid those who are less economically inclined in comprehending cost-effectiveness and distribution of effort, thereby fostering the development of more practical policies (Respondent #3).

Tulkens further accentuates the importance of quantification and suggests that open debates based on quantified information are necessary to determine effective climate resilience and emission mitigation options. When Member States or regions present diverse scenarios, potential consequences, remedies, and cost projections, it enhances transparency, facilitates well-considered choices, and fosters institutional trust, according to Tulkens.

Regarding quantification and allocation principles, Lung, one of the authors of the EEA & FOEN (2020) EU downscaling report, mentioned that having multiple allocation principles is considered key:

*“The idea that we have different ways of calculating was very much appreciated. These calculations are inevitably normative and if we only apply the per capita principle, there is a high risk that people will criticize your analysis. If you do not have results and answers complementing the per capita thinking, then your analysis is incomplete. So, this basket of different normative calculation or implementation approaches is probably key for me in any further work.”*

Secondly, the data suggests that S&JOS operationalisation is intricately linked to boundary defining processes. Hahn underscores the difficulty of demarcating regional boundaries. In the context of biodiversity, metrics reliant on spatial parameters, such as protected areas or areas requiring restoration, offer a suitable approach to address environmental issues within distinct regions (Hahn).

Worth noting is that Hahn advocates using the term ‘targets’ instead of ‘boundaries’ to adopt a more practical and less alarming approach. Additionally, she emphasizes the importance of recognising and honouring the economic policy competencies of [EU] Member States and their distributive impacts when delineating boundaries. Respondents also mentioned that although EU (or UN-level) policy instruments may not always possess optimal rigor or expediency, each nation retains the autonomy to manage the transition while considering social equity and an even dispersion of costs and gains (Tulkens, Daly). The progress pace of the slowest nation becomes a decisive factor in this progression (Daly), shaped by the self-governance and obligations of national, regional, and local authorities (Tulkens).

Ploeg contends that target setting in EU policy that solely focuses on certain aspects, such as carbon emissions, might overlook unintended consequences, like the environmental impact of mining for lithium batteries and the waste generated by the car industry. He argues that this underscores the risk of narrow goals and targets, even though the S&JOS is comprehensive in scope (Ploeg).

Thirdly, linked to boundary setting, another theme emerging from the results pertains to the selection of indicators for the S&JOS. Baumgartner particularly emphasizes the challenge of determining the indicator for biodiversity boundaries. He exemplifies this by highlighting the current use of land occupation as the core indicator in the EMAS Regulation for environmental management systems, which he considers to be overly indirect. Baumgartner elaborated as follows:

*“The challenge lies in understanding the connection between corporate decisions and products to biodiversity, particularly in the later stages of the supply chain, making it a major research challenge to develop approaches that link company decisions with their biodiversity impact.”*

Fourthly, several respondents also highlighted key considerations regarding allocation principles and their connection to fairness and justice. Broman contends that an exclusive reliance on mathematical computations for the determination of a fair share carries significant risks. Baumgartner raises the issue of allocating global thresholds to a single entity and he suggests that S&JOS downscaling necessitates the establishment of allocation principles, such as an ‘ethical just share’ for the EU.

Drawing from concrete instances, Daly elucidates the intricacies associated with delineating a ‘safe and just’ allocation. She underscores her point by referencing the persistent ozone hole over Australia, which, despite global progress the ozone hole recovery, engenders cancer-related fatalities, thereby triggering apprehensions regarding fairness and justice (Daly). While sustainability frameworks, including the FSSD, acknowledge a certain degree of admissible harm, Daly contends that permitting

such detriment to assume a systematic or widespread character within a societal milieu poses the peril of corroding its foundational fabric (Daly).

Arnold points out that staying within the S&JOS raises questions about imposing limits on per capita consumption, carbon emissions, and the destruction of nature. According to Arnold, such a paradigm shift redirects emphasis from purely economic concerns to ethical considerations, thereby probing the legitimacy of disparate entitlements to ecological harm. He also stresses that divergent aspirations for a decent standard of living at the EU level present a challenge, as sustaining such aspirations may prove unsustainable for a global population of 10 billion, thus making current high levels of consumption a significant concern (Arnold).

Within the discourse of allocation principles, Respondent #3 invokes the notion of intergenerational justice as an integral facet of climate policy discussions, posing the need to balance short-term actions with long-term consequences:

*“We must balance short-term actions with long-term consequences. This helps us identify where our focus should lie in terms of climate policy, which often involves complex debates about short-term versus long-term actions.”* (Respondent #3)

Fifthly, in the context of the operationalisation of the S&JOS, a significant theme arising from the results pertains to the specific process of operationalisation. Moore emphasizes the paramount significance of the procedural aspect in the context of downscaling S&JOS at the EU level. Also Ploeg underscores the critical nature of well-planned processes when downscaling both S&JOS and the FSSD.

While Johnson acknowledges the effectiveness of frameworks like the S&JOS and the FSSD in simplifying intricate subjects without succumbing to the pitfalls of oversimplification, he holds the view that striking a delicate equilibrium between simplicity and comprehensiveness presents a challenge (Ploeg, Johnson). It is noted by Johnson that the scientific and scholarly terminology used within these frameworks might not align with all stakeholders, especially those from the political and action-oriented sectors. Ploeg also suggests that excessive complexity may not always be advantageous, particularly in the context of visioning processes.

Respondent #2 asserts that cultivating a robust social dialogue constitutes a fundamental requirement in the downscaling process. He suggests that the involvement of high-level working groups can significantly contribute to representing diverse stakeholders (Respondent #2). Additionally, Respondent #2 underscores the pivotal role of integrating scientific insights into policymaking. In this regard, he suggests the inclusion of an independent advisory board which can provide invaluable contributions to the process.

In addition, Respondent #2 suggests that on a national scale, the enactment of a Climate Law emerges as a mechanism capable of bestowing legitimacy and fostering coherence across various governmental ministries. He posits that centralising coordination, possibly through a dedicated entity such as the Prime Minister's office, has the potential to enhance the effectiveness of the downscaling process (Respondent #2). Complementing this, the establishment of a national scientific advisory board could serve to amplify the quality and relevance of the scientific inputs involved, thus enhancing the overall process of national-level downscaling, according to Respondent #2.

Finally, there were some detailed suggestions for downscaling the S&JOS at the EU level. For example, Claeys proposes the concept of certifying positive action to achieve sustainability objectives, such as certificates for carbon removals and biodiversity. This idea, according to Claeys, aims to demonstrate significant contributions to sustainability without harming other aspects, aligning with existing certifications like organic farming and the Renewable Energy Directive.

Another suggestion, made by Respondent #3, is to combine setting a limit or hard cut on emissions and at the same time incorporating social aspects into climate policies (Respondent #3). He argues that initiatives like ETS2 (Emissions Trading System) and the social climate fund exemplify this approach by supporting the most affected and vulnerable groups, regardless of financial implications (Respondent #3).

Regarding the process of S&JOS operationalisation, specifically linking to hosting and facilitating, Daly mentioned the following:

*“Academic frameworks are really helpful as education devices, but how are we going to share in a finite world with limited resources? This requires an inner perspective of the convener and that cannot be underplayed. There is such a barrier to creating change through the political system that it has to happen in these small ways through individual actors.”*

#### 5.4.6 S&JOS and pathways for transformation

Finally, respondents were asked what is necessary for a S&JOS framework to create pathways for transformation at sub-global level. First of all, respondents argue for a further integration of economics in the S&JOS operationalisation process. Tulkens contends that the S&JOS framework necessitates integration with mainstream economists and active involvement of businesses (Tulkens). This perspective is exemplified through his observation of the inadequate participation of distinguished economists within the processes of IPCC and IPBES (Tulkens). Moreover, Tulkens underscores the significance of optimizing existing economic instruments, such as pricing mechanisms, taxation policies, and subsidies, to effectively shape behavioural patterns and attain more profound transformative outcomes.

Secondly, another element contributing to the formulation of avenues for transformative change pertains to the discernment of vested interests, as identified by respondents. Respondent #2 underscores the utmost significance of identifying vested interests that impede progress, encompassing instances like opposition originating from the chemical industry, agrochemical suppliers, and supermarket chains within the agricultural sector. The assimilation of a stakeholder mapping approach within the operationalisation of the S&JOS framework could effectively facilitate the comprehension of vested interests and foster collaborative engagement with them, according to Respondent #2.

Expanding on this discourse, Moore posits that the objectives of EU policies frequently necessitate reconciling diverse interests, a process not exclusively driven by scientific considerations, but rather aimed at achieving consensus and legislative approval. According to Moore:

*“Politics involves diverse interests, and it is worth noting that agricultural companies tend to receive a more favourable reception in DG AGRI compared to DG CLIMA, for example.”*

Thirdly, Hahn and Claeys argue that creating transformative pathways with the S&JOS framework necessitates a comprehensive approach to the 'how' aspect of the transition. This involves the consideration of multifaceted perspectives and varying needs, regular reporting and assessment procedures, the elevation of ambitions to bridge gaps, and the effective management of perceived risks, as posited by Hahn and Claeys.

Remaining neutral in her stance, Hahn refrains from advocating for either the integration of these pathways into a unified framework or their separate existence. She draws attention to the intricate challenge of devising a singular approach that suits all citizens, regions, or cities, underscoring the imperative of a practical methodology that duly accommodates the diverse perspectives and needs of stakeholders (Hahn).

Supplementing this discourse, Claeys contributes by identifying factors that either propel or hinder the progress towards established objectives (Claeys). He suggests that the practice of regular reporting and stocktaking emerges as pivotal in appraising collective advancement and pinpointing disparities between the prevailing status quo and the envisioned transformative outcomes (Claeys). This assessment then informs the need for increased ambition to bridge the identified gaps, exemplified by the progressive ambition principle demonstrated in the Paris Agreement's continuous efforts towards achieving climate goals, as argued by Claeys.

For transformative change to happen, Claeys contends that it is imperative to address the perceived risks associated with transitions. According to him, when people perceive changes as too risky and lack a satisfactory response to these risks, they may resist altering their behaviours (Claeys). For instance, the transition to organic farming carries substantial risks for farmers, yet prevailing insurance systems and compensation mechanisms inadequately account for these risks (Claeys). Novel instruments such as the Just Transition Fund and the Social Climate Fund offer a supportive scaffold for navigating shifts to new economic paradigms and extending aid to the most vulnerable segments (Claeys). Claeys suggests that these innovative approaches, with their potential for replication, hold the capacity to extend to other sectors, such as the food system, thereby buttressing farmers and offsetting the incurred expenses resulting from alterations in agricultural practices driven by influential corporate entities over the course of time.

Fourthly, four respondents emphasize the significance of societal transformation when discussing how the S&JOS can contribute to creating pathways for transformative change at EU level (Respondent #3, Respondent #2, Arnold, Hahn). Respondent #3 particularly accentuates societal transformation as an intricate facet, necessitating a synthesis of elements extending beyond mere legislative measures (Respondent #3). This encompasses the imperative of fostering willingness among the younger generation for altering their mindsets, as well as individuals making conscientious adjustments to their lifestyles, says Respondent #3. Respondent #3 mentioned the following:

*“To make a difference, we must consider all the social impacts and design systems that empower people to change if they want to while also providing assistance to those undergoing compulsory changes.”*

Furthermore, Respondent #3 suggests that support mechanisms can be extended to those amenable to change, such as facilitating the installation of solar panels and streamlining application processes. Nevertheless, it remains acknowledged that not all will willingly embrace such shifts, and certain



segments might find themselves compelled to change owing to deteriorating circumstances. Irrespective of this variability, Respondent #3 argues that the EU holds the potential to extend assistance, encompassing measures like aiding in the transition of employment or supporting assistance across a spectrum of other domains.

Regarding societal change, Respondent #2 highlights the need to address multiple elements in EU climate policy simultaneously for effective system transformation. He also points to agriculture, mentioning that transforming the sector requires considering consumption patterns, diets, and food value chain economics. Respondent #2 argues that a missing aspect in EU climate policy is addressing consumption and promoting sustainable food demand. Neglecting these factors may undermine sustainable growth strategies, according to Respondent #2.

Hahn also refers to the key challenge of convincing people to embrace lifestyle changes. The Paris Agreement was a significant achievement but lacked implementation, according to Hahn. Hahn argues that engaging individuals, as exemplified by the citizens' convention on abortion, is crucial, emphasizing the need for flexibility in tailoring solutions to meet targets.

Arnold suggests that addressing inequality and promoting a sustainable lifestyle for all presents challenges, particularly with poverty (Arnold). This may entail curbing excessive consumption while ensuring development and inclusion for the less privileged (Arnold). Determining a fair level of inequality and finding politically acceptable approaches become central research questions, says Arnold. He suggests that overcoming ideological entanglements requires shifting the conversation towards informed scientific debates involving citizens and stakeholders (Arnold). Engaging different actors and perspectives can lead to solutions beyond ideological standpoints and create a fair and sustainable framework for society (Arnold).

In the context of transformative change, Arnold introduces the 'Overton Window' concept as a method to determine the acceptable range of governmental policies (Arnold). The concept describes that politicians operate within the accepted range, but advocates of transformative policies must persuade the public to broaden its boundaries (Arnold). Arnold acknowledges that some transformative ideas currently lie outside the Overton Window, but he encourages efforts to expand it and make seemingly implausible ideas acceptable (Arnold). However, Arnold points out that these transformative values and policies are not yet in the current policy space due to hesitancy from governments in democracies.

Finally, cities have been identified as a big factor considering their flexibility and adaptability of the S&JOS framework to be fully contextualised and needs-based. Grcheva points out that while there is interest, national governments are slower than cities in adopting the S&JOS (she referred to it in a Doughnut Economics context), which allows cities to experiment with smaller-scale projects without committing to large-scale changes. According to Grcheva, regarding cities, one element that helps provide a pathway offering framework is creating a methodology that allows for adaptable solutions for cities and regions, allowing them to start from their current position and tailor solutions to their specific needs. She points to while there are many examples of collaborative partnership models that bring together public actors with for example the private sector, that is not how cities are designed. She mentioned the following:

*“One of the pathways of deep transformative change would be changing the way that municipalities, local governments, administrations at all levels are organised to work and act and collaborate internally and externally.”*

### *Summary*

This chapter delves into the operationalisation of the S&JOS framework in the context of EU policymaking and planning for transformative change. Key findings encompass varying opinions on the usefulness S&JOS operationalisation, the necessity of aligning policy objectives with economic measures, and the significance of science and international processes in climate policies. Factors influencing biodiversity policies involve scientific input and EU politics. Operationalising the S&JOS framework necessitates quantification, boundary definition, and indicator selection. Respondent mentioned that the process requires robust social dialogue and scientific insights.

The results also indicate that transformative change demands economic integration, the identification of vested interests, and a comprehensive approach. Societal transformation is deemed essential by respondents, entailing engagement with younger generations, lifestyle adjustments, and addressing inequality. The concept of the Overton Window is introduced to broaden the spectrum of acceptable policies, and cities are recognised as relevant actors in implementing the S&JOS framework. In summary, this chapter offers insights into the intricate process of operationalising the S&JOS framework at the EU level and its potential to drive transformative change in policymaking.

## 6. Discussion

In this chapter, I expand on the obtained results and explore the implications. The purpose is to establish a coherent connection between the findings, the overarching research aim, the research questions, and how it relates to current scientific knowledge. In chapter 6.4, on the fourth research question, I directly address the objective of this research, which is to answer how to operationalise the S&JOS to the EU level. Finally, I reflect on the research approach and methodology employed.

### 6.1 Discussing the Safe and Just Operating Space downscaling discourse

The findings in Chapter 5.1 pertain to the research question: What guidance can be harnessed from the current scientific discourse on the central concept of Safe and Just Operating Space for its downscaling to sub global levels? Section 5.1.4 shows results indicating that most of the downscaling studies focus on the national level (Nykvist, Persson & Persson, 2013; Dao, Peduzzi & Friot, 2018; Häyhä et al., 2016; O'Neill et al., 2018; Parsonsová, 2021, among others). The prevalence of national-level downscaling may be explained by the idea that complexity decreases with larger geographical scales (Ryberg et al. 2020). Indeed, the local level yields specific challenges such as data availability and indicator selection, as noted by Turner and Wills (2022). However, Han, Yu & Qui (2023) suggest that downscaling needs to be able to address sustainability issues across scales and socio-ecological contexts. This holds the implication that despite numerous national-level studies, local-level downscaling needs to be considered relevant to be able to address sustainability issues in different contexts.

It is also noteworthy that several authors such as Kim and Kotzé (2021), Raworth (2012), and Turner and Wills (2022) refer to the S&JOS framework as a political construct and underscore that its operationalisation involves more than scientific quantification alone; it encompasses normative judgments influenced by human perceptions of risk and justice. An important implication for the discussion is that the incorporation of scientific knowledge into S&JOS frameworks must navigate the normative and political task of establishing thresholds under varying conditions, influenced by subjective risk and justice evaluations.

Consequently, when downscaling S&JOS frameworks to the regional level, for the EU, the downscaling process becomes susceptible to normative and political considerations. This requires normative choices to determine boundaries and safeguards. Ferretto et al. (2022) argues that such a dynamic played out during the Paris Agreement negotiations. Some countries deemed limiting global warming to two degrees Celsius as reasonable, while others, particularly small island developing states (SIDS), advocated for a stricter target of 1.5 degrees Celsius, given their heightened vulnerability to climate change consequences (Ferretto et al., 2022). Nevertheless, it is crucial to acknowledge that defining planetary and social boundaries on any scale, whether global or sub-global, involves inherently normative decisions.

Additionally, the assessed downscaling literature makes clear that justice aspects, particularly in PB downscaling, have seldomly been rigorously addressed. Kim & Kotzé (2021) emphasize the need for a more unified justice approach. Allocation principles, in particular the per capita approach, have been widely criticised for ignoring varying needs and historical contributions. For example, O'Neill et al. (2018) argue for a deeper understanding of equity and responsibility in resource management. While

the S&JOS needs operationalisation to be practicable for context-specific situations (Keppner et al., 2020), an important implication is that a more unified approach is needed that can address complex issues like shared responsibilities among stakeholders or the entitlements of developed and developing nations in the face of transboundary challenges like climate change, in line with suggestions by Kim & Kotzé (2021), as well as Hossain & Ifejika Speranza (2020). And this is where, considering the political leadership role played by the European Union, downscaling the S&JOS to the sub-global level entails strong normative considerations.

Furthermore, noteworthy for the discussion is that downscaling studies such as Lucas & Wilting (2018) or EEA & FOEN (2020) facilitate ethical decision comparisons across various scenarios compared to just using one allocation principle. Linking this back to literature, Ryberg et al. (2018) mentions that the allocation process is inherently normative as it recommends an approach for dividing resources, and Hoff et al. (2018) assert that various allocation principles can lead to different results. The implication this holds is that using a variety of allocation principles in S&JOS downscaling studies can offer insights into different outcomes, depending on allocation principles used.

The results also show that the development of the PBs and S&JOS frameworks was primarily led by the scientific community, with for example Pickering & Persson (2020) raising concerns about democratic legitimacy. In fact, several authors, such as Häyhä et al. (2016), Hossain and Ifejika Speranza (2020), Biermann & Kim, (2020), and Pickering & Persson (2020) stress that S&JOS operationalisation is not only a scientific exercise, but also necessitates the participation of other stakeholders. The implication this holds is that operationalising the S&JOS for decision-making at sub-global scales requires engagement with relevant stakeholders and involves ethical and political decisions, emphasizing the need for collaboration between scientists and policymakers to ensure legitimacy and effective implementation. Interestingly, this aligns with Hossain & Ifejika Speranza's (2020) suggestion to approach the S&JOS operationalisation with a transdisciplinary method that aims to negotiate and integrate the diverse perspectives of various stakeholders. Similarly, Häyhä et al. (2016) suggest that collaborative practices between scientists and policymakers ensure legitimacy and robust scientific foundation.

Finally, while the literature review provides guidance on various aspects of S&JOS downscaling it also reveals gaps that the framework does not address. For instance, results indicate a lack of understanding regarding the complex interplay between spatial heterogeneity and temporal dynamics in environmental performance and human well-being and point out the need for a scalable and transferable method to measure S&JOS sustainability at local scales (Han, Yu & Qui, 2023). This underscores the need for more precise operationalisation methodologies at local levels to formulate specific policy recommendations. Interestingly, this perspective aligns with Lung's interview, who emphasized the value of localized assessments over another European assessment.

## 6.2 Complementarity of the Framework for Strategic Sustainable Development

Section 5.2 (results 2) outlines the similarities and differences between the Safe and Just Operating Space (S&JOS) framework and the Framework for Strategic Sustainable Development (FSSD) and demonstrates that the FSSD can enhance the operationalisation of the S&JOS in various ways. One key aspect where the FSSD stands out is its potential for providing procedural support for organisational planning, a feature that was reported to be missing in the S&JOS framework. This observation implies not only that the S&JOS may require additional tools or frameworks for effective implementation but also suggests that the FSSD could be a relevant and integrative fit for specific purposes. Arguably, this support can be particularly valuable when scaling down to local and regional levels, especially considering the identified research gaps in the previous chapter.

Respondents highlighted that the S&JOS heavily relies on global data, making it less user-friendly for organisational planning at sub-global levels. While this observation holds true for the original global character of the S&JOS framework, implementing bottom-up operationalisation at the sub-global level often necessitates regional or local datasets, as pointed out by Xue and Bakshi (2022). This potential shift towards utilising more localised data can make the S&JOS framework more actionable for organisations, while not necessarily having to rely on other frameworks. Returning to the recent paper by Rockström et al. (2023), the authors acknowledge that sub-global boundaries are often the relevant scale for action, specifying that "nations, cities, businesses, and other key actors need to set and achieve science-based targets for reducing their environmental impacts based on the translation of the safe and just ESBs to actor fair shares" (Rockström et al., 2023, p.8).

The results indicate that the S&JOS framework may not be as efficient for transformative change planning as the FSSD. Respondents underscored the FSSD's potential to address the root causes of sustainability challenges, foster collaboration, provide procedural support, and facilitate strategic thinking. Notably, a recurring theme is the FSSD's capacity to bridge silos within governments and enhance the coordination of sustainability efforts. As emphasized by Nilsson & Persson (2012), achieving greater coherence is not only necessary between different portfolios but also across various levels of governance, over time, and between the EU and other regions.

Furthermore, respondents underscore the importance of intentionally created spaces and stakeholder perspectives in designing processes for transformative change, thereby emphasizing the need for careful process design and surfacing of underlying values, assumptions, and goals. With respondents arguing for the importance of intentionally created spaces and inclusion of perspectives, an important implication is that stakeholder inclusion necessitates careful process design, which aligns with some of the literature that was part of the literature review in chapter 1. For example, Hossain and Ifejika Speranza's (2020) contention of establishing social learning spaces and deliberative processes to test stakeholders' mental models of change and ability to contemplate their own actions.

Additionally, the FSSD incorporates the precautionary principle in both its design and operationalisation. Respondents emphasized the FSSD's reliance on the precautionary approach, which would cover aspects potentially overlooked by the S&JOS framework. Although Raworth (2012; 2017) does not explicitly mention the precautionary principle, Rockström et al. (2009a) have indicated that the global limits set by the PBs are quantified based on the precautionary principle. Interpreting this, one could argue that while the FSSD not only includes the precautionary principle in its design but also in its operationalisation, the S&JOS framework may incorporate it primarily in its design and not

necessarily in its operationalisation. One could argue that the precautionary principle may not need to be explicitly included in the operationalisation of the S&JOS framework, as it is inherently embedded in its design. However, this does not imply that the operationalisation to sub-global contexts follows a similar approach, emphasizing the case for the FSSD as a complementary framework.

Regarding EU policymaking, findings suggest that certain elements of the FSSD such as the sustainability principles, strategic thinking, and procedural structure, with a particular focus on anticipating unintended consequences, applying the precautionary principle, and supporting collaboration, can help EU policymakers to craft more effective policies. Interestingly, respondents suggest that the FSSD's eight sustainability principles can aid EU decision-makers in strategically addressing complex issues like chemical pollution and plastic pollution. While EU policy allows regulation based on the precautionary principle (Brennan et al., 2021), a more robust methodology like the procedures provided by the FSSD could support more forward-looking substance bans as they are identified. This approach could align with the EGD's goal of being "waste-free and non-toxic by 2050" (Bruinen de Bruin et al., 2022, p. 514), for example by integrating the S&JOS and the FSSD's assessment of unintended consequences for decision-making. A notable illustrative example relates to per- and polyfluorinated substances (PFAS), for which the European Chemicals Agency (ECHA) proposed a ban in February 2023 due to their persistence and toxicity. Since regulating them, as noted by Brennan et al. (2021), presents political, practical, economic, and scientific challenges, the FSSD's precautionary approach may help prevent the adoption of similar substances in the future.

Finally, reported challenges associated with integrating the FSSD into S&JOS operationalisation underscore the issue of accessibility for both frameworks, particularly emphasizing the importance of simplifying language and concepts to enhance user-friendliness and facilitate their adoption, especially with regards to the FSSD's sustainability principles. As suggested by respondents, depending on the purpose and nature of the downscaling process, stakeholders involved may struggle to fully grasp the intricacies involved. I assume here that the process involves not only experts but also various actors and stakeholders who are integral to the process. A purely scientist- or expert-led approach might differ significantly from a participatory downscaling approach involving stakeholders from diverse backgrounds. Arguably, while a unified approach to downscaling might benefit aspects of justice as discussed in the previous section (6.1), there may not be a one-size-fits-all solution. Aligned with several suggestions in the literature, it becomes imperative to tailor process to accommodate for diverse contexts and different audiences, as in studies such as by Keppner et al. (2020) or Lucas & Wilting (2018).

### 6.3 Does the EU Safe and Just Operating Space exist?

The results presented in the section 5.3 contributed to answering the research question: What are the normative goals and visions linked to a Safe and Just Operating Space articulated in EU biodiversity and climate policies, and how do they compare to the EU downscaled Safe and Just Operating Space made by scientists? The climate and biodiversity policy document analysis suggests that PBs are consistently mentioned in the analysed documents, underscoring their significance in assessed EU policy documentation. Yet, in many instances, the PBs are referenced only once, indicating a more platonic rather than a consistently integrated role. In addition, most respondents did not directly refer to the PBs when discussing climate policy goals and visions. A potential reason for this could be linked to the PBs potentially lower prominence in EU policy objectives and in the minds of EU experts. This observation aligns with Hoff et al.'s (2017) assertion that the PBs were central to the 7th Environment Action Programme (7th EAP) but lacked clear practical implications and systematic incorporation into broader EU policymaking.

The comparison of EU climate policy goals with downscaled climate boundary as suggested by scientists in the section 5.3.3, indicates that they do not align with each other. For example, the scientifically recommended boundary of 350 ppm CO<sub>2</sub> concentration target and per-capita emissions caps seems more ambitious than the EU's current emissions trajectory. However, it is good to mention that such comparison can be calculated in multiple ways, depending on the sample of scientific studies used and their allocation principles. The studies I selected largely used per capita allocation and were not very recent, sometimes excluding EGD progress since 2019. Arguably, if allocation principles related to burden-sharing, as described by Turner and Wills (2022) or the ability to pay allocation principles, as described by Hjalsted et al. (2021) were used, results would be different. Another nuance to add is that the comparison largely related to the 2030 target as part of the EGD Fit for 55 legislative package. The upcoming 2040 target, which was not assessed, will likely be much stricter, potentially employing different aspects of fairness. In fact, the European Advisory board's recommendation for the 2040 target implies a 90-95% reduction, suggesting that pursuing a more ambitious 2040 target could improve the fairness of the EU's contribution to climate mitigation globally (European Scientific Advisory Board, 2023). However, 2040 public consultation outlined a range of emission reduction options, spanning from 65% to 90% by 2040 (European Commission, n.d.-d). It is a common assumption that the final target will likely fall somewhere in the middle of this range.

Regarding biodiversity, both the document analysis (section 5.3.4) as well as the interview results (section 5.3.5) point to interconnections between climate and biodiversity, and to a certain extent societal issues related to fairness. Specifically, respondents pointing out that this interconnection seems to be lacking in EU policy and suggest holistic approach (Claeys). Interestingly, these results align with Pascual et al.'s (2022) suggestion that it is needed to consider the three-way interaction between climate, biodiversity and society to foster transformative change in societies (Pascual et al., 2022). Additionally, in the context of biodiversity, results suggest that monitoring progress remains a complex endeavour, aligning with existing literature on quantification challenges. Quantifying this boundary is uncertain as the results suggest, with researchers seeking improved control variables for ecosystem understanding (EEA & FOEN, 2020; Häyhä et al., 2016). This might be one reason why it proved to be so difficult to draw a meaningful comparison between EU policy goals and the biodiversity boundary as suggested by scientists.

Finally, regarding the human rights and social justice policy analysis, there are some points for discussion. Interestingly, respondents highlight the link between human rights, social justice, and environmental sustainability, but also point to the persisting challenges in prioritizing human rights in the EU policy. Interview results call for a more comprehensive approach to integrate human rights into environmental policies. This aligns with existing literature, for example, Ferretto et al.'s (2022) assertion that establishing connections between the PBs and the social foundations remains challenging. However, as per Raworth's (2012) assertion, environmental issues and social factors are interconnected and mutually reinforcing, making the case for careful consideration of balance between PBs and social foundations.

Interestingly, while human rights were not directly mentioned in the analysed documents, the SDGs were often mentioned in relation to the PBs. One could argue that the social foundations almost directly relate to the SDGs, which are guided by human rights standards, as per de Man (2019). It turns out that policy objectives often associated PBs with concepts like well-being, inclusion, and equity, indicating the recognition that achieving environmental sustainability must be intertwined with social considerations. This aligns well with Raworth's (2012) assertion that the two go hand-in-hand.



## 6.4 Operationalising the Safe and Just Operating Space to EU context

The discussion on the final research question: 'How could the Safe and Just Operating Space framework be operationalised for the EU level, and what does this mean for EU policymaking?' directly aligns with the main research aim of operationalising the S&JOS framework for transformative change planning in the EU.

Interestingly, while respondents highlight the value of EU-level operationalisation of the S&JOS framework, they also note that full EU implementation may face hurdles due to the current governance structure. In this structure, Member States retain the authority to implement the European Green Deal in their own distinct ways, including the formulation of fiscal policies. This observation aligns with established literature, exemplified by Bongardt and Torres (2022), who contend that the European Green Deal does not introduce new EU competencies, thereby necessitating policy coordination within the existing framework. EGD implementation mainly operates within the European Semester framework, criticized for its limitations in promoting open coordination by Verdun and Zeitlin (2018). Historical issues like national policy competencies, unclear priorities, and a lack of ownership of reforms, as discussed by Bongardt & Torres (2022), have also hindered the European Semester. Consequently, a noteworthy implication emerges that underscores the importance of strategic alignment within the existing governance framework when operationalizing the S&JOS framework.

Another implication that follows from this thesis is that operationalising S&JOSs at sub-global level requires planning for transformative change, aligning with Pereira et al.'s (2015) assertion that it is necessary to implement transformative changes within our economies and societies. The interview results validate this notion, highlighting the pivotal role that societal transformation plays in driving transformative change, necessitating active engagement with younger generations, fostering lifestyle changes, and fostering societal acceptance of transformative possibilities.

Furthermore, the findings indicate that when operationalizing S&JOS for transformative change at the EU level, it is essential to consider various influential factors, including international scientific processes, economic growth, lobbying efforts, and EU politics. However, it is important to note that these are just illustrative examples. EU policymaking can be considered an intricate system with numerous interconnected elements. In this thesis, I do not provide a comprehensive analysis of EU policymaking, so these findings should be considered indicative rather than exhaustive.

When considering the operationalisation of the S&JOS, it becomes evident that there are several significant implications that warrant discussion. To start with, given challenges and shortcomings linked to the S&JOS framework, and the complementary as found in results chapter 5.2 and discussed in chapter 6.2, I suggest that the FSSD should be considered next to the S&JOS to plan for transformative change. The FSSD can particularly help with its science-based sustainability principles, procedural support, and comprehensive approach to social and ecological aspects, aiding in boundary-setting, promoting sustainable development, and enabling informed, democratic discussion. Noteworthy examples are where sub-global boundaries are not able to be defined, when working with organisations, and addressing silos within governments and promote more strategic thinking. It however requires initial experimentation and prototyping to assess in which context FSSD integration would be beneficial. This falls outside the scope of this thesis.

Additionally, both the literature review and the findings from interviews highlight the critical role of quantification, boundary setting, and indicator selection in this process. Arguably, well-defined boundaries and thresholds play a crucial role in providing valuable guidance for policymaking. The interview results underscore the importance of establishing clear boundaries. This importance is closely linked to the diverse competencies of Member States and the necessity for a multi-level approach. This perspective aligns with existing scholarly literature, as exemplified by Häyhä et al.'s (2016) assertion that the operationalisation of S&JOS inherently involves addressing decision-making and action scales within society.

While quantification is undoubtedly regarded as important, it is worth considering that an excessive emphasis on quantification in sub-global operationalisation contexts may potentially have counterproductive consequences. While quantification is deemed crucial, quantifying environmental boundaries or social foundations in sub-global socio-economic and environmental contexts may pose challenges, primarily due to reported issues such as data availability. Hence, I assert that when utilizing the S&JOS, "the map is not the territory." This perspective aligns with two key functions of S&JOS operationalisation at the sub-global level, as elucidated by Dearing et al. (2014). These functions include guiding complexity thinking across governance and policymaking domains and serving as a metaphor and communication tool to stimulate discussions on regional equity and sustainability. In other words, the utility of the S&JOS extends beyond quantification alone.

The absence of a unified conceptual framework for addressing fairness and justice concerns in quantification, as identified by Kim and Kotzé (2021), underscores the necessity of integrating these considerations in S&JOS operationalisation. Aligning with Kim & Kotzé's (2021) findings, respondents stressed the importance of fairness and justice concerns in quantification, raising important questions about fairness, responsibility allocation, and justice. Overall, the lack of a unified approach fits well with Gupta et al.'s (2021) assertion that there is a gap in analysing the inherent justice dimensions of establishing PBs targets. Consequently, an important implication in the context of a fragmented fairness and justice landscape, is that shared guidelines might enhance coherence and effectiveness of S&JOS operationalisation.

Furthermore, as previously discussed, results indicate that engaging in S&JOS operationalisation requires navigating norms and unveiling normative decisions. The literature review highlights the crucial role of normative considerations in the operationalisation of S&JOS (Lucas & Wiltling, 2018; Wiedmann & Allen, 2021; Steffen, Rockström, and Constanza, 2011; Kim and Kotzé, 2021; Raworth, 2012; Turner and Wills, 2022). These results pose the implication that when engaging in downscaling the S&JOS framework to a specific context, for example in the EU, acknowledging normativity and engaging in reflexivity to check for biases could be beneficial for transparent outcomes.

Interestingly, the challenge of discussing acceptable levels of planetary and, to some extent, social destruction, given the reported blind spot in political party agendas, becomes increasingly relevant in the context of heightened climate change awareness. As noted by Forchtner (2019), these tumultuous times bring forth environmental concerns and provoke profound questions about liberal democracy, capturing the public's attention. Yet, it remains challenging to determine what constitutes an EU safe and just space, bringing forth practical policy challenges.

Findings also emphasize the importance of a robust operationalisation process for S&JOS at the EU level, which involves nurturing social dialogue, integrating diverse perspectives, and addressing challenges related to stakeholder inclusion, bringing with it several implications for discussion. Results also indicate that S&JOS operationalisation to EU-level could take many forms, depending on a variety of factors. In particular, the findings underline the importance of a more robust operationalisation process for S&JOS, which necessitates nurturing social dialogue and integrating a wide range of perspectives. Key elements, including addressing vested interests, stakeholder mapping, and identifying opportunities for collaboration, have been identified as essential components for achieving success in this endeavour. While inclusion of various stakeholders, values and perspectives is a desired aspect of sustainability transformation, it brings several challenges, including uniting powerful and marginalized stakeholders, harmonizing representation and deliberation among diverse groups, balancing diversity with transformation goals, and defining clear boundaries for inclusion processes, as outlined by Kok et al. (2021).

Interestingly, a respondent proposed replacing 'boundaries' with 'targets' in connection with the process, echoing Downing et al.'s (2019) call for a more positive portrayal of sustainability goals. This shift underscores the need for a nuanced framing of sustainability discussions, turning traditional boundaries into adaptable parameters. However, it is worth noting that the term 'Safe and Just Operating Space' already embodies this constructive perspective, it still retains the term 'boundaries'. Arguably, the term 'planetary boundaries' continues to hold inherent value as it represents science-based limits within the Earth system.

Furthermore, in the context of reframing sustainability discourse, some respondents advocated for the establishment of more ambitious policy targets that encompass historical responsibility. They stressed the necessity of adopting assertive objectives to promote significant progress and address systemic debt effectively. Their emphasis lay on the importance of implementing robust frameworks and striving for ambitious goals to achieve meaningful sustainability outcomes. This perspective aligns with the evolving concept of 'beyond sustainability,' a notion identified by Gibbons (2020), which strives to cultivate thriving living systems where overall health and well-being continuously advance.

Operationalising the S&JOS in EU level context, as results suggest, may involve exploring innovative forms of democracy, like citizens' assemblies and policy labs, to match more ambitious boundaries and social foundations and generate transformative ideas, emphasizing the importance of bridging the scientific evidence and political feasibility gap. Drawing upon literature, Pickering et al. (2022) suggest that democracies find it difficult to act swiftly to address problems like climate change and biodiversity loss. However, Pickering et al. (2022) argue that democratic practices can foster transformations towards sustainability. While some 'eco-authoritarians' argue for curtailing democratic safeguards or implementing technocratic rule (Humphrey, 2007; Shearman and Smith, 2007), most scholars suggest a synergistic relationship between democratization and sustainability (Pickering et al., 2022). An interesting question that emerges is: what types of democratic practices could enable transformative change?

## 6.5 Reflections on the credibility and limitations of the study

In this final discussion chapter, I critically reflect on the credibility and limitations of this thesis. To start with, I contend that the use of the theories informed conceptual framework provided useful insights in the attempt to operationalise the S&JOS framework to the EU level. The interactive research design proved to be useful as it allowed for revisiting the research questions, methodology and research approach.

Furthermore, while the combination of a literature review, a document analysis, and qualitative interviews led to a robust set of results, enabling data triangulation, it turned out to be more time intensive than initially planned for. An alternative approach would have been to focus on including more literature in the literature review and spending less time on the document analysis. Covering more literature would have increased the robustness of the findings. Conversely, relying solely on interviews would have increased the likelihood of the data reflecting the personal opinions of respondents. Therefore, the research approach chosen demonstrated to have both strengths and limitations.

In terms of data collection, the choice of conducting qualitative semi-structured interviews is considered appropriate, as it allowed for non-anticipated information and considerations to be shared. I conducted a test interview prior to data collection to improve the quality of the questions. However, in hindsight, some of the research questions remained too exploratory, resulting in more general results, which in turn affects the ability to draw conclusions. Secondly, some interviews were shorter in length than others due to varying availability of respondents, leading to a varying amount of data gathered per respondent. Nonetheless, this does not seem to have significantly influenced the study's results.

The data sample primarily includes EU officials, experts, and scholars, providing valuable insights, the latest information, and personal perspectives from within the EU. However, to achieve a more comprehensive view, incorporating perspectives from other EU institutions and EU-related organisations, would have been beneficial. For instance, the perspectives from the European Parliament, the European Council, other EU agencies, as well as various stakeholder organisations, could have been included.

Regarding the results, it is good to mention that in their responses, respondents more often referred to the PBs framework, and much less so to the social foundations or the S&JOS framework. This tendency was also observed in the literature review, where more articles consisted of PBs downscaling studies. Consequently, some results exhibit a stronger focus on the PBs framework rather than on the S&JOS framework. It is still considered reasonable to draw meaningful conclusions, as there are results that cover both the PBs and the social foundations. Nonetheless, it is a nuance worth mentioning.

Also, the results predominantly highlight the differences between the ecological aspects of both frameworks rather than the social aspects. One plausible explanation could be that the PBs framework is more widely known. On the social side, the FSSD's social sustainability principles were derived from the adaptive capacity of social systems, while the social foundations of the S&JOS are more in line with the 2030 Agenda and the SDGs without explicitly defining social sustainability itself. The effects of the PBs having been published earlier, obtaining greater attention, and the environmental dimension of

sustainability being more robustly documented than the social one, have influenced this thesis' data collection. It further highlights the current challenge of integrating the social and the environmental dimensions in sustainability science.

As mentioned before, the interview questions were of exploratory character pertaining to 'the EU level', without specifying the scale of implementation (e.g., national level, company level) nor the involved actors in the operationalisation process (e.g., civil servants, only scientists). This left respondents room for interpretation, resulting in a variety of responses, but precluding drawing conclusions regarding a specific scale. Nonetheless, given the research objectives, this exploratory approach was considered the most appropriate considering the scope of the research questions.

## 7. Conclusion

The main research question of this thesis was: How can the Safe and Just Operating Space framework be operationalised for transformative change in the European Union? The literature review of the Safe and Just Operating Space (S&JOS) downscaling efforts (SRQ1) reveals a diverse landscape of approaches, scales, allocation principles, and indicators employed, reflecting the complex and evolving nature of sustainability assessments across regional, national, and local levels. Furthermore, the discourse surrounding the downscaling of S&JOS underscores its inherently political nature, influenced by normative judgments and justice considerations, emphasizing the need for a unified approach capable of guiding justice-oriented dimensions in downscaling studies. However, technical knowledge gaps persist, including the need to address spatial and temporal dynamics and to consider both biophysical processes and social well-being in sustainability assessments.

Furthermore, qualitative interviews were conducted to compare the S&JOS framework with the Framework for Strategic Sustainable Development (FSSD) and assess their potential complementarity (SRQ2). Most respondents described the FSSD as valuable to complement and support to the S&JOS framework. The FSSD can offer a broader perspective, helps organisations align with global goals, and guides strategic actions within sustainability boundaries. The FSSD's complementarity extends to EU policymaking and transformative change, emphasizing the importance of principled, systemic, and collaborative approaches in achieving sustainability goals. However, challenges in understanding and integrating both frameworks remain, especially on the social side and related to the relative inaccessibility of both frameworks for non-scientist stakeholders in S&JOS operationalisation processes.

The policy document analysis (SRQ3) revealed a complex landscape of climate, biodiversity and human rights goals and visions. While the planetary boundaries (PBs) are consistently mentioned in the EU documents such as the 7<sup>th</sup> and 8<sup>th</sup> Environment Action Programme (EAP), their practical integration is not clear. Also, depending on the allocation principles used, disparities can be observed between EU climate goals and the climate PB as suggested by scientists. Biodiversity is often linked in relation to the food system and mentioned less frequently than climate change in direct connection with planetary boundaries. However, it was much harder to compare the biodiversity policy goals with the biodiversity PB as suggested by scientists due to challenges in quantification. The human rights analysis, which was done within selection of policy documents for climate and biodiversity, revealed that PBs were mentioned in relation to the Paris agreement, the SDGs and several aspects of justice.

Finally, addressing the 'how' of S&JS framework operationalisation at the EU level (SRQ4), EU experts have expressed differing opinions on the usefulness of implementing the S&JOS framework within the EU context. While there is potential to bridge policy gaps, particularly in areas like the EGD's social dimension, several challenges exist. Key drivers influencing the formulation of climate and biodiversity policies in the EU include science, international processes, economic growth, and competitiveness. To successfully operationalise the S&JOS framework at the EU level and create pathways for transformative change, there is a need for quantification, boundary-setting processes, indicator selection, consideration of fairness and justice, and a focus on societal transformation, along with active involvement of economics and the identification of vested interests.

While this thesis has an exploratory character, a natural progression of this work is to further analyse how S&JOS operationalisation could look like by using a case study, local or regional, to draw best

practices or identify obstacles and enablers. Further research might also explore the relationship between S&JOS operationalisation and transformative change better.

## 8. Recommendations

Drawing from the insights gathered in this thesis, I formulate a set of practical recommendations for two specific types of actors concerning the operationalisation of the S&JOS for transformative change planning in the European Union.

For researchers, I propose the following recommendations:

1. More efforts are needed to explicitly link downscaling studies to the concept of transformative change. Although not found as a reported research gap in the literature, this suggestion aligns with Pereira et al.'s (2015) assertion that incorporating transformative change can provide valuable insights for addressing global challenges and promoting sustainable development in an interconnected world.
2. The findings confirm that the S&JOS framework needs complementation from other frameworks. Further inquiring into and analysing how to integrate the Framework for Strategic Sustainable Development (FSSD) could bring additional practical guidance for the downscaling process to the regional level.
3. This thesis shows that engaging in S&JOS operationalisation requires navigating norms and unveiling normative biases. When engaging in studies that downscale the S&JOSs to sub-global contexts, acknowledging normativity and engaging in reflexivity could be beneficial to check assumptions and create more robust and transparent outcomes.
4. When operationalising the S&JOS, rather than using only one allocation principle, employing multiple allocation principles, akin to a policy menu, might help scientists be more transparent about the values underlying the approaches. Arguably, determining what is safe and just should rest with democratically elected politicians, decisionmakers, philosophers and the public, even if scientists can provide valuable insights as well.
5. Given that S&JOS downscaling has often been led by experts or scientists, which legitimately raise concerns about democratic legitimacy, it would be beneficial to involve relevant stakeholders in the operationalisation process. S&JOS downscaling, while rooted in scientific methods, should incorporate ethical, political, and social factors by engaging various stakeholders to achieve meaningful and impactful outcomes.

For EU policymakers, I recommend the following:

1. In a European Green Deal context, the combination of the science-based S&JOS and the FSSD frameworks might be of use in EU policymaking to support a more robust integration between environmental and social policies translating into effective planning for transformative change. This approach would be supported by a greater and long due deeper collaboration between scientists, politicians, policymakers and stakeholders.
2. Prioritising open and inclusive dialogues to determine acceptable levels of planetary and social impact can help identify shared beliefs and values, offering guidance for shaping policies that promote a safer and fairer future for the EU society.



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## 10. Annexes

### 10.1 Annex 1 - Overview of respondents.

Table 4 – Overview of respondents.					
Respondent	Referencing name	Name	Role	Interview date	Interview location
1	Broman	Göran Broman	A key contributor to the creation of methodology for strategic sustainable development, leader of the establishment of strategic sustainable development as a new academic subject area, professor and science director at the Department of Strategic Sustainable Development, and Dean of the Faculty of Engineering, at the Blekinge Institute of Technology	27-06-2023	Online (Teams)
2	Respondent #2	Anonymous	EU expert, Belgian Federal Climate Change Department	03-07-2023	Brussels, Belgium
3	Respondent #3	Anonymous	EU official, Directorate-General Climate Action, European Commission	04-07-2023	Brussels, Belgium
4	Tulkens	Philippe Tulkens	Head of Unit Climate & Planetary Boundaries (RTD.B.3), Directorate-General for Research and Innovation, European Commission	04-07-2023	Brussels, Belgium
5	Claeys	Florian Claeys	Policy officer Nature Restoration Law and climate-biodiversity synergies, Directorate General for Environment, European Commission	04-07-2023	Brussels, Belgium
6	Hahn	Claudia Hahn	Team Leader Environmental Strategy, Directorate-General for Environment, European Commission	04-07-2023	Brussels, Belgium
7	Moore	Brendan Moore	Brendan Moore, Postdoctoral Researcher at the Centre for Environment, Economy and Energy of the Brussels School of Governance	06-07-2023	Brussels, Belgium
8	Daly	Elaine Daly	University Lecturer, Blekinge Institute of Technology	07-07-2023	Online (Teams)
9	Ploeg	Pieter Ploeg	Design strategist & facilitator for a NGO in landscape restoration	11-07-2023	Online (Teams)
10	Baumgartner	Rupert Baumgartner	Professor of Sustainability Management, University of Graz	11-07-2023	Online (Teams)
11	Arnold	Thomas Arnold	Active Senior Green Transition, European Commission	12-07-2023	Online (Teams)
12	Johnson	Pierre Johnson	Adjunct Lecturer in Strategic Sustainable Development at Blekinge Institute of Technology	12-07-2023	Online (Teams)
13	Sroufe	Robert Sroufe	Falk Chair of Socially Responsible Business in Chatham University's School of Sustainability & Environment	17-07-2023	Online (Teams)
14	Lung	Tobias Lung	Project Manager at the European Environmental Agency (EEA)	26-07-2023	Online (Teams)
15	Grcheva	Leonora Grcheva	Cities and Regions Lead, Doughnut Economics Action Lab (DEAL)	06-09-2023	Online (Teams)

## 10.2 Annex 2 - Overview of downscaling efforts per level (non-exhaustive).

Table 5 - Overview of downscaling efforts per level (non-exhaustive).						
Scale	Authors	Brief description	Approach	Purpose	Allocation principles	Justice theory
Regional	Dearing et al. (2014)	Downscaled S&JOS to two regions in China.	Bottom-up	Regional sustainability assessment	Equal per capita	Egalitarian
	Hoff, Nykvist & Carson (2014)	PBs applied to Europe.	Hybrid	Consumption-based assessment	Equal per capita	Egalitarian
	Sohel (2017)	Operationalises the PBs framework at regional scale by considering the dynamic relationships between social and ecological systems in Bangladesh.	Bottom-up	Regional sustainability assessment	Not specified	Not specified
	Teah et al. (2016)	Sustainability assessment based on downscaling the PBs for the Heihe River Basin in the Gobi Desert in Northwestern China.	Top-down, bottom-up	Regional sustainability assessment	Not specified	Not specified
	Fanning and O'Neill (2016)	Downscales the PBs framework, linking sustainability of resource flows final consumption in Nova Scotia (Canada), and Andalusia (Spain).	Top-down	Biophysical accounting framework	Equal per capita	Not specified
	Hossain et al. (2017)	Operationalises the SOS at a regional scale by considering the complex within a systems dynamic model in a social-ecological system in Bangladesh delta.	Hybrid	SOS development	Not specified	Not specified
	Cooper (2018)	Operationalises the S&JOS as a forward-looking tool to identify interaction pathways for sustainable future for Chilika Lagoon Fishery (India).	Top-down	Regional sustainability assessment	Not specified	Not specified
	Bjørn et al. (2019)	Operationalises Planetary Boundaries for strategic decision-making related to environmental impacts of products in a LCA perspective	Not specified	Life cycle assessment of products	Not specified	Not specified
	EEA & FOEN (2020)	Assesses environmental footprint in relation to PBs for 33 EEA member countries (EU28 + Iceland, Liechtenstein, Norway, Switzerland, and Turkey).	Top-down	Environmental footprint analysis	Equal per capita, needs, right to development, sovereignty, capability	Egalitarian, utilitarian, prioritisation, grandfathering
	Fanning, O'Neill & Büchs (2020)	Analyse relevance of 6 theories to provisioning systems in a safe and just space	Not specified	Methodological contribution	Not specified	Not specified
	Hu et al. (2020)	Applying LCA and develop regional boundaries to assess environmental sustainability of China's food production.	Hybrid	Environmental sustainability assessment	Equal per capita	Egalitarian
	Zipper et al. (2020)	Operationalise the water Planetary Boundary for Cienaga Grande de Santa Marta Wetlands in Colombia.	Top-down, bottom-up	Methodological contribution	Equal per capita	Egalitarian

	Zoe Institute (2021)	S&JOS downscaling to EU level. Development of a ‘beyond GPD dashboard’.	Bottom-up	Development of a policy dashboard	Not specified	Not specified
	Weidner & Guillén-Gosálbez (2023)	PB assessment of deep decarbonisation options for building heating in the EU.	Bottom-up	LCA	Not specified	Not specified
<b>National</b>	Nykvist, Persson & Persson (2013)	Translates the PBs into a corresponding set of national boundaries for the country of Sweden.	Top-down	National PBs assessment	Equal per capita	Egalitarian
	Sayers, Trebeck & Stuart (2014)	Operationalises the S&JOS and provides a snapshot of Scotland’s performance against suggested domains and indicators.	Bottom-up	Consumption-based assessment	Per capita	Egalitarian
	Fang et al. (2015)	Downscales the PBs for climate change, water use and land use to 28 countries and compare it to their corresponding environmental footprints.	Top-down, bottom-up	Footprint-boundary environmental sustainability assessment	Per capita	Egalitarian
	Kahiluoto et al. (2015)	PBS for freshwater systems and the N boundary downscaled to the socio-ecologically contrasting local cases of Finland and Ethiopia.	Bottom-up	Sustainability assessment	Equal per capita	Prioritisation/grandfathering
	Cole, Bailey & New (2014)	Developed a decision-based S&JOS framework downscaling methodology and created a national “barometer” for South Africa.	Hybrid	National barometer	Not specified	Not specified
	Dao, Peduzzi & Friot (2018)	Proposes a methodology to apply the PBs concept to the national level for Switzerland.	Top-down	Environmental sustainability assessment	Per capita	Egalitarian
	Lucas & Wilting (2018)	Operationalises the Planetary Boundaries to support national implementation of environment-related SDGs for the Netherlands.	Top-down	Environmental sustainability assessment.	Various principles used	Grandfathering, equal per capita, cumulative equal per capita, ability to pay, development rights, resource efficiency and full range
	Stoknes & Rockström (2018)	Downscales the climate boundary and analyses progress on carbon productivity (“CAPRO”) in Nordic countries.	Hybrid	Methodological contribution	Not specified	Development rights
	O’Neill et al. (2018)	Quantify the resource use associated with meeting basic human needs and compare this to downscaled planetary boundaries for over 150 nations.	Top-down	Measures national performance	per capita approach	Egalitarian, grandfathering
	Roy and Pramanick (2020)	Operationalises the S&JOS for India.	Top-down	Sustainability assessment	Per capita	Not specified
	Tan et al. (2022)	Introduces Planetary Boundaries as a global sustainability benchmark to expand the evaluation of the major function zoning.	Top-down	Sustainability assessment	Per capita	Not specified

	Fanning et al. (2022)	Analyse historical dynamics of social and biophysical indicators across 140 countries using the S&JOS framework.	Top-down	Not specified	Per capita	Egalitarian, equality-based cumulative approach
	Ali & Ryberg (2023)	Sustainability assessment for the energy and transport sector in Tonga to assessing the extent of policies contributing to staying within the PBs.	Not specified	Effectiveness evaluation	Not specified	Not specified
	Han, Yi & Qiu (2023)	Integrate S&JOS with SDGs to assess regional sustainability and interactions between environmental performance and human well-being across scales in China.	Top-down	CCD for sustainability assessment	Per capita	Equal rights per capita
<b>Local / urban</b>	Hoorweg et al. (2016)	Develop urban monitoring tool and propose a methodology to downscale PBs from a city's perspective in Toronto, Shanghai, Sao Paulo, Mumbai, and Dakar.	Top-down, hybrid & bottom-up	Methodological contribution, assessing urban performance	Per capita	Not specified
	Pasgaard & Dawson (2019)	Explores the S&JOS framework for social-ecological systems at Laos village level.	Top-down	Environmental justice assessment	Not specified	Human needs
	Wiedmann & Allen (2021)	Propose integrating consumption-based accounting and benchmarking against PBs and social thresholds in Australian cities.	Hybrid	Consumption-based (footprint) accounting & benchmarking	Per capita	Egalitarian
	Li et al. (2020)	An absolute water footprinting assessment for Chinese provinces and cities.	Hybrid	Environmental sustainability assessment	Per capita	Egalitarian
	Hachaichi and Baouni (2020)	Downscaling the PBs to city level for Arab cities.	Top-down	Footprint assessment	Per capita	Egalitarian

### 10.3 Annex 3 - Interview questions

#### Interview questions - FSSD scholars & experts (SRQ2+4)

Table 6 - Interview questions FSSD scholars and experts		
Topic/theme	Leading question	Sub-questions
<b>A) Role in the organisation</b>	1. Can you briefly describe what your research is focused on these days?	
<b>B) Framework for Strategic Sustainable Development</b>	1. What was your role in developing the FSSD and do you still work with it now – if so, how? 2. Can you briefly elaborate how the FSSD is typically applied or implemented?	2.1 Can you mention any success stories or best practices where the FSSD has been effectively utilized at sub-global level (e.g., in a public organisation, a private corporation)?
<b>C) The Safe and Just Operating Space</b>	1. Can you provide a brief overview of your experience and familiarity of the S&JOS (meaning Rockström’s Planetary Boundaries framework and Kate Raworth’s social foundations)?	
<b>D) Comparison between FSSD &amp; S&amp;JOS</b>	1. In your view, what are the main similarities and differences between the FSSD and the S&JOS?	
<b>E) Complementarity and support</b>	1. Do you think the FSSD can complement and support the S&JOS framework? 2. If yes, how do you think the FSSD can help in terms of concrete EU policy making? 3. And how do you think the FSSD potentially complement and support the S&JOS framework for transformative change planning at sub-global level?	1.1. Can you give an example into how the FSSD's principles or methods can enhance the implementation of S&JOS? 1.2. One of the challenges that the S&JOS faces is that the establishment of the boundaries is done by experts-driven, involving value-based assumptions about what is acceptable risk. Could the FSSD make boundary-defining processes more democratic and yet science-based? If so, how?



	4. What do you see as challenges or limitations that may arise when attempting to integrate the FSSD and S&JOS at sub-global levels?	
<b>F) Closing remarks</b>	1. Is there anything else you want to share? 2. Are there other key scholars or experts who you think I should interview?	
*Note: these questions were adapted where needed, depending on the background of the respondent and the course of the interview.		

### Interview questions – EU experts (SRQ3+4)

Table 7 -Interview questions EU experts.		
Topic/theme	Leading question	Sub-questions
<b>A) Role in the organisation</b>	1. Can you briefly describe your field of work and your role?	
<b>B) Biodiversity and climate policy affiliation</b>	1. In what ways have you been involved with EU biodiversity/climate policy?	
<b>C) EU policy goals on climate and biodiversity</b>	[mention/cite policy documents mentioning normative EU policy goals and visions] 1. In your understanding, what are the key normative goals and visions in EU biodiversity and climate policies?	
<b>D) Factors influencing policy goals and boundaries</b>	1. What are the main factors that you believe influence the formulation of normative goals and visions in EU climate and biodiversity, policies?	1.1 How do you look at socio-economic rights and development rights when developing policy? 1.2 [Prompt about the just transition within the Green Deal].

<b>E) Normative goals and visions linked to a Safe and Just Operating Space in EU biodiversity and climate policies</b>	1. Do you know if these policy goals are directly related to environmental and social boundaries?	1.1 How do the goals and visions link to environmental boundaries and social safeguards? Is there such thing as a ‘safe and just operating space’ within EU policymaking? 1.2 What is the reasoning behind EU responsibilities towards other countries (e.g. it’s NDC for climate change)?
<b>F) S&amp;JOS operationalisation to EU level</b>	1. Do you think that operationalising the Safe and Just Operating Space framework, meaning regional planetary and social boundaries, to EU level could be useful? 2. How could the Safe and Just Operating Space framework be operationalised for the EU level, and what does this mean for EU policymaking? 3. What do you think is necessary for such a framework to create pathways for transformative change (e.g., fundamental system-wide restructuring of the root causes to sustainability challenges, which are underpinned by complex social paradigms, values, and behaviours).	2.1 What are your suggestions or recommendations for enhancing the alignment between normative goals, visions, and downscaled boundaries in EU policies. 2.2 What do you see as challenges or limitations that may arise when attempting to integrate the FSSD and S&JOS at sub-global levels?
<b>G) Closing remarks</b>	1. Is there anything else you want to share? 2. Are there other key scholars or experts who you think I should interview?	
*Note: these questions were adapted where needed, depending on the background of the respondent and the course of the interview.		

