European Commission

Exploring new visions for a sustainable bioeconomy

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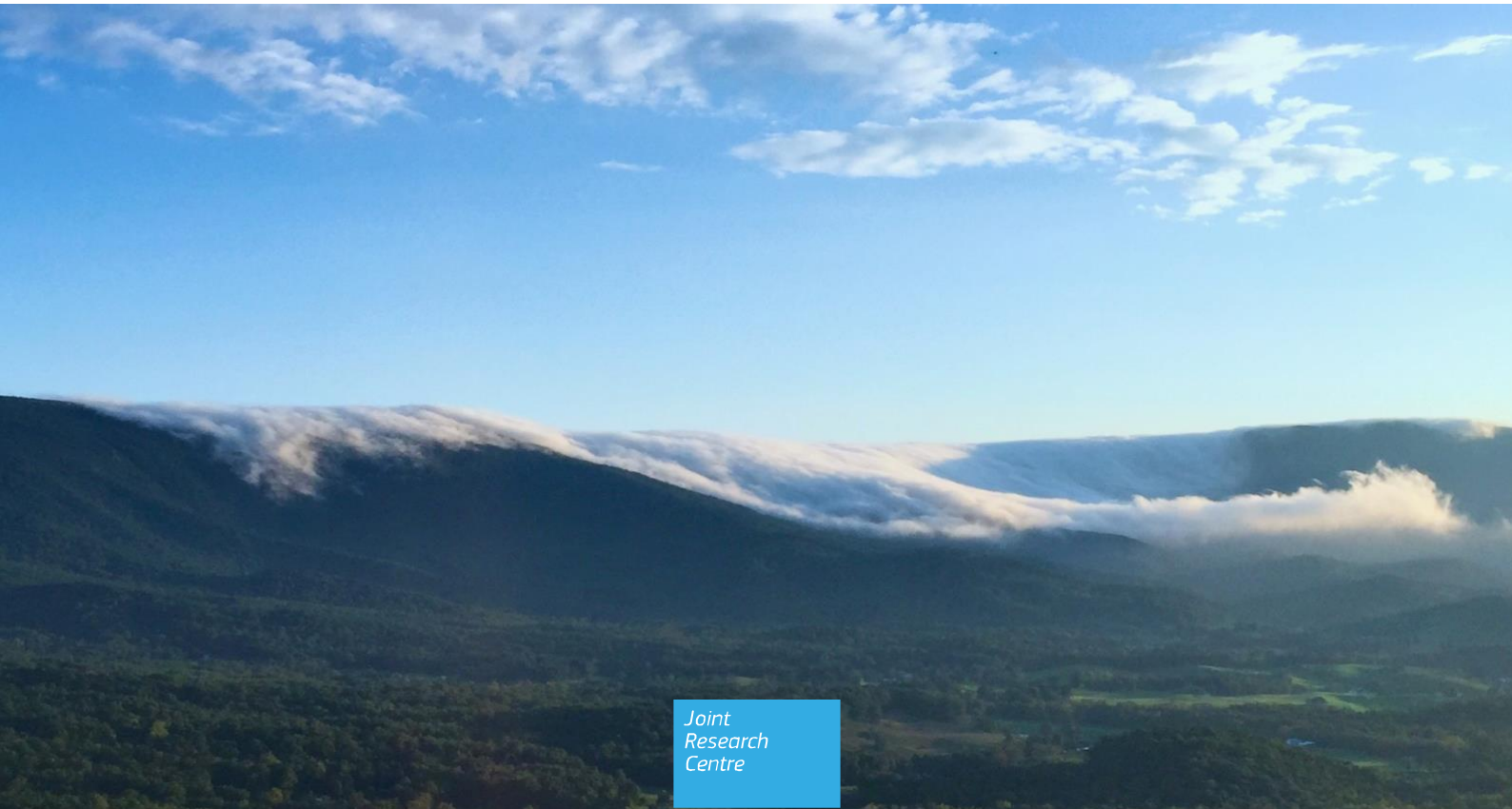

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Contents

Abstract

The Bioeconomy is both an enabler and an end for the European Green Deal transformation: achieving the EGD transformation entails transforming the very meaning of sustainable bioeconomy.

Among the deepest and most effective leverage points to transform a system are the worldviews driving our behaviours: they yield an enormous power to influence the framings which determine the solution space we explore. Transforming the bioeconomy, thus, requires reflecting on the stories we tell about ourselves, our place in nature, and our relationship with others.

Scholars have highlighted how narratives surrounding the EU Bioeconomy have predominantly embraced a "Green Growth" perspective, centred around economic growth, technological innovation, and anthropocentric values, largely ignoring the social and justice dimensions, as well as not questioning the role, relations, and responsibilities of humans in the web of life. These dominant framings are increasingly contested, though, because they have failed to produce the social and ecological outcomes desired.

This report introduces perspectives which have been under-represented in the Bioeconomy discourse and integrates them into an alternative vision for a "green, just and sufficient bioeconomy". This vision places environmental sustainability and social equity at its core, regardless of economic growth; has an inclusive and participatory perspective; care, respect, and reciprocity for and with other humans and non-humans are core values; technology is important to deliver on the green and just objectives, but ethical considerations for new technologies are openly debated.

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Executive summary

The EU Bioeconomy Strategy aims to accelerate the deployment of a sustainable European bioeconomy and defines five objectives that a sustainable and circular EU bioeconomy should achieve. However, sustainability is a meta-discourse that can be interpreted, and consequently operationalized, in many different ways.

From sustainability science perspective the key to achieving sustainability transformations requires building shared imaginaries about desirable and attainable futures, hence the need to address the question: "Transformations to what?". Environmental social sciences further highlight the need to deliberate on "how, for whom and by whom" questions of transformations, emphasizing the importance of process, politics, and justice. Hence, in addition to the need to define and agree on the long-term visions and goals of transformations, there is also a need to deliberate on the process, triggers and praxis of transformations.

Scholars have highlighted how narratives surrounding the EU Bioeconomy have predominantly focused on a techno-scientific and industry- and economy-oriented interpretations and concerns, centered around economic output, technological innovation, and the substitution of fossil carbon with biological. Recent studies have revealed how a broad concept such as the 'bioeconomy' can be associated to very different framings and that the dominant narratives are increasingly contested, especially by citizens and some NGOs, because they have so far failed to produce the social and ecological outcomes desired. Especially in ecological terms, they have shown to be not consistent with the biophysical limits of the planet.

Given the climate and ecological breakdown as well as inequality crises, we urgently need to expand the solution space at our disposal. This report aims to initiate a constructive dialogue on the bioeconomy, by introducing perspectives which have been so far under-represented in the Bioeconomy discourse.

This report stems from the keynote speeches delivered at the Community of Practice on the Bioeconomy workshop organized by the JRC titled "**Visions for a sustainable EU bioeconomy - *Exploring existing narratives and introducing novel perspectives"*** held on 9-10th November 2022. This report is an anthology of Chapters written by scholars external to the JRC, presenting a varied spectrum of views, expertise, and perspectives. The Chapters, thus, represent the views of each respective author and are not necessarily shared or endorsed by the other authors, nor by the JRC. The information and views set out in each chapter of this report are those of the authors and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this report. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use that may be made of the information contained therein.

Policy context

The latest 2022 Bioeconomy Progress report (COM/2022/283) states that the Bioeconomy can be seen as both a means and an end for the European Green Deal (EGD) transformation: on the one hand transitioning *to* a bioeconomy (i.e. expanding the current size of the bio-economy) supports the EGD by providing renewable materials to eliminate fossil fuels from industrial processes, at the same time, transforming *the* bioeconomy itself to be green and just is one of the goals of the EGD (e.g. Farm to Fork, Biodiversity Strategy, Forest Strategy etc…).

Thus, achieving the EGD transformation entails transforming the very meaning of sustainable bioeconomy. Among the deepest and most effective leverage points to transform a system are the mental models and mindsets which drive our actions and behaviours, and thus determine the systems we create, maintain, and reinforce. The stories we tell about ourselves, our place in nature, and our relationship with other humans and with other-than-humans, have an enormous power to influence the systems we create. These worldviews and the values they embed influence the framings through which we look at problems and determine the solution space we end up exploring.

Transforming the bioeconomy, thus, will require reflecting on such deep leverage points and deep questions of our existence, our roles, relations and responsibilities in the web of life, the values that define us and that ultimately drive our actions and behaviour.

Key conclusions

The report presents a potential new vision for a "**green, just, and sufficient bioeconomy**", located in the 'unexplored' areas of the option space, and then ventures into analysing what potential consequences

embracing this new vision could have for bioeconomy research and governance. The challenges we face in achieving the Green Deal transition are unprecedented, and our goal for these rather bold proposals is to stimulate a constructive discussion so that the bioeconomy can really be a pillar of a new sustainable society.

Instead of focusing on promoting biomass extraction with the goal to decouple economic growth from fossil resources use and their climate impacts, this new vision places environmental sustainability and social equity at its core, regardless of economic growth. On the contrary, since absolute decoupling is highly unlikely or unlikely to take place at the speed required to avoid climate breakdown, this vision focuses on sufficiency and frugality rather than aiming for perpetual economic growth. The underlying goal of the bioeconomy in this vision is to support "a good life for all within planetary boundaries". The vision has an inclusive perspective, whereby the moral community includes humans as well as other-than-humans, leading to a moral reckoning of the place of humans in the web of life. Care, respect and reciprocity for and with others are core values in this vision. Reliance on technology and technological solutions is not a core tenet in this vision, but the role and potential of technology to deliver on the green and just objectives is recognized. Thus, ethical considerations on new technologies are openly debated in the public.

Accepting that a large unexplored option space exists, including this new vision but also many other variants, then we argue that this option space should be explored: this could be as simple as designing and including new scenarios in policy Impact Assessments, in modelling activities, in scenario analysis, etc. Or more radically, different knowledge framings and modelling approaches could be embraced within bioeconomy research: e.g. Quantitative Storytelling approaches, indigenous knowledges, methods from systems thinking, sociometabolic approaches etc..

Further, embracing a new vision for a sustainable bioeconomy has some clear implications for bioeconomy governance which can be summarized in the following ten points which are expanded in chapter 8.3: 1) Democratizing the bioeconomy; 2) Preventing neo-coloniality and exploitation in global bioeconomy; 3) Integrating a global decolonial environmental justice perspective; 4) Reflecting on the value of Nature and a hierarchy of Sustainability priorities; 5) Integrating explicitly ethics and values in deliberation process; 6) Guaranteeing public access to nature; 7) Promoting Commons; 8) Applying labour and economic policies from degrowth scholarship; 9) Taking a systemic perspective; 10) Promoting Reflexivity.

Main findings

The chapters in this report span a broad range of topics and academic disciplines, and some of the most prominent scholars in their fields contributed to writing chapters 3 to 7. We report here the key messages for each chapter and topic.

Chapter 2 frames, broadly, bioeconomy governance as a process to deliberate on how to govern highly intertwined social-ecological systems towards the goal of a 'sustainable bioeconomy', **where sustainability is defined as maintaining the integrity of the biosphere and promoting social equity and justice, regardless of the economic system and processes in place**. Additionally, Chapter 2 introduces 'visions' as a key leverage point to achieve the European Green Deal transformation and shows how the current hegemonic visions expressed in EU documents are all largely aligned in a narrow quadrant of the possible option space, capturing visions characterized by green growth, decoupling objectives, and anthropocentric perspectives. Given the climate, ecological, and inequality crises, we argue that we urgently need to expand the option space explored well beyond the existing hegemonic narratives. To this goal, this report aims to introduce perspectives which have been under-represented in the Bioeconomy.

Chapter 3 focuses on different understandings of our-human nature relationship and what that might mean for how we frame the bioeconomy. The key messages from Prof. Oliver's chapter are the following: i) The dominant western worldview has been an anthropocentric one, and it has fundamentally shaped an economic system that is proving inefficient for environmental sustainability; ii) Perspectives from diverse indigenous cultures and state-of-the-art scientific findings both suggest that human exceptionalism and a sense of individual sovereignty is misplaced– a worldview of deep interconnection between all natural entities is more valid; iii) **Developing our human-nature relationship away from an anthropocentric perspective is an essential leverage point to achieve genuine sustainability**, a fact increasingly also recognized by major science-policy initiatives; iv) This presents a challenge requiring a deeper reframing of bioeconomy strategy based on a fundamental pivot in conceptions of human-nature relationships.

Chapter 4 fundamentally questions whether 'Green Growth' is possible. The key messages from Prof. Kallis' chapter are the following: i) **There is increasing evidence that genuine green growth is not happening and is unlikely to happen in the near future**; ii) Alternatives to green growth, such as post-growth or degrowth, face considerable obstacles regarding their implementation and acceptability that call for new research; iii) Political acceptability is a central obstacle: only through a coevolutionary change of personal/everyday practices, social mobilization and institutional change can new transformative politics emerge; iv) Whether such political change can happen fast and far enough remains still uncertain. Prof. Kallis identifies four pragmatic measures to move in the direction of degrowth (see section 4.3 for details): **1) A Green New Deal without growth; 2) Universal Care Income; 3) A Four-day Workweek; 4) Wealth tax.**

Chapter 5 discusses how the Environmental Justice agenda can contribute to a more just bioeconomy. The key messages from Prof. Ramcilovic-Suominen are the following: i) Justice in environmental policies such as bioeconomy is a matter of moral responsibility, as well as a precondition for sustaining a policy over time; ii) Bioeconomy has global implications and therefore responsibility for global justice; iii) Global environmental justice requires a decolonial perspective that accommodates the marginalized actors' (e.g. local and Indigenous communities) knowledge and legal systems, their right to self-determination and self-governing authority; iv) The responsibility of the EU to promote globally just bioeconomy relates to its colonial history and neocolonial tendencies that drive global inequalities, various forms of extraction and domination, biodiversity loss and climate change; v) **Reducing EU's overconsumption and epistemic domination are the key preconditions for globally just bioeconomy**.

Chapter 6 dives into more details into a crucial bioeconomy sector, the agri-food system, and explores potential ways forward that comply with biophysical and social sustainability. In this chapter, George Monbiot makes the case that farming has the biggest impact on the living planet, but that the impacts of this sector are not tackled with the same standards which are applied to other industries. Monbiot especially stresses how livestock farming generates agricultural sprawls, both for grazing and for growing the crops required as feed, and how low-yield agriculture might not be environmentally-friendly since it exacerbates the use of land from agriculture sectors. Monbiot argues instead that what we need is low-impact agriculture, especially low-land use technologies, such as precision fermentation. Monbiot concludes with **an appeal to look in-depth at the potential perverse incentives in European agricultural policy which might perpetrate the expansion of agricultural area and thus hinder the possibility of restoring natural ecosystems and habitats**.

Chapter 7 connects the concepts and ideas of degrowth, justice and relationality (worldview that all living beings, plants and animals, are connected and that one's personal wellbeing depends on that of the other) in the context of transformations, where they are seen as means and preconditions for transformations. The key messages from Prof. Ramcilovic-Suominen are the following: i) Existential socioecological crises are systemic (i.e. driven by the political and economic system dependent on perpetual economic growth) and relational (i.e. crises of a lack of connection and relation), and have common causes. ii) Addressing these causes requires: (a) dismantling power and economic relations that drive violence and exploitation; (b) ontological reflection, including reimagining human roles, relations and responsibilities in the web of life; and (c) **reinventing structures and ontologies to rely on principles of care, respect, and reciprocity;** iii) Degrowth, justice and transformations are not metaphors, silver bullets, or blueprints. They are embedded in the cultural and the political contexts.

Related and future JRC work

The EU Bioeconomy Monitoring System (BMS) is being developed by the JRC, pursuant to the Action 3.3.2 of the 2018 EU Bioeconomy Strategy (COM/2018/673), to track progress towards the five objectives defined in the Strategy. The BMS consists of an on-line dashboard of indicators and a first progress assessment report has been recently published (Mubareka et al., 2023).

The BMS is part of a set of on-going research activities carried out at JRC focusing on: understanding the social-ecological outcomes of the Bioeconomy, and reflecting on the normative basis for the Bioeconomy. The ideas and perspectives explored in this report can support this process of deliberation on new visions and trajectories for the EU bioeconomy and the society it will support. The rather bold proposal for a "green, just, and sufficient bioeconomy" provides ideas for new research avenues, as well as reflections on different governance approaches.

Quick guide

Chapter 2 frames the main concepts and the goals of the report. Chapters 3 to Chapter 7 present a broad overview of perspectives which have so far been under-represented in the bioeconomy discourse; these chapters contain edited transcriptions of the keynotes delivered at the workshop. In Chapter 3, Prof. Tom Oliver offers a perspective on human-nature interconnectedness and the need to incorporate self-identity as a key driver of system transformation. In Chapter 4, Prof. Giorgos Kallis expresses the need to face the impossibility of achieving 'green growth' and counters instead with measures from degrowth scholarship. In Chapter 5, Prof. Sabaheta Ramcilovic-Suominen discusses how the Environmental Justice agenda can contribute to a more just bioeconomy. In Chapter 6, George Monbiot dives into more details into a crucial bioeconomy sector, the agri-food system, and explores potential ways forward that comply with biophysical and social sustainability. In Chapter 7, Prof. Ramcilovic-Suominen weaves all these perspectives together as key elements of transformations in relation to bioeconomy. Chapter 8 finally proposes to integrate these perspectives into a new vision and explores its implications for bioeconomy research and governance in Europe.

1 Introduction

Jacopo Giuntoli and Sabaheta Ramcilovic-Suominen

The EU Bioeconomy Strategy (European Commission, 2018) aims to accelerate the deployment of a sustainable European bioeconomy and defines five objectives that a sustainable and circular EU bioeconomy should achieve ([1]). The JRC is developing the EU Bioeconomy Monitoring System (henceforth 'BMS') ([2]) to track progress towards these five objectives and current efforts are ongoing to populate it with functional indicators.

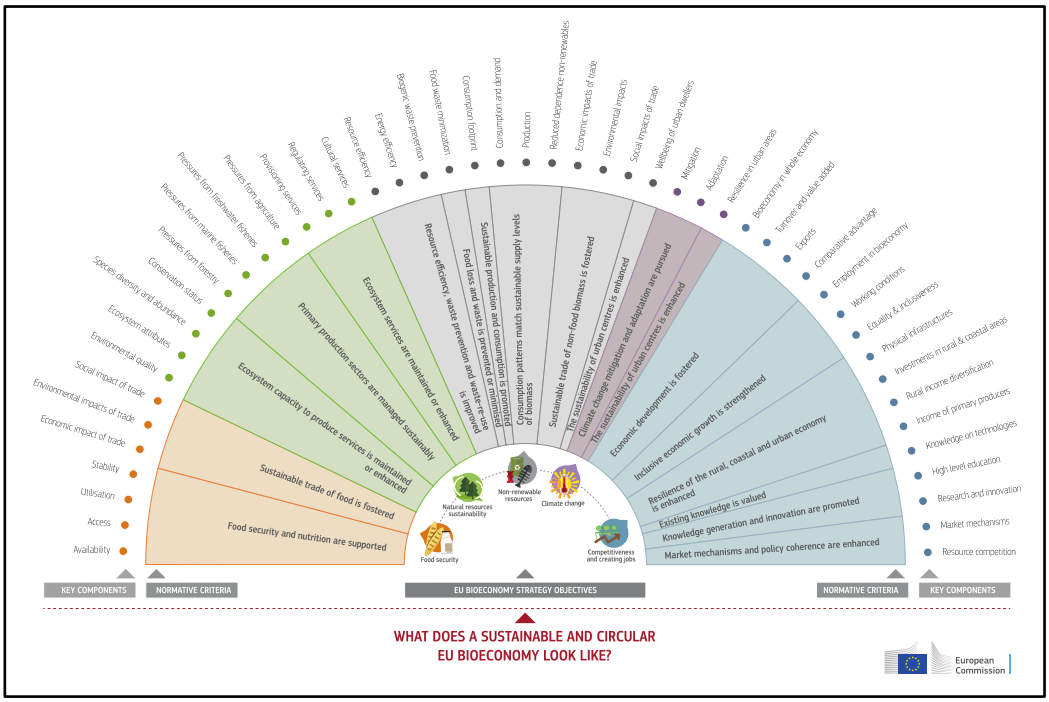

Figure 1: Visualization of the conceptual framework developed for the EU Bioeconomy Monitoring System.

At the centre of the BMS is the conceptual framework in Figure 1, which aims at operationalising the five political objectives into a vision for a sustainable EU bioeconomy. However, sustainability is a meta-discourse that can be interpreted, and consequently operationalized, in many different ways.

From sustainability science perspective the key to achieving sustainability transformations requires building shared imaginaries about desirable and attainable futures, hence the need to address the question: "Transformations to what?" (Clark and Harley, 2020). Environmental social sciences further highlight the need to deliberate on "how, for whom and by whom" questions of transformations, emphasizing the importance of process, politics, and justice (Bennett et al., 2019; Mehta et al., 2021; Ramcilovic-Suominen, 2022). Hence, in addition to the need to define and agree on the long-term visions and goals of transformations, there is also a need to deliberate on the process, triggers and praxis of transformations.

Scholars have highlighted how narratives surrounding the EU Bioeconomy have predominantly focused on a techno-scientific and industry- and economy-oriented interpretations and concerns, centered around economic output, technological innovation, and the substitution of fossil carbon with biological. Recent studies have revealed how a broad concept such as the 'bioeconomy' can be associated to very different framings and that the dominant narratives are increasingly contested, especially by citizens and some NGOs, because they have so far failed to produce the social and ecological outcomes desired. Especially in ecological terms, they are incompatible with the biophysical limits of the planet.

([1]) The five strategy objectives are: 1. Ensuring food and nutrition security; 2. Managing natural resources sustainably; 3. Reducing dependence on non-renewable, unsustainable resources, whether sourced domestically or from abroad; 4. Mitigating and adapting to climate change; 5. Strengthening European competitiveness and creating jobs.

([2]) https://knowledge4policy.ec.europa.eu/visualisation/eu-bioeconomy-monitoring-system-dashboards_en

Given the climate and ecological breakdown as well as inequality crises, we urgently need to expand the solution space at our disposal. This report aims to initiate a constructive dialogue on the bioeconomy, by introducing perspectives which have been so far under-represented in the Bioeconomy discourse. These perspectives are actually applicable to the overall economy and European societal structure, but the issues and proposals presented in this report are tailored to address mainly sectors within the bioeconomy.

This report stems from the keynote speeches delivered at the Community of Practice on the Bioeconomy workshop organized by the JRC titled "**Visions for a sustainable EU bioeconomy - *Exploring existing narratives and introducing novel perspectives"*** held on 9-10th November 2022. The Community of Practice on Bioeconomy was launched in December 2018 with the aim to bring together researchers, policymakers and other experts in the field, to foster collaborative and multidisciplinary activities and to contribute to a holistic perspective of the bioeconomy.

The report is structured as follows:

(a) In Chapter 2, Jacopo Giuntoli and Prof. Ramcilovic-Suominen provide the framing and main reasoning behind this report;

(b) In Chapter 3, Prof. Tom Oliver offers a perspective on human-nature interconnectedness and the need to incorporate self-identity as a key driver of system transformation.

(c) In Chapter 4, Prof. Giorgos Kallis expresses the need to face the impossibility of achieving 'green growth' and counters instead with measures from degrowth scholarship.

(d) In Chapter 5, Prof. Sabaheta Ramcilovic-Suominen discusses how the Environmental Justice agenda can contribute to a more just bioeconomy.

(e) In Chapter 6, George Monbiot dives into more details into a crucial bioeconomy sector, the agri-food system, and explores potential ways forward that comply with biophysical and social sustainability.

(f) In Chapter 7, Prof. Ramcilovic-Suominen weaves all these perspectives together as key elements of transformations in relation to bioeconomy.

(g) In Chapter 8 finally, Jacopo Giuntoli and Prof. Ramcilovic-Suominen propose to integrate these perspectives into a new vision and explore its implications for bioeconomy research and governance in Europe.

This report is an anthology of Chapters written by scholars external to the JRC, presenting a varied spectrum of views, expertise, and perspectives. The Chapters, thus, represent the views of each respective author and are not necessarily shared or endorsed by the other authors, nor by the JRC. The information and views set out in each chapter of this report are those of the authors and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this report. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use that may be made of the information contained therein.

2 Framing the report

Jacopo Giuntoli and Sabaheta Ramcilovic-Suominen.

2.1 Key concepts: "Bioeconomy" and "Sustainability"

The 2018 Bioeconomy Strategy provides a broad and comprehensive definition of the bioeconomy to include 'all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles' (European Commission, 2018). By including ecosystems with their services and their management in the definition, the subject of bioeconomy policy and research become a large set of social-ecological systems 'in which social and ecological subsystems are coupled and interdependent, each a function of the other, expressed in a series of mutual feedback relationships' (Berkes, 2017). Thus defined, the bioeconomy policy project moves beyond its original industrial/innovation focus, and rather becomes a part of a larger vision for a whole new system of production and consumption and consequently, a part of a vision for a new society.

Seen through this lens, we can argue then that the bioeconomy policy project is really about answering a question as old as human societies: how do we want to co-exist with our natural surroundings and the biological resources they offer; for which goals, and to the advantage (and disadvantage) to whom? How we answer this question will have enormous consequences on the society that we strive to achieve and support.

The goal to achieve a "sustainable bioeconomy" is largely undisputed (European Commission, 2018), however, sustainability is a meta-concept that can be interpreted, and consequently operationalized, in very different ways depending on any given set of beliefs and worldviews, as well as interests, concerns and political agendas. The elasticity of this concept has led to several negative consequences, from polarizing debates (e.g. the debate on sustainable bioenergy (Mubareka et al., 2022)), to outright greenwashing (Kurki and Ahola-Launonen, 2021; Vivien et al., 2019). Indeed, a meaningful body of scientific literature maintains that the fuzziness of the term 'sustainable' might be one of the reasons why the concept has failed to deliver concrete results in the 30 years of its existence (Blühdorn, 2022; Blühdorn, 2017; Foster, 2017): when the word "sustainable" becomes an empty buzzword, this can be used as a rhetorical device by interested actors to merely legitimize unsustainable business-as-usual through a socially accepted framing (Peltomaa, 2018; Ramcilovic-Suominen and Pülzl, 2018).

A common framework for sustainability is the "3-pillars model", whereby social, environmental, and economic goals are seen as equally important and desirable in moving towards a sustainable society. Studying the origins of this now widespread conceptualization, Purvis et al. (2019) come to the conclusion that "sustainability" as a concept in its modern interpretation has actually emerged from ecological and social critiques of the economic status quo, highlighting the importance of limits and boundaries in opposition to the search for perpetual economic growth (Meadows et al., 1972; Vivien et al., 2019; Weber and Cabras, 2019). However, the introduction of the third pillar focusing on economic efficiency, broadly operationalized as "economic growth" (and usually conflated with GDP growth), within the sustainability discourse largely neutralized the other two dimensions, weakening the original idea and the power of the concept itself. This by far and large transformed sustainability from a critical concept to a support tool for economic growth. As the current worsening social and socio-ecological crises show, the notion that economic growth correlates with decreasing inequality and improving ecological conditions has been seriously questioned (Hickel, 2019; Raworth, 2017).

The 3-pillars model was also embedded in the development of the EU Bioeconomy Monitoring System (Robert et al., 2020). However, we argue in this chapter that this is one concept among others that should be reviewed. We take inspiration from the "Do no harm" ethics of Hans Jonas (Schoop, 2022) to define a hierarchy of priorities for what a sustainable bioeconomy should aspire to achieve. A similar hierarchy is presented and embraced across several disciplines and different schools of thought, such as: sustainability science (e.g. the 'wedding cake for SDGs' by Folke et al. (2016)), ecological economics (Vivien et al., 2019), economic and social (in)equity (Hickel, Sullivan, and Zoomkawala, 2021; Leach et al., 2018), and wellbeing economy (e.g. the 'Embedded Economy' framing by Raworth (2017)). The following three points establish a hierarchy of priorities:

1. The integrity of the biosphere and our life-support systems provides non-negotiable limits.
2. Economic and social inequity exacerbates and is further aggravated by ecological degradation, and thus even besides any further ethical considerations, it goes counter to the first principle.
3. Economic systems are means to an end (well-being) and as such they can be redesigned and reinvented.

In broad terms, in this report we frame bioeconomy governance as a process to deliberate on how to govern highly intertwined social-ecological systems towards the goal of a 'sustainable bioeconomy', where sustainability is defined as maintaining the integrity of the biosphere and promoting social equity and justice, regardless of the economic system and processes in place.

2.2 "Visions" as deep leverage points for transformation

The latest 2022 Bioeconomy Progress report (European Commission, 2022) states that the Bioeconomy can be seen as both a means and an end for the European Green Deal (EGD) transformation: on the one hand transitioning *to* a bioeconomy (i.e. expanding the current size of the bio-economy) supports the EGD by providing renewable materials to eliminate fossil fuels from industrial processes, at the same time, transforming *the* bioeconomy itself to be green and just is one of the goals of the EGD (e.g. Farm to Fork, Biodiversity Strategy, Forest Strategy etc…).

Thus, we argue that achieving the EGD transformation entails transforming the very meaning of sustainable bioeconomy. In systems analysis, leverage points are places to intervene in a complex system to exert change on the system itself. Meadows (1999) defined a hierarchy of twelve leverage points, ranked according to their effectiveness: 'shallow' leverage points are interventions expected to achieve only minor changes in the outcomes of the system, while 'deep' leverage points are interventions which are likely to have transformational effects. Sustainability Science literature has demonstrated that deep leverage points have a much stronger impact compared to 'shallow' leverage points, which, though, are often the main focus of policy interventions (e.g. taxes and subsidies) (Davelaar, 2021).

Among the deepest and most effective leverage points are the mental models and mindsets which drive our actions and behaviours, and thus determine the systems we create, maintain, and reinforce (Abson et al., 2017). The stories we tell about ourselves, our place in nature, and our relationship with other humans and with other-than-humans, have an enormous power to influence the systems we create (Bentz, O'Brien, and Scoville-Simonds, 2022). These worldviews and the values they embed influence the framings through which we look at problems and determine the solution space we end up exploring (SAPEA, 2020).

Transforming the bioeconomy, thus, will require reflecting on such deep leverage points and deep questions of our existence, our roles, relations, and responsibilities in the web of life, the values that define us and that ultimately drive our actions and behaviour.

When talking about different visions, though, conflicts and debates are natural and even desirable. Nonetheless, in policy design and implementation, mediating the different positions, including goals, values and ideologies, is required and compromises are ideally negotiated in a transparent and open manner (Wolff, 2022). The JRC as a boundary organization at the interface between science and policy, is well positioned to act within the Post-Normal Sphere (PNS) as described by Giampietro and Bukkens (2022). The PNS-sphere sits between the scientific and the political spheres. In the scientific sphere scientists produce empirical evidence according to different representations, framings, and epistemic boxes, and experts then identify and elevate relevant knowledge claims. In the political sphere concerns are identified and prioritized within the policy process. The PNS-sphere has the crucial goal to fight hypocognition ([3]) and to challenge existing framings by introducing uncomfortable knowledge, i.e. knowledge which is largely outside the mainstream narratives and discourses (Rayner, 2012).

The goal of this chapter is thus not to define which visions "should" be adopted, but to present knowledge claims which appear to be currently underrepresented in policy narratives about the bioeconomy, and to initiate an open and frank discussion on alternative visions for a sustainable bioeconomy which "could" be explored in the EU's bioeconomy research and in governance.

2.3 Existing narratives and visions for the EU bioeconomy

In the past decade a large body of literature has analyzed the main narratives and visions either as embedded in EU and national bioeconomy policy documents as well as expressed by multiple actors involved in the bioeconomy. The visions were identified as ranging from biotechnology or science-based, bio-resource, or

([3]) Quoting Giampietro (2019b): 'Lakoff (2010) suggested this term to flag that any selection of a given framing of an issue implies hypocognition in relation to the aspects neglected by the framing. Similar formulations of this concept, but with a more positive take are: "all models are wrong, but some are useful" (Box, 1979) and "Models are 'blinders' which 'leaving out certain things', [...]provide a frame through which we see the world" (Stiglitz, 2011)'.

biomass based, and bio-ecology, or biosphere limits visions (Bugge, Hansen, and Klitkou, 2016; Vivien et al., 2019).

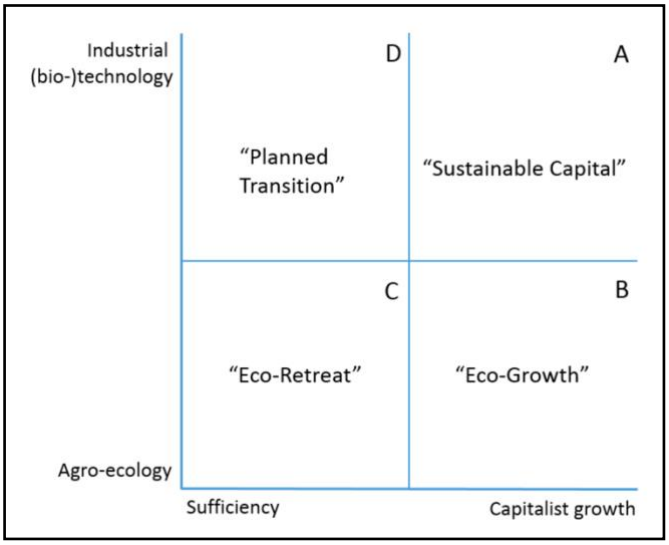

Figure 2: Techno-political option space for visions of a bioeconomy. Source: Reproduced with permission from Hausknost et al. (2017)

In order to provide a common classification for the various visions and mentalities found in the literature, we use the techno-political option space first defined by Hausknost et al. (2017) and afterwards adopted in several other studies (Figure 2). This bi-dimensional space positions the 'political-economic' dimension on the bottom axis and the 'technological-dimension' on the vertical axis. The space can thus be divided into four quadrants: with the top right corner representing largely 'Green Growth' perspectives, where the main vision is for a bioeconomy as an engine for economic growth, driven mainly by technological development. On the bottom left is an alternative, if not opposite, vision in which 'sufficiency' is preferred to economic growth and the focus of the bioeconomy is on environmentally conscious practices (e.g. agro-ecology).

Hausknost et al. (2017) themselves have analysed and placed in their techno-political option space several EU, national and international bioeconomy policy documents as well as the views of different Austrian stakeholders. They found that largely the positions of policy documents and stakeholders can be positioned on a diagonal line, with the large majority resulting to be aligned on the top-right quadrant. They also place the 2012 EU Bioeconomy strategy (European Commission, 2012) in the top right quadrant, which is in line with the findings of other studies (Eversberg and Holz, 2020; Ramcilovic-Suominen and Pülzl, 2018). While the paper from Hausknost et al. (2017) predates the 2018 Bioeconomy Strategy, other studies also highlight that while the updated strategy reflects a moderation of certain aspects from the 2012 strategy, it is still a growth strategy, embedded in human-nature dichotomy and the idea of 'Green Growth' (Eversberg, Holz, and Pungas, 2022; Ramcilovic-Suominen, 2022). Peltomaa (2018) used the same option space to classify the narratives emerging from media reporting on the bioeconomy in Finland and found that the majority of narratives could be classified in the top-right quadrant.

It is important to highlight that the bioeconomy policy project has been defined as an 'elite master narrative' (Birch, Levidow, and Papaioannou, 2010), which has been shaped by and discussed within a limited group of actors, often including industry and techno-scientific research, while the views of citizens and civil society organizations have often been marginalized (Riemann, Giurca, and Kleinschmit, 2022). Eversberg and Fritz (2022) distilled the responses of the survey on Environmental Consciousness in Germany 2018 into various 'mentalities' which they position on a socio-ecological space of possibilities similar to the space in Figure 2. While they found mentalities that could be placed in all four quadrants, the largest clusters appeared in the top-right and bottom-left quadrants. This is further reinforced by the work of Dieken et al. (2021), who looked at the bioeconomy visions supported by different stakeholders through a literature review, and found that the only actors envisioning a potential "bio-ecology vision" (i.e. placed in the bottom-left of the option space) were citizens.

Partly in response to these and similar findings, the European Commission has acted to strengthen the role of youth in the bioeconomy policy process by setting up the EU bioeconomy youth ambassador programme ([4]).

An extensive literature review is outside the scope of this chapter, however the reader can find an updated and revisited categorization of bioeconomy visions in Ramcilovic-Suominen et al. (2022). Nonetheless, from the existing literature, we broadly conclude that:

- 'Traditional' bioeconomy stakeholders are firmly in the top-right quadrant, i.e. "Green Growth" or "Sustainable Capital". This vision is also largely embraced and promoted within the EU's and MS's bioeconomy strategies.
- However, there appears to be a sufficient interest among citizens, youth and some NGOs for visions associated with sufficiency and ecological practices (i.e. the bottom-left quadrant of Figure 2), resonating with ideas of "Eco-Retreat", "Less is More" and "Bio-ecology".
- Finally, while the option space analysed in a large share of the literature is bi-dimensional, focusing mainly on technological and political-economic alignments, it is evident that a third dimension focusing on socioecological justice and equity is largely still missing from the bioeconomy debates (Ramcilovic-Suominen, 2022; Ramcilovic-Suominen, Kröger, and Dressler, 2022).

Based on these findings, Figure 3 tries to capture the evolution of Bioeconomy visions embedded in various EU bioeconomy strategies and their main characteristics. The visions are placed along a temporal scale because the EU bioeconomy policy discourse has clearly changed in time, even though in other international or national bio-economy strategies some of these visions might still co-exist (e.g. the US bioeconomy discourse is mostly aligned with a "Bio-technology" vision, but also in part with a "Bio-resource" one (Frisvold et al., 2021)).

We argue that before the 2012 Strategy, the main focus of the EU bioeconomy was indeed on the promotion and support for bio-technologies; however, already with the 2012 Strategy the narrative shifted towards a more "Bio-resource Bioeconomy" (Bugge, Hansen, and Klitkou, 2016). Summarizing broadly, this vision focused mainly on the bioeconomy as a means of substituting fossil resources with renewable biomass. However, environmental aspects were largely ignored, with an implicit assumption that renewable resources would be automatically better than fossil ones. The paradigm of economic growth was not questioned, and bioeconomy was seen as a means to achieve decoupling of economic growth from environmental impacts, but the bioeconomy sectors themselves were effectively considered opportunities for economic growth. Finally, this vision exhibited an anthropocentric and utilitarian view of nature, with extractive mentality and a focus on market-based tools.

With the 2018 Strategy a new "Sustainable Bioeconomy" vision was embraced, moderating several aspects from the previous iterations. The focus is still largely on substitution of fossil resources with renewable biomass, but the use of biomass is expected to be limited by the boundaries of healthy ecosystems. Environmental sustainability of biomass supply and consumption is not taken for granted anymore, but rather required, often through mandatory criteria (e.g. the criteria for sustainable bioenergy in Directive 2018/2001). Other characteristics remain unchanged, such as a Green Growth perspective and anthropocentric and extractive approaches to nature.

The 2022 Progress report reflects on the Bioeconomy strategy in light of the European Green Deal and appears to depart on some aspects from the 2018 strategy, but no studies have yet analysed this document in depth.

([4]) https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/meet-our-bioeconomy-youth-ambassadors-2022-08-04_en

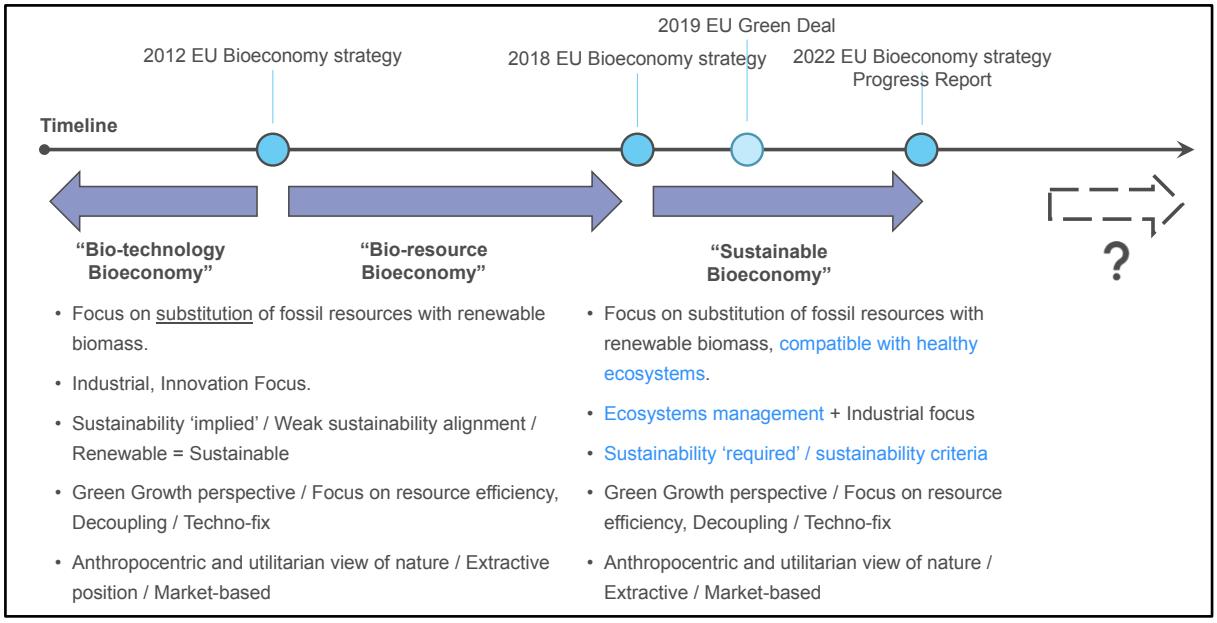

Figure 3: Illustration of different bioeconomy visions as expressed in subsequent EU bioeconomy strategies and their characteristics.

2.4 The role of "Visions" within the EU Bioeconomy Monitoring System

While visions and narratives are key drivers in the evolution of social-ecological systems, the role of the JRC Bioeconomy Monitoring System is to monitor the state of the Bioeconomy at various time stages and to assess whether the current trajectory is in line with the desired vision. This vision is operationalized into the conceptual framework illustrated in Figure 1 and described in Giuntoli et al. (2020) and Robert et al. (2020). The current framework focuses on the five objectives defined in the 2012 EU bioeconomy strategy and confirmed in the 2018 strategy: given what we have described in section 2.3, these objectives represent a clear political will and reflect a specific vision and specific values (see Figure 3).

In practice, this conceptual framework acts as a "compass" in which the North is constituted by the normative and deliberated vision of a sustainable bioeconomy. We argue that this compass can only be effective if: 1) the 'North' is well-defined, and 2) if the compass is well calibrated. Figure 4 illustrates this concept. Starting from an initial bioeconomy state at time *t0*, the Deliberated and Desirable Vision captured in the framework works as a constraint telling us which pathways are considered desirable (green dashed line) and which ones are not (red dashed line). This vision might change in time (*t2*) as priorities, concerns and imaginaries are context-dependent and are likely to change (Oliver et al., 2021). The second argument is that the compass must be well-calibrated, that is there should be no significant blind spots. Epistemic boxing and framing of the issues at hand is unavoidable when dealing with complex systems, and thus some concerns or knowledge claims will be unavoidably left out of the deliberated vision (the 'North'). However, if this 'uncomfortable knowledge', once included, were to restrict our desirable pathway (the grey dashed circles), then we would be suffering from hypocognition, i.e. following the orange pathway.

In order to tackle both issues described above, frequent and inclusive discussions and deliberations about a desirable bioeconomy are essential to make sure that this vision is suited to each context and time period (point 1) as well as to fight hypocognition (point 2).

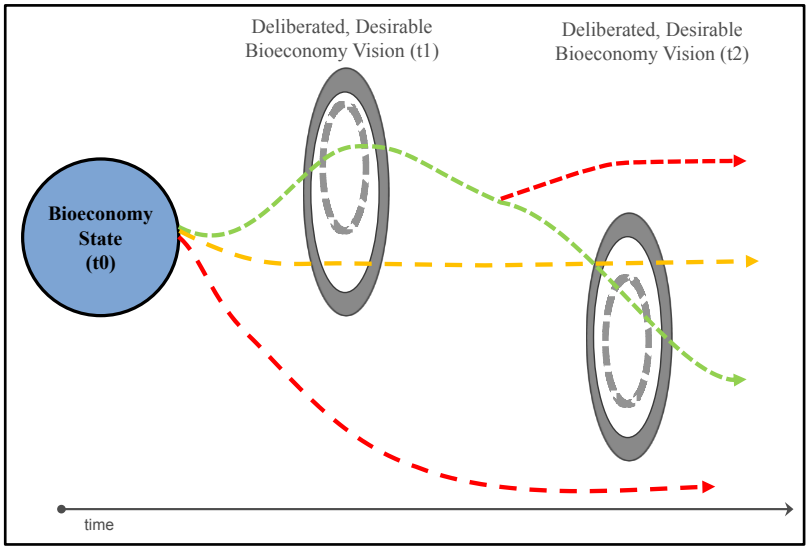

Figure 4: Illustration of possible trajectories of the EU Bioeconomy State across time and how visions can act as compass to evaluate the Bioeconomy sustainability and desirability.

2.5 Goal of the report: Expanding the option space

Summarizing the main argument laid oud in this chapter:

1. Literature shows that the current dominant imaginaries for the bioeconomy are mainly in the "sustainable capital" quadrant: characterized by green growth, decoupling objectives, and anthropocentric perspectives.
2. These visions are increasingly contested, especially by citizens and some NGOs, as well as by a part of academia, all actors which have been often absent from the bioeconomy literature, dominated instead by technological and engineering disciplines. Unsurprisingly, thus, the social and justice dimensions are greatly underrepresented in the dominant narratives.
3. These dominant framings have so far failed to produce the outcomes desired: especially in ecological terms, they are incompatible with the biophysical limits of the planet (our hard-coded limits based on the sustainability framing presented earlier).
4. Given the climate and ecological breakdown as well as inequality crisis, we argue that **we urgently need to expand the option space** explored well beyond the existing hegemonic narratives.
5. This report aims to introduce perspectives which have been under-represented in the Bioeconomy discourse and to propose ways to integrate them into an alternative vision which could be explored in bioeconomy research and governance.

3 Changing human-nature relationships – implications for bioeconomy strategy.

Tom Oliver

Key messages – Chapter 3

- The dominant western worldview has been an anthropocentric one, and it has fundamentally shaped an economic system that is proving inefficient for environmental sustainability.
- Perspectives from diverse indigenous cultures and state-of-the-art scientific findings both suggest that human exceptionalism and a sense of individual sovereignty is misplaced– a worldview of deep interconnection between all natural entities is more valid.
- Developing our human-nature relationship away from an anthropocentric perspective is an essential leverage point to achieve genuine sustainability, a fact increasingly also recognized by major science-policy initiatives.
- This presents a challenge requiring a deeper reframing of bioeconomy strategy based on a fundamental pivot in conceptions of human-nature relationships.

This chapter focuses on different understandings of our-human nature relationship and what that might mean for how we frame the bioeconomy.

3.1 Incremental adaptation of the economy is insufficient

The economic system currently in place has evolved over centuries and there is now extensive evidence that it is damaging the environment, with negative impacts on water quality, air quality, and biodiversity etc. There have been many attempts to try to reduce those impacts by adapting the economic system. One such example has focused on broadening the lens of what is considered 'efficient': rather than focusing on efficiency in a very economic sense of balancing supply and demand and making sure we can buy things for the cheapest possible price, it means actually broadening the lens to focus on other desirable outcomes, like reducing greenhouse gas emissions. International biofuels policies attempted to do that by producing energy in a way which is less damaging in terms of CO_2 emissions. Yet, even that broadening of the 'efficiency lens' was still too narrow; just focusing on carbon has led to burden shifting with impacts on food security and biodiversity from the rapid expansion of land-use devoted to bioenergy cropping (e.g. soy in Brazil supplying the global biodiesel market ([5])). So, we need to broaden the efficiency lens a little bit further to think about more of the things we care about (some refer to this as "systemic efficiency" e.g. (Benton and Bailey, 2019))

Another example of "greening" of economic process concerns farming systems with the attempts to introduce incentive schemes for land-owners to farm in a way which is less damaging to water, nature, and air. It is possible to pay farmers to do that, but the problem is it is expensive because of the high opportunity cost of the foregone yield in areas reserved for nature protection. The levels of incentive that would be realistically needed to actually stop and reverse biodiversity loss in farmed landscapes is substantial (especially when crop prices are high). Many implementations deemed "affordable" by regulators are well below these levels and, therefore, agri-environment incentive schemes have not been very effective in reducing greenhouse gas emissions and impacts on ecosystems (European Court of Auditors, 2021) ([6]). This holds true for many countries across the world, not just the EU.

3.2 The need to work on deeper leverage points

These examples challenge the idea that adapting, or tweaking, the economic system is sufficient to achieve sustainability. Instead, we likely need a more systemic approach where we think about the multiple outcomes that we want, and also entertain the notion of working on "deeper" leverage points (Abson et al., 2017), for

([5]) E.g. https://knowledge4policy.ec.europa.eu/biodiversity/bioenergy_en

([6]) E.g. on pag. 3, Executive Summary point IV states: "Overall, we found that the €100 billion of CAP funds attributed during 2014-2020 to climate action had little impact on agricultural emissions, which have not changed significantly since 2010."

example involving transformation of mindsets and culture (i.e. our "worldviews", in particular how we frame our human relationship to nature and the function of the bioeconomy).

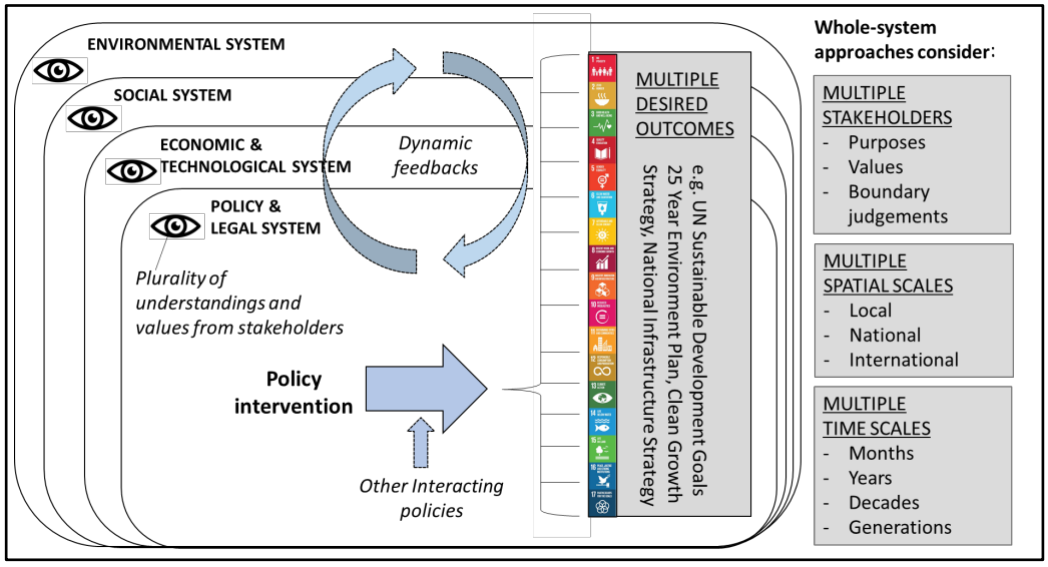

Figure 5: Key elements of a systems approach for achieving multiple desirable outcomes for society (Source: Oliver et al. (2021))

For example, considering the UN Sustainable Development Goals, just focusing on carbon alone (i.e. for SDG 13) is obviously not sufficient, as this leads to the important trade-offs mentioned above. Figure 5 outlines key factors in broadening that lens through systems thinking (Oliver et al., 2021). Policy interventions for sustainability indeed need to think about the economic system, but also how it interacts with the social system, environmental system, legal systems, to try ideally to deliver those multiple outcomes that we want to achieve concurrently. And, as shown on the right side of Figure 5, systems thinking requires thinking at large spatial scales, so including those feedbacks that happen at the international level affecting what's going on in any focal country, and over long time scales, not just thinking about the here and now, but considering future generations. Crucially, at the top right of Figure 5, is indicated the need to reflect on how different people perceive systems in different ways, and about the different worldviews that we need to accommodate. In particular, we may need to think about deeper change in these worldviews, rather than just focusing on economic interventions, or even technological interventions (e.g. precision farming, geoengineering, genetic modification, etc.). These all have a role but are insufficient without deeper transformations of our mindsets and culture. One crucial aspect of this is our human relationship with nature, which underpins our values and actions, and ultimately the structure of our social institutions (including our economy).

3.3 Our human-nature relationship – moving beyond anthropocentrism

Our dominant worldview in the West has been very anthropocentric, based on a sense of separation and (instrumental) objectification of nature, and our economic system is firmly based on these perspectives. Since the Enlightenment period, a rationalist worldview prompted by philosophers such as René Descartes increasingly saw the world from a mechanical perspective. Rather than any kind of divine spirit inhabiting the natural world, there was a split between Mind and physical Matter. Anything non-human (and ultimately even the human body) fell into the latter category and was likened to clockwork machines. This segregation of human minds with the natural world went hand-in-hand with seeing individual people as sovereign and isolated from one another. We developed an economics framed around increasing utility for individual humans, alongside treating the natural world as a new type of capital ('natural capital') providing quantifiable services to us.

However, beyond anthropocentrism, there are alternative types of human-nature relationships, as shown in Box 1.

Box 1: Alternative human- nature relationships (Elaborated from Anderson et al. (2022))

- **Anthropocentrism:** Nature is valuable only in respect to human needs. Nature has instrumental values.
- **Biocentrism:** Emphasises nature's intrinsic or inherent value, defined by the moral sense of each living organism's right to life
- **Ecocentrism:** Collectives like ecosystems and biomes also have an intrinsic values in the moral sense of the right to exist. Non-living entities (e.g. waterfalls, stones) may also be deemed to have intrinsic value.
- **Pluricentrism:** An emerging conception that aligns with relational values. The focus is on relationships between humans and other-than-human beings, as well as nature's elements and systemic processes, conceived as reciprocal, interdependent, intertwined and embedded.

When the Intergovernmental Platform for Biodiversity and Ecosystem services (IPBES) was tasked with producing the first global assessment of biodiversity and ecosystem services, it initially adopted what they saw at the time as a "common sense" kind of anthropocentric framing of nature, employing terms such as "ecosystem services" and "natural capital", reflective of an instrumental perspective on nature's value, contingent upon the benefits it provides for us. Much academic research and many science-policy reports have implicitly taken this perspective. They develop frameworks and methodologies to quantify those benefits, with an ultimate aim to feed the values of nature into the economic system. Some projects, such as one funded by EU Life+ called *NatureTrade ([7])* have advocated helping landowners monetise the value of nature on their land and write up contracts so they can sell them in a marketplace, creating an 'Ebay for ecosystem services'.

The underlying assumption is that when nature is given a price, externalities can be incorporated into the market, and the market will assess the level of "damage" and environmental impacts which are optimal. However, the IPBES is an international assessment involving over 120 UN countries that have to agree on the final assessment, and many countries in the Global South really didn't feel that the instrumental relationship with nature, as framed in initial IPBES reports, captured the way they see nature, which was much more based on a sense of kinship and reciprocal obligations (Masood, 2018). It has been argued that pressing on with the anthropocentric worldview would have equated to a form of epistemic colonialism (Vermeylen, 2019). So, the IPBES conducted a whole new assessment where they considered the plurality of different values and types of human relationship with nature (IPBES, 2022). And of course, the views that emerged are very varied. A whole range of indigenous cultures present diverse ways to see and interpret their relationships with nature and each other. But actually, a thread that runs through the worldviews of so many indigenous cultures, in diverse countries from within South America, to North America, New Zealand, to Africa, is that they see nature very much as a kind of ancestor, they feel a sense of kinship with it rather than something to simply use as an "asset". This is, for instance, captured in the philosophy of "*Buen Vivir*", an indigenous Andean philosophy that emphasizes community well-being, reciprocity, solidarity, and harmony with *Pachamama* (Mother Earth). And the concept of Buen Vivir actually features as a key right in the constitution of several countries, like Ecuador.

3.4 The science behind our interconnected bodies and minds

Along parallel lines to these ancient indigenous cultures, modern science has started to question the evidence behind our relationships with nature. Whether from neuroscience or molecular biology, evolutionary biology or social network theory, there is a large amount of evidence to show that our separation from each other and from nature is actually an (evolved) illusion (Oliver, 2020). Starting from our own human body as a first example, before the advent of modern medicine, we used to think that our bodies were composed of four "humours" (likely guided by the fact that when blood settles, it separates into different coloured layers): "yellow bile", "black bile", blood and "phlegm". The balance of these humours was thought to affect our temperament, (e.g. choleric, melancholic, sanguine, phlegmatic). This belief held until the chemical analysis of our bodies revealed that we are made of the same chemicals that make up everything else on this planet: oxygen, carbon, hydrogen, nitrogen, and a few other trace elements. This might seem quite dull, but actually it is quite fantastic when we think about where these elements came from and go to. When we die, the molecules and elements which make

([7]) https://zoo-naturetrade.zoo.ox.ac.uk/

up our bodies will be released into environment. Imagine them dispersing evenly across the Earth's atmosphere; ultimately, those molecules (just over 40 kilogrammes of oxygen for a 62 kg person) would spread to over just 0.3 mm apart. So, you could take a cubic metre of air from anywhere above the globe and there would be 29 million molecules of oxygen that were once in your body. So, almost a dense fog that is mingling with a dense fog of molecules that were in other plants and animals. When you take a breath, you are breathing in a zoological legacy. Our bodies are composed of the bodies of countless other organisms.

And the cells in our body are not with us our whole life, in many cases such as for our gut cells and our skin cells, they are with us for just a few weeks, there is a kind of continual turnover of matter and energy. And of course, we are comprised not of just human cells, we have an equal number of bacterial cells to match our roughly 37 trillion human cells. Bacteria colonise the whole of our bodies: about 450 species in our elbow joints, 125 behind our ears, 1000 bacterial species in our mouths, for example. And each one of our individual cells has mitochondria, the powerhouses that provide energy to our cells, and these were originally formed from free living bacteria that were incorporated into a eukaryotic cell. So, we humans are kind of a chimaera of human and bacterial cells (as well as fungi, protozoa and viruses). What's more, the microorganisms living in our gut and brain can affect our mood, our emotions, and our personality and, as such, further detracting from our supposed autonomy.

So, if you stand in front of the mirror and think "this is me", actually, that is just a transient collection of matter that has been brought together for a brief moment in time. One may argue that we look the same as we did yesterday and the day before. What is it that keeps that coherency of us? Well, maybe it is our DNA, the genetic code that scavenges these materials and builds a body with them and has the instructions to continue to build and repair that body. But that DNA is borrowed from our ancestors, and we are going to pass it on to our ancestors to come. And lots of DNA is ferried across the tree of life horizontally by viruses. For example, the genes for building our human placenta actually come from a rabbit gene that was transferred into humans. So, rather than a tree of life with tips representing distinct species, it is much more of a kind of tangled web with genes flowing horizontally as well as vertically. So, even our DNA is borrowed and, when you look in the mirror, there is nothing that is really yours alone.

So, where then is the independent "*me*" that is separate from everything else? We might argue that our minds are what make us uniquely us. However, every word that we hear from each other, every touch, changes the neural networks in our brains. We have about 170 billion neurons in our head and millions of connections are changing every minute. And those connections are influenced by everything that we hear and everything that we touch. So, in reality, we are changing each other's brains all the time! And whoever you've interacted with today has changed your mind, and you are not the same person you were just this morning, let alone one year ago. Even smells exert influence on our brains. For example, Mujica-Parodi et al. (2009) collected the T-shirts from novice skydivers and people simply running on a treadmill. They found that under a brain scanner the odour from the skydiver group, but not the treadmill group, elicited heightened responses in the amygdala brain region of participants, a neural region associated with fear responses. Singh et al. (2018) then found that when a mannequin of the kind that dentists use to practise their dental surgery was wearing a t-shirt worn previously by students in stress-inducing situations, the dentists made more mistakes than when the mannequin was wearing a t-shirt that someone had sweated in, but not in an anxiety inducing situation. So, anxiety is contagious and it can be transmitted through pheromones in the air below the conscious radar. Other research shows that happiness and wellbeing are also contagious and can be transmitted through pheromones as well (Chen and Haviland-Jones, 2000).

At the level of social networks, theory shows that we influence people that we have never even met through our web of inter-human connections (Fowler and Christakis, 2011). Our voting preferences, our taste in music, our risk of obesity can all be influenced by people we have never even met, up to three links away in these networks.

One last example in breaking down this idea that we are somehow separate from each other is that, in our Western cultures, we have a common myth of an "inventor" as being a lone genius, like a lone wolf. But, actually, most of the revolutionary inventions, such as the incandescent light bulb, the thermometer, the telephone, were all invented independently in different locations, in some cases, like the telephone, patents were filed on exactly the same week in different countries. So, inventors are not lone geniuses, they are actually working with a body of knowledge that is ready to birth these innovations. Creativity is part of a great linked human endeavour.

3.5 The evolution of self-identity and our relationship with nature

So, the idea that we are separate from each other or from nature is arguably an illusion when you really consider the science. And this is aligned with what the indigenous cultures mentioned above feel as well. We should look at why we might have that illusion. To have a discrete sense of self is useful, we need it to have a coherent place for our memories so that we can know how to gather food, to manage our complex social interactions, and, essentially, to survive. And because of its usefulness, even if we have a transitory revelation of our inter-connectedness, our mind quickly snaps back to thinking that we are separate entities. We might speculate that, in pre-historic human groups and tribes the sense of individuality would have been balanced with a sense of group identity. If someone were too selfish, they would be punished by the group. There was a series of checks in the social system, balancing the level of individuality versus collective identity. But in our modern (digitally connected) societies, our group size is potentially 8 billion people. And we now have a globalised economy where we can, for example, buy a product that has impacts on rainforests on the other side of the world; or we can buy an SUV and literally poison the air of people around us, and there is no legal mechanism or moral system stopping us or challenging these behaviours. While our economic system has become globalised, our moral and legal system has not kept pace. The checks and balances to our individuality have weakened in the modern world. Actually, these individualistic attitudes and behaviours have been exacerbated by modern western culture which has taught us to celebrate a distinct self, with education systems encouraging self-esteem, even to the extent of creating one's own "personal brand". Various governments have repeatedly told us that there is no such thing as society (Margaret Thatcher) or that 'greed is good' (Boris Johnson). Our minds are like sponges and we soak up this culture, and this has led to trends in individualism increasing over the last 50 years. Several papers have shown an increase in individualistic practices or values in the years, especially in western societies (Santos, Varnum, and Grossmann, 2017). Narcissism, which is an extreme form of individualism has also been shown to be increasing (Twenge and Foster, 2010; Twenge and Foster, 2008). When searching Google Ngrams for trends in individualistic phrases or words used in songs, books, and literature (e.g. the sentence "all about me") we see that they have been increasing over time.

By analogy, our craving for fatty or sugary foods is another trait which evolved because it was useful, it was adaptive, but has become maladaptive in our modern world. When those foods were sparse in the environment, it was useful to seek them out, but in the modern world these food types are abundant, and our culture encourages excess consumption. We have advertising nudging us to consume fast foods, and food deserts where it is difficult to buy healthy food, leading to the on-going obesity crisis where 2 billion people, a quarter of the world's population, are overweight or obese, whilst 2 billion people are underweight or malnourished. So, a trait which was an adaptive strategy during our evolution, has become maladaptive in the modern world.

In a similar way, I would argue our sense of self as being independent is becoming maladaptive. For a start, it is in part responsible for the ongoing mental health crisis. Some of the figures of this crisis are quite startling (and the statistics below are from before the COVID-19 pandemic):

- 1 in 10 UK children have a diagnosable mental health problem, but only a quarter of these are accessing treatment services;
- One in five older people living in the community and 40% of older people living in care homes are affected by depression;
- 40% of primary care appointments are about mental health;
- 17% of UK adults are on antidepressants.

A large body of literature now points out how if we feel separated from others, we tend to be lonelier and that leads to anxiety and depression (Loades et al., 2020; Mushtaq et al., 2014; Saltzman, Hansel, and Bordnick, 2020). But this links to the planetary health crisis as well, because if we feel separate from the natural world, we inevitably care less about our impacts on that world. Evidence shows that when people feel less connected to nature they show fewer pro-environmental behaviours (e.g. Mackay and Schmitt (2019) and Udall et al. (2021)). So, for example, people may be less sustainable in the products they choose to buy, in reducing their carbon footprint, or the environmental credentials of the political party they vote for. There are several different mechanisms underpinning how our sense of identity links to the planetary health crisis, which we review in a recent paper (Oliver et al., 2022).

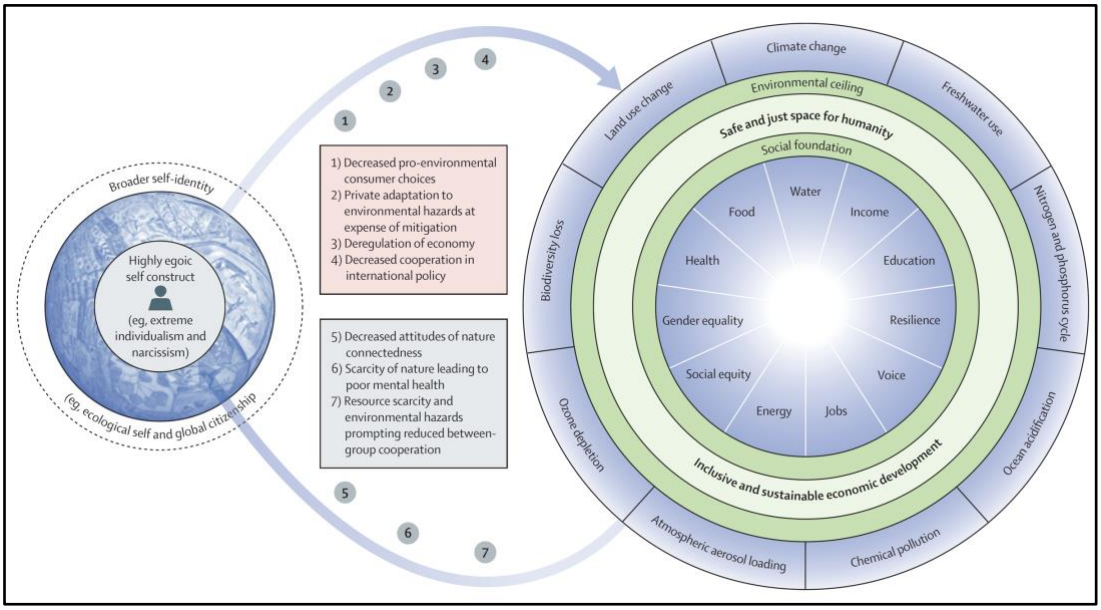

Figure 6: Dynamic feedback cycles between self-identity and environmental quality (Source: Oliver et al. (2022))

Figure 6 summarizes various feedback loops involving the degradation of nature and decline of pro-environmental/pro-social behaviours that are linked to self-identity. If we destroy nature, there is less nature around in our towns and cities, we encounter it less, and that means people will likely feel less connected to nature because they experience it less on a daily basis. When people feel less connected to nature then they are less likely to look after it and consciously buy products that are more sustainable. And that then leads to further environmental degradation; it is a vicious cycle. This also reverberates upwards to the institutional level: for instance, environmental shocks like climate change and extreme weather events can facilitate the election of more right-wing political leaders, endorsing a nationalistic and xenophobic worldview. But many environmental problems are transboundary, be it biodiversity loss, air pollution, zoonotic diseases, climate change, all these crises need enhanced international cooperation at a time when environmental shocks are instead driving reduced international cooperation. So, there is a whole set of mechanisms tied up into these potential vicious cycles. The positive aspect is that the mechanisms can be reversed, and the vicious cycles can turn into virtuous circles, for instance by restoring the environment and with programmes to enhance nature and social connectedness.

3.6 A new paradigm for human-nature relationship?

On a more positive note, this need for a changing paradigm around our human-nature relationships has started to be recognised in many science and policy institutions. For instance, in 2020 the UN Secretary-General emphasised the need for paradigm shift from a 'human-centric society to an Earth-centred global ecosystem' ([8]), and the need for learning from ancient cultures and indigenous paradigms that have a deep connection with nature ([9]).

The latest IPBES values assessment (2022), mentioned earlier, concluded that: 'goals linked primarily to values of individualism and materialism – defining societal progress as wealth, profit, competition and growth – are not aligned with future sustainability or social justice'. And yet, this sounds very familiar to the way we structure our economies nowadays. Instead, the IPBES report talks about moving away from values that are barriers to conservation, including inter-human values such as individualism and human-nature values based solely on instrumentalism, and instead moving towards "sustainability-aligned" values: inter-human values rooted in care,

([8]) See United Nations (2022) pag. 2: 'Mother Earth would only be preserved through a paradigm shift from a human-centric society to an Earth-centred global ecosystem'

([9]) See United Nations (2022) pag. 2: 'Education is critical to safeguarding Mother Earth: training courses on harmony with nature and earth jurisprudence approaches will be essential in creating a resilient world for everyone, everywhere. I commend Member States who promote teachings from ancient cultures who have a deep connection with nature.'

unity and justice, and more balanced human-nature values combining care (relational, instrumental) and respect (intrinsic).

So how do we change and shift our dominant paradigm? A starting point is to try and understand our connection to nature better. Many scales have been proposed to measure our nature connectedness, and several meta-analyses have now shown that people who feel their identity to be enmeshed with others and the natural world have a greater sense of care and responsibility for the environment (Mackay and Schmitt, 2019; Richardson et al., 2020; Whitburn, Linklater, and Abrahamse, 2020; Zylstra et al., 2014). The next question then is how to promote greater nature connectedness. Luckily, there is growing evidence showing the effectiveness of several types of interventions. Nature engagement, through facilitation of activities such as bird watching and painting, out in the natural environment promotes nature connection (Richardson et al., 2020). For instance, nature conservation charities like the UK Wildlife Trusts organize a "30 days Wild" activity, where they get kids out in nature for 30 days and then measure how this intervention improves their connection to nature. Similar evidence-based interventions are carried out by charities such as the RSPB and supported by the statutory body Natural England.

Meditation is another effective intervention. Neurobiology has shown that the pathways in our brain are changed through meditation approaches and mindfulness (Goleman and Davidson, 2018). Through meditation the "default mode network", which is the part of our brain responsible for self-rumination and highly linked to anxiety and depression, gets downregulated allowing us to feel more connected to each other and the natural world, and enhancing the sense of compassion and empathy.

We might wonder whether reading and learning facts about nature might be also an effective intervention. Within my book presenting the science of our connection to nature and each other (Oliver, 2020), there is a link to an online survey to assess the reader's nature connectedness, before and after reading the book. The results of that survey do show that reading the book improves our sense of nature connectedness. So, knowledge-based interventions can work too, potentially because they promote awareness and understanding of the importance of our connection to nature and that can motivate then to pick up practices of direct, experiential nature engagement that effectively improve our nature connectedness.

These changes in values and mindsets can and should also be scaled up to institutional and government level. Luckily there are examples of this happening already: in the UK there are initiatives to promote skills and competencies in systems thinking ([10]) as well as to promote mindfulness among policymakers to accelerate action on climate change (Bristow, Bell, and Wamsler, 2022). The UN Development Programme has launched the initiative "Conscious Food System Alliance" (CoFSA) (Legrand et al., 2022) which tries to transform the food systems by going beyond economic interventions or techno-fixes and recognizing instead the need to also promote transformative practices focused on reconnecting with ourselves, each other and with nature. Oliver et al. (2018) highlighted how there are many diverse mechanisms that "lock-in" the global food system into its current undesirable state, which is damaging to nature. While many policy interventions have focused so far on changing economic and regulatory constraints (e.g. subsidies), there is a whole range of other mechanisms which are often ignored and neglected, especially sociocultural constraints, which include the deep leverage points discussed earlier, like mindsets and beliefs. Programmes like the UNDP CoFSA initiative are trying to address this deficit.

This Chapter started by showing the limitations of our approaches when trying to slowly and incrementally adapt our economic system to deal with the current environmental challenges. The UN Environment Programme (UNEP, 2021) produced a report titled 'Making Peace with Nature', in which they present actions to transform our economic and technological system to cope with the ongoing environmental crises. They conclude that 'Transforming humankind's relationship with nature is the key to a sustainable future' ([11]).

([10]) E.g. https://www.gov.uk/government/publications/systems-thinking-for-civil-servants

([11]) UNEP (2021) Pag. 15: 'Only a system-wide transformation will achieve well-being for all within the Earth's capacity to support life, provide resources and absorb waste. This transformation will involve a fundamental change in the technological, economic and social organization of society, including world views, norms, values and governance.'

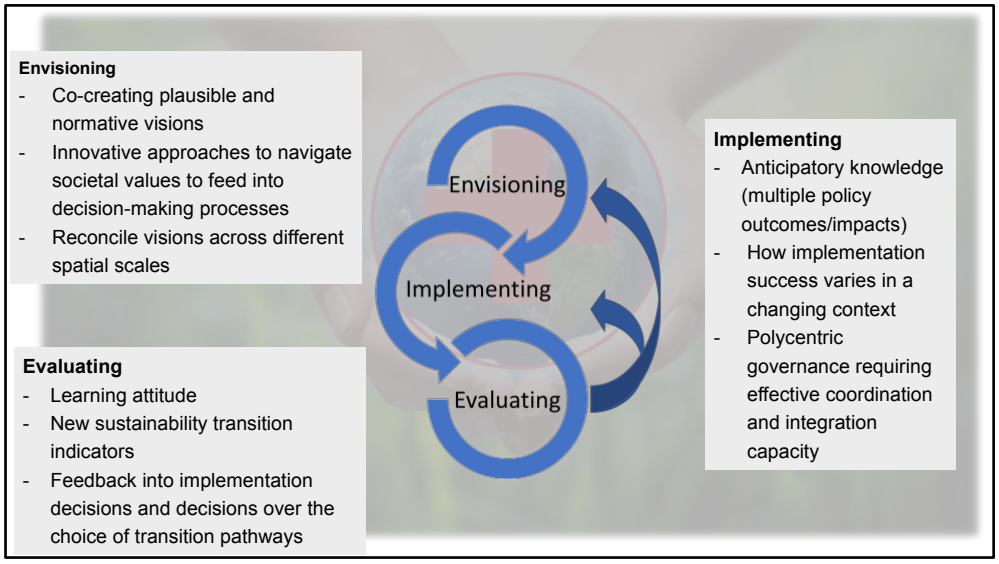

Figure 7: Iterative processes fundamental to successful sustainability transitions. Source: Oliver et al. (2021)

Figure 7 summarizes the iterative processes needed to transform our linked social-ecological systems, highlighting the interlinked envisioning phase, implementation phase, and evaluation phase (Oliver et al., 2021). We can think about the bioeconomy as having gone through this cycle several times and, as shown in section 2.3, the vision has evolved from a bio-resource to a sustainable economy framing. This report might be a new starting point for another "envisioning" cycle, exploring what a bioeconomy strategy based on radically different human-nature relationships could look like. Maybe it would be more of a biocentric economy, but we certainly want to be mindful of errors in the past when anthropocentric and utilitarian values have been imposed on other cultures, and instead embrace the plurality of existing worldviews and perspectives (IPBES, 2022). At the same time, we should be cautious that plurality does not mean embracing and accepting all worldviews as equal, and ecocidal values should be avoided (Oliver et al., 2022). Navigating alternative worldviews towards a new vision is challenging, yet both indigenous wisdom and the findings of modern science on our human-nature relationship provide a timely and important challenge for a more fundamental reframing of our bioeconomy strategy.

4 Is green growth possible? The case for degrowth.

Giorgos Kallis

Key messages – Chapter 4

- There is increasing evidence that genuine green growth is not happening and is unlikely to happen in the near future.
- Alternatives to green growth, such as post-growth or degrowth, face considerable obstacles regarding their implementation and acceptability that call for new research.
- Political acceptability is a central obstacle: only through a coevolutionary change of personal/everyday practices, social mobilization and institutional change can new transformative politics emerge.
- Whether such political change can happen fast and far enough remains still uncertain.

The main question addressed here is whether "Green Growth" is possible. A similar argument is laid out in Hickel and Kallis (2020).

First of all, it is essential to have common definitions of the terms and concepts:

1. Green growth = economic growth compatible with planetary sustainability, that is reducing our environmental impacts within the planetary boundaries, biophysical thresholds beyond which the Earth system might become incompatible with human civilization (Rockström et al., 2009; Steffen et al., 2015). Green growth is the basis of government actions regarding climate and the environment (e.g. in OECD (2011) and World Bank (2012), in the UN's SDGs ([12]), as well as in the European Green Deal ([13])).
2. Decoupling = separating economic growth from resource use and environmental impacts. Two types of decoupling can be defined: *Relative* decoupling means that GDP grows faster than resource use or environmental impacts, but these continue to grow. *Absolute* decoupling implies that resource use and environmental impacts actually decrease while GDP keeps growing.

Green growth, according to most policy strategies, means developing new, cleaner technologies and improving the efficiency with which we use resources. Because many planetary boundaries are already trespassed (Persson et al., 2022), green growth requires not only *absolute* decoupling, but also that environmental impacts, especially greenhouse gas emissions, decrease fast enough to avoid crossing environmental irreversible thresholds, such as the 1.5-2°C climate change objective. So, it is more accurate to talk about not just absolute decoupling, but sufficient absolute decoupling, and not just green growth, but genuine green growth, that is sufficient and fast enough for keeping societies from crossing irreversible thresholds.

4.1 Question #1: Is absolute decoupling of resource use from GDP happening? Is it even possible?

Empirical data on global material footprint shows that from 1990 to around 2010 relative decoupling can be detected in the data, but from around 2010, this trend reverted, and material use has actually been increasing faster than GDP. For individual countries, we can see signs of absolute decoupling between GDP and the domestic material consumption (DMC) indicator. As defined by Eurostat ([14]), this indicator only accounts for materials directly used by an economy and does not include upstream flows related to imports. When these resources are included in the calculation, as done with the Material Footprint indicators ([15]), then the data show

([12]) Note from Editors: SDG 8 'Promote sustained, inclusive and **sustainable economic growth**, full and productive employment and decent work for all'.

([13]) Note from Editors: COM(2019) 640, pag. 2: '[The European Green Deal] is a new **growth strategy** that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where **economic growth is decoupled from resource use**.'

([14]) Note from Editors: "DMC measures the total amount of materials directly used by an economy. It is defined as the annual quantity of raw materials extracted from the domestic territory of the focal economy, plus all physical imports minus all physical exports. It is important to note that the term 'consumption', as used in DMC, denotes apparent consumption and not final consumption. DMC does not include upstream flows related to imports and exports of raw materials and products originating outside of the focal economy" (https://ec.europa.eu/eurostat/cache/metadata/en/sdg_12_20_esmsip2.htm)

([15]) Note from Editors: e.g. https://unstats.un.org/sdgs/report/2019/goal-12/

that actually the material footprint has increased proportionally with GDP for USA, EU-27 and OECD countries, with no sign of absolute or even relative decoupling taking place. The strong coupling of GDP and material use was also shown by Steinberger et al. (2013) through panel data analysis: comparing the material use and GDP of different countries overtime, they showed that 1% difference in the size of economies is associated with 0.8% difference in material use.

One may argue that decoupling could still happen in the future, but Hickel and Kallis (2020) assessed all public studies and models by the UN regarding future resources use until 2050 and concluded that absolute decoupling would not be feasible on a global scale with continued economic growth. These findings might look surprising as a common narrative is that technological progress, digitalisation, and the shift towards a more service-based economy in high-income countries would lead to decoupling of resources from GDP. However, there are at least three arguments which provide a theoretical foundation to the tight coupling of GDP and resource use. Firstly, efficiency gains do not necessarily lead to using fewer resources. If we think in terms of labour resources, for example, machines did not lead to mass unemployment, because the surplus labour that was liberated by machines was hired to new activities of the economy which grew as labour became more productive (efficient). This phenomenon remains valid also for natural resources, as formulated in the "Jevons Paradox" (Polimeni et al., 2012), named after the 19th century economist Stanley Jevons who was the first who noted how steam engines used coal more efficiently, but as a result, societies used more coal, not less. As the cost of coal went down because of efficiency gains, new uses were invented to make good use of the cheaper coal.

Secondly, services can be resource intensive. Materials are needed to build the hardware and energy is needed to sustain the software and network infrastructure required for the digital economy. Even emails do not come free of impacts or resources (Berners-Lee, 2022).

Thirdly, service providers, even if not directly affecting material use through their activities, can use their income to consume material goods and thus contribute to the GDP-material coupling.

4.2 Question #2: Is absolute decoupling of GDP from carbon emissions in line with the 1.5°C target possible?

Concerning greenhouse gas emissions, data shows that global CO_2 emissions increased proportionally with GDP until about 2010, but afterwards emissions have increased slower than GDP, indicating the achievement of relative decoupling. A 1% growth of GDP is associated with 0.5-0.8 % increase of CO_2 emissions the same year. Indeed, 21 countries have reduced their carbon footprint during 2010-2014 while their economies grew. However, these reductions have been in the range of 1-2% per year, a rate which is not nearly fast enough to avoid catastrophic climate change. For instance, Anderson et al. (2020) recently calculated that UK and Sweden would have to reduce their GHG emissions by more than 10% per year to comply with their fair contribution to the Paris Agreement commitment and without resorting to planetary scale of Negative Emissions Technologies (NETs). However, their pledges indicate a decarbonization rate which is half as ambitious. Additionally, the countries which managed to achieve absolute decoupling of CO_2 emissions from GDP, did it while their economies grew between 1-2% per year. If growth was close to 3% per year in these countries, there would not have been any reduction in GHG emissions. Higher growth implies a larger economy, and thus bigger systems to decarbonize. Trying to reduce emissions with a growing economy is like trying to go down an escalator which is accelerating in the opposite direction!

If we look at the future, can we expect higher rates of decoupling? In ongoing research with Aliosa Slameršak, Dan O'Neill and Jason Hickel, we find that the only global pandemic recovery path that would be aligned with the 2°C global warming goal, includes zero GDP growth in the Global North. Some scenarios from the IPCC meet the 2°C temperature goal while including GDP growth, but these scenarios achieve the climate mitigation goals by including the use of BECCS (BioEnergy with Carbon Capture and Storage), which is a speculative and unproven negative emission technology (Anderson and Peters, 2016; Stoddard et al., 2021) and, if realized at the scales suggested by the models, it would require an area equal to three times the size of India just to cultivate the biomass needed to fuel BECCS plants. Other scenarios achieve the target by including drastic reduction of energy use. So, according to these scenarios, green growth, with regard to GHG emissions, could be possible, but with technology that is uncertain whether it will ever be viable, and even if it was, its deployment at the scales needed would be largely incompatible with other sustainability aspects, like ecosystems health (Hanssen et al., 2022).

4.3 Question #3: How can we break out from the fairy tales of green growth? The case for Degrowth.

The fairy tale of green growth is powerful. That economic growth may no longer be sustainable is an inconvenient truth because capitalist economies depend on economic growth for stability. Lack of growth means unemployment, debt and, depending on who governs, also austerity. Without growth, it becomes more difficult to raise the income of the poor, and it gets harder to pay for clean energies. Politicians also rely on whether the economy does well or not in the short-term to get re-elected. Electorates have little appetite to cut energy, or meat consumption, or pay a carbon tax. And the vested interests that finance political campaigns put their profits first, and their profits depend on a growing economy. The last thing they would want to hear from politicians is that they are going to implement policies that slow down the economy. Well-meaning people then think that challenging growth is impossible, and thus green growth *must* be possible, or must be made possible because there is no other alternative. But what if green growth is not possible? Then we need to consider other alternatives, and our responsibility as researchers is to ask the questions that would illuminate such alternative paths.

Kallis et al. (2018) reviewed the main research questions in the field of degrowth, such as:

- Can we secure meaningful employment without growth?
- And if yes, how can we combat global poverty without growth in the Global North? And how?
- Is it possible to roll out clean energy if economy slowed down?
- How would we pay for renewable energy without GDP growth?
- How do we create the cultural and political change that is necessary?
- How can we sustain functional democracies without growth?

Beyond such technical questions, there is a harder, political question (Kallis et al., 2020): What is to be done politically? By whom? And how? Indeed, the main concern with alternatives to green growth, such as post-growth or degrowth, is that they are unlikely to be supported by the population, and hence politically impossible, even if ecologically necessary.

In the aforementioned book we proposed a theory of change that builds on the work of the political theorist of the 1930s, Antonio Gramsci. We envisage a co-evolution of personal, communal, and political change towards degrowth. What does this mean? It means that as persons, we have to be the change that we want to see in the world, dedicating more and more of our work time in post- or non-capitalist spaces of production and consumption, such as consumers cooperatives, energy cooperatives, community gardens, open software, open knowledge. Of course, unless we change together with others, and unless we give a collective expression to this alternative desires and practises, our personal change becomes mere lifestyle: we fly less, we take the train, but that's just us. The question is, how do we do that together? Coming together in alternative projects and alternative ways of living and working, we are bound at some point to face the limits of our actions and risk being eaten up by the market (e.g. a cooperative), or crushed by the State (e.g. placing limits on fossil investments). Unless, as a society, we organise to defend, generalise, and upscale the new projects and the new alternative economies we create. This requires political work and political organising. It is not easy, it goes against the grain, against the current. An example of the work needed and the successes that can be obtained through protest and political work is represented by the raise of *Barcelona en Comù* ([16]) in the city of Barcelona. This was a citizens movement emerging in the occupied squares of the city in 2011, most of its activists already engaged in the various alternative economies and cooperative projects in the city. As the movement took a political expression, it won the municipal elections and is governing the city of Barcelona since 2015, implementing policies that open new spaces for alternative economic projects. We see here a miniature case of our coevolutionary model in action, whereby persons changed through everyday practice, become political agents, and their political project in turn, once institutionalized, opens up space for more persons to change and more projects to emerge.

The co-evolutionary aspects of this dynamic are key. We will not have political and policy change unless there are people who want it and live it in their everyday lives. And there will not be people who want some change

([16]) https://en.wikipedia.org/wiki/Barcelona_en_Comú

and can live it unless political institutions allow spaces where people can desire different things. In that sense, protest and prefiguration, that is experimentation with new things, personal and collective, as well as policy and institutional reform, feed on one another. There cannot be one without the other.

Coming to pragmatic policy reforms, Kallis et al. (2020) identified four "non-reformist" reforms to move in the direction of degrowth. Why "non-reformist" reforms? Reforms because they seem like amendments to what we are already doing, they are not revolutionary in their essence. However, they are non-reformist because they are not easy to realize.

The following are the four main measures proposed:

1. **A Green New Deal without growth** (The Green New Deal for Europe, 2019). This proposal is different from the EU Green Deal (European Commission, 2019) because it has much more emphasis on the role of the public, and a lot of emphasis on questions of social justice. Additionally, it must be designed without depending on growth for paying its costs. So, we are developing the idea of a bold investment programme, anywhere near 3% of GDP annually, to decarbonize energy and transport, re-forest and transform agriculture, funded with taxes, cutting funds to the military industry and issuing money to fund expenditure with social returns (Mastini, Kallis, and Hickel, 2021).
2. **Universal Care Income**. This is a basic income at around 20% of per capita income that could be funded with an increase of taxes for the top 15% of the income scale. We call this a "care income" to emphasise that it is given to people not as a poverty relief, but in recognition of the unpaid care work that all of us, and especially women, do for the economy and without which economies would not exist. The importance of this unpaid care work became very visible during the COVID-19 pandemic.
3. **A Four-day Workweek (Ashford and Kallis, 2013)**. The proposal is to reduce working hours, one day less per week at the same monthly salary. This allows sharing the available work among more people, reducing unemployment, and distributing more fairly the benefits of productivity, while reducing environmental pressures. There is quite substantial scientific evidence for all these claims by now ([17]).
4. **Wealth tax**: We propose to tax carbon and resource use and return the revenue to people as a basic income or as tax breaks. In other words, we propose to tax carbon and not work, especially of working people (e.g. see Boyce (2019)).

4.4 Conclusions

It is granted that the transition to something like degrowth would be messy, and if it were to happen, it would happen under conditions that will not be of our own choosing. As we overshoot multiple planetary boundaries and the planet heats up, we should expect more economic and social instability, as we increasingly see and experience in our everyday life. This instability brings new political dangers and, of course, new political possibilities, as is always the case with human affairs. Our responsibility, at least as scientists is to state clearly which paths are feasible and desirable and which are not. As argued in this chapter, green growth is not possible ecologically, but degrowth is politically and economically extremely hard, but worth trying or at least contemplating.

([17]) Note from Editors: And employees and businesses alike are starting to embrace this change (e.g. https://www.4dayweek.com/uk-pilot-results)

5 Global Environmental justice and why it matters in EU's Bioeconomy

Sabaheta Ramcilovic-Suominen

Key messages – Chapter 5

- Justice in environmental policies such as bioeconomy is a matter of moral responsibility, as well as a precondition for sustaining a policy over time.
- Bioeconomy has global implications and therefore responsibility for global justice.
- Global env. justice requires a decolonial perspective that accommodates the marginalized actors' (e.g. local and Indigenous communities) knowledge and legal systems, their right to self-determination and self-governing authority.
- The responsibility of the EU to promote globally just bioeconomy relates to its colonial history and neocolonial tendencies that drive global inequalities, various forms of extraction and domination, biodiversity loss and climate change.
- Reducing EU's overconsumption and epistemic domination are the key preconditions for globally just bioeconomy.

5.1 Background: Global bioeconomy trends

The last decade saw a proliferation of bioeconomy policies and strategies, with more than 50 countries having adopted bioeconomy related policies and strategies ([18]). Analysing bioeconomy policy frameworks of 41 countries worldwide, Dietz et al. (2018) showed that only a few mention the potentially negative implications of transitioning to a bio-based economies. Similarly, Zeug et al. (2019) highlight that the risks, conflicts and sustainability related trade-offs are rarely addressed in the existing bioeconomy strategies, as are the global dimensions and international trade dimensions (Dietz et al., 2018; Ramcilovic-Suominen, 2022; Zeug et al., 2019).

Such trends are concerning especially when considering that in the EU and EU member states: (i) industry actors and interest have a dominant role in bioeconomy (Korhonen et al., 2018; Scordato, Bugge, and Fevolden, 2017); (ii) the stakes for maintaining status quo are high (Holmgren et al., 2022; Ramcilovic-Suominen, Kröger, and Dressler, 2022; Vogelpohl, 2023), and (iii) the systemic structural injustices and discrimination against marginalized segments of society in the patterns of production, consumption and trade (Backhouse et al., 2021; Bastos Lima, 2022).

The emerging research suggests similar trends across the Global South countries, where the large-scale and often multi-/ or international industrial actors, such as agribusiness are better positioned to participate and profit, while small-scale businesses face barriers, such as access to technology, finances, and new markets. Studies from the front-running biomass producing countries in the Global South, including Brazil, India and Indonesia, suggest that new regulatory and economic incentives for biomass and bioenergy production facilitate soybean, sugarcane and palm oil cultivation for biodiesel, ethanol and other energy production (Backhouse et al., 2021; Bastos Lima, 2022). In many other bio-resource producing countries, the burden appears to have fallen on the food producing industry as a whole (Oliveira and Schneider, 2016), on the small-scale businesses, lacking the access to investments and markets, and on the local people, who are losing access to land and resources for food provision to the raising agribusiness (Bastos Lima, 2022; Kumeh et al., 2021). For these reasons, Borras et al. (2016) refer to the shift to bioeconomy, as to a capital accumulation strategy of actors most able to flex their production in the global bioeconomy, which are mainly the large-scale and multi-national corporations. Within similar lines of argumentation, Kröger (2016) discusses pathways of power relations that "forest biorefinery" and the "flexing trees and commodities" opens up for the capitalist and neoliberal actors and their agendas, on both industrialized and less industrialized countries.

([18]) German Federal Ministry of education and Research: "Worldwide Bioeconomy strategies" https://biooekonomie.de/en/topics/in-depth-reports-worldwide

5.2 Why Global Environmental Justice?

Global environmental justice in the EU's bioeconomy matters for several reasons. First relates to the EU's ecological footprint, which is substantially higher than the EU's fair share and which creates material and immaterial pressures on peoples and nature elsewhere (Hickel, 2020; Hickel, O'Neill, et al., 2022; Wiedmann et al., 2015; Fuchs, Brown, and Rounsevell, 2020). Second, the EU bioeconomy policy, logics and discourses promoted by it, such as for instance the idea of development and technological innovations, create ontological and epistemic injustices in the Global South (Backhouse et al., 2021; Backhouse and Lorenzen, 2021; Ramcilovic-Suominen, Kröger, and Dressler, 2022). The injustices, therefore, go beyond the tangible and material (e.g. access to technology and resources), and relate to power asymmetries, including participation and decision-making power, various forms of epistemic and cultural oppression and domination. It is also important to highlight that social inequalities drive climate change and that unequal societies are more difficult to decarbonise (Green and Healy, 2022; Millward-Hopkins, 2022). Carbon inequality between and within world regions and countries is the best example, as the available data suggests that globally and in average the richest 10% emit close to 50% of the consumption-based emissions, while the poorest 50% of the world population contribute to only about 10% of the total consumption emissions (Dabi et al., 2022; Hickel, 2020; Hickel, O'Neill, et al., 2022; Oxfam, 2015).

Addressing environmental justice is important for the success and sustainability of a policy, since a policy that reproduces the existing injustices, or creates new ones, is destined to fail. More importantly, seeking justice is a moral reason and responsibility. The EU has a moral responsibility towards other countries and regions due to its colonial history, as well as contemporary position in the world economy associated with material and immaterial extractivism, social injustice and domination (Hickel, Dorninger, et al., 2022; Rutazibwa, 2018). As a former imperial power, the EU member states profited from the enslavement, dispossession and extraction of land, natural resources, agricultural commodities, minerals and labour, which puts the EU bloc in an unequal position in terms of wealth and political power, as well as in a position of responsibility.

This historical background is important since the logics of colonial extractivism, domination and superiority continue to the present day and are visible in the post-colonial international relations, where economic and trade institutions maintain unequal power and neo-colonial forms of governance (Hickel, 2017; Rutazibwa, 2018). The neo-colonial tendencies are further visible in inequality in global production and consumption patterns, appropriation of resources, land and labour from the Global South for maintaining economic growth in high income economies (Hickel, Sullivan, and Zoomkawala, 2021). It is also evident in asymmetric power relations and global trade, which disproportionally benefit and burden different parts of the world and countries, a division which tends to follow historical colonial lines.

Atmospheric colonisation (Borràs, 2019; Hickel, 2020) and related climate injustices and responsibilities have also gained attention, where calls for climate reparations most recently resulted in an international agreement on the Loss and Damage Fund for vulnerable countries (UNFCCC, 2022). Finally, I should highlight the epistemological burden and ideological domination, related to the imposition of Eurocentric worldviews, value, and knowledge system elsewhere, including through EU policies and development programmes and projects in former colonies and other low-income countries (Escobar, 1995; Rutazibwa, 2018).

The global implications of the EU's transition to green and bio-based economy relates to the growing demand vis-à-vis the increasingly depleting biological "resources" that are the foundation for the life on Earth as we know it. As the competition between food, feed and energy grow, so do the local conflicts over food security and food sovereignty, leading to dispossession and relocations of tenure insecure local populations (Backhouse et al., 2021; Sovacool et al., 2021). Similarly, the bioeconomy policy assumes a range of policy problems (e.g. carbon emissions) for which it proposes adequate solutions (e.g. substitution of fossil to bio-based materials). While important, however, such a selection of problems and solutions justifies policy measures which can lead to intended and unintended socioecological consequences, including social and epistemic injustices. Nature conservation and carbon offsetting are good examples of policy solutions which disproportionally allocate burdens and benefits to diverse sectors of society (Ramcilovic-Suominen et al., 2021). Similarly, promoting renewable and green energy transitions can end up feeding green grabbing and green extractivism, local conflicts and dispossession (Bruna, 2023). By targeting symptoms of a problem (e.g. CO_2 emissions, climate change, and biodiversity loss), while bypassing the causes – including governmental subsidies for fossil energy and bioenergy alike, rapid urbanization, industrial agriculture, overconsumption and trade of commodities from the Global South, combined with artificially low prices for such commodities – the EU and other international

environmental policies often reproduce the injustices, intensifying rather than addressing social burdens and injustices.

Against this background, we must question who makes decisions for whom, at what scale, and in accordance to whose political and legal systems in the bioeconomy. Concerning the cognitive or epistemic justice the question is whose values, knowledges, notions of nature, and notions of justice are promoted and maintained in the bioeconomy, and whose are erased (see Ramcilovic-Suominen (2022)). The decolonial environmental justice (Ramcilovic-Suominen, 2022; Ramcilovic-Suominen et al. 2023) presented in the next section is one of the frameworks that allows for addressing those and other related questions.

5.3 Environmental Justice and the need for Decolonial Environmental Justice

The study of environmental justice (EJ) has its origins in social movements and activism against environmental racism in the early 1990s in the United States (Walker, 2012). Since then, the EJ as a field of study has expanded and evolved, both thematically and geographically.

One of the most used frameworks of EJ is the so-called three-dimensional EJ framework (Schlosberg, 2009; Schlosberg, 2004). As the name suggests, it includes three dimensions of justice; procedure or procedural justice, which concerns participation and representation in decision-making, distribution, or distributional justice, which is about equal distribution of burdens and benefits from an initiative or a project, and recognition and recognitional justice, which is about respecting differences and identities – from racial, to gender, sexual, cultural, religious, neurological and other forms of diversity. The three-dimensional EJ framework suggests that as long as these three dimensions are addressed and satisfied, justice is served.

The foundation for the three-dimensional EJ is embedded in the western scientific traditions and theories of ethics, and it works well in parts of the world like some European countries, where there is a certain level of homogeneity in political, legal, and philosophical or ideological senses. This does not mean that there are no differences within and between European countries, but by far and large there is one political authority – the state. Similarly, while there are local traditional knowledges across Europe, the internal onto-epistemological tensions or competition for legitimacy in relation to western scientific traditions are smaller compared to such tensions in the postcolonial states, where Indigenous knowledge systems strikingly differ from the Eurocentric western traditions (Winter, 2021; Escobar, 1995).

The three-dimensional EJ is promoted, applied and/or imposed in many post-colonial countries, where there are parallel legal, cultural and knowledge systems – traditional vs. state structures, and indigenous vs. scientific knowledges. As this EJ framework does not account for other than state authority and state legal system, and as it is not based on the traditional and Indigenous knowledge systems and philosophies of life, the utility of the framework in such contexts has been questioned (Álvarez and Coolsaet, 2020; Temper, 2019). Hence, the very tool that many EU and other international policies and projects use to promote justice can result in causing epistemic injustices and political denial for the more marginalized societal groups.

Other approaches to justice have therefore been developed based on Indigenous knowledges and by Indigenous (McGregor, Whitaker, and Sritharan, 2020; Whyte, 2020a), and other scholars (Temper, 2019; Winter, 2021). In my recent work, drawing on the existing studies, I have tried to operationalize such justice approaches in the context of policies, such as bioeconomy (Ramcilovic-Suominen, 2022) and forest restoration (Ramcilovic-Suominen, Chomba, and Larson, 2023). In short, such notions of justice demand rethinking the idea of objectifying and distributing nature, as well as rethinking the human-nature dichotomy (i.e. the view that nature/ environment and humans are separate entities). It also requires the right to self-determination of Indigenous and other traditional ethnic minority groups to reclaim and self-define their identities and their roles and relations within their territories, in accordance with their value, legal and knowledge systems, rather than having to adopt to the binaries and definitions framed in accordance with the dominant hegemonic legal and knowledge systems imposed onto them.

5.4 Implications for EU bioeconomy and related policies

To reduce the risk of injustices such as those described above in bioeconomy and related policies, there is a need to recognise and engage with the EU's historical and current responsibilities for the existing socioecological crises. Such a recognition should be followed by an adequate action package, which would include measures that tackle over-consumption and promote sufficiency and frugality in the EU, together with commitments to climate reparations and debt cancelation for the Global South countries (Ramcilovic-Suominen, Kröger, and

Dressler, 2022). To bridge the gap between the locality where policy is designed versus where it it is implemented and has an impact, there is need to shift from EU-centrism to EU-reflectivism in the process of defining policy problems and solutions. When acting in post-colonial states, pluralistic legal and cultural structures, indigenous knowledges, indigenous authorities, right of nature and multispecies justice need to be taken into consideration. Dedicating attention to improving the position of vulnerable groups (e.g. small-scale producers, rural communities in the biomass provisioning areas in and outside the EU borders), as well as removing the causes for their vulnerability may require among others to reduce pressure, demands and interventionalism, while holding space for local concerns, knowledges and locally desired and designed problems and solutions. Finally, I call for questioning and unlearning of the dominant, mainstream positions, myths and paradigms, including those of unquestioned economic growth, trickle-down economics, consumerist mentalities and supremacy of markets and technological solutions, while encouraging and funding alternative visions for alternative economies, alternative existences and alternative knowledge systems.

6 Feeding the world without devouring the planet: the need for radical changes in European agriculture.

George Monbiot

While we might earnestly debate what should be done and while at the current COP27 meeting in Egypt there are lots of discussions about what needs to be done, what we need to attend to, above all, is what is being done, what are the realities that affect the bioeconomy. And in Europe those realities, despite the huge body of scientific documentation of our environmental crisis, have scarcely been changed by the evidence. We should always start to look at European farming policy, because this has by far and away the biggest impact on the natural world: what we see is a continuing disaster that has been in place ever since the Common Agricultural Policy came into existence. I start with farming, because farming has the biggest impact of all human activities on the living planet. It's the greatest cause of habitat destruction, it's the greatest cause of deforestation, it's the greatest cause of wildlife loss, it's the greatest cause of extinction, it's the greatest cause of soil degradation, and it's the greatest cause of freshwater use. It's one of the greatest causes of climate breakdown, much greater than transport, and it's one of the greatest causes of air pollution and water pollution. Here in my country, the UK, it is the major cause of river pollution, and yet we scarcely talk about it! We talk about fossil fuels, we talk about plastics, we talk about the chemicals industry, but there's sort of moral force field around farming which says "don't go here, don't criticize this industry" and we apply radically different standards when we assess farming to the standards we apply to any other industry.

And far from trying to ameliorate the harm that farming does, our public policy greatly exacerbates it, and there's no better example of that around the world than the Common Agricultural Policy. Now, I say this as a Remainer, as someone who deeply regrets the fact that the UK has left the European Union, but if I had voted only in terms of our agricultural policy and European agricultural policy, I would have voted to leave, I would have voted for Brexit. The only good thing that Brexit has brought us is getting out of the Common Agricultural Policy, which is one of the world's greatest causes of environmental destruction, and possibly one of the greatest causes of perverse public spending.

Under the Common Agricultural Policy in order to qualify for "Pillar 1" payments, your land has to be in what's called agricultural condition ([19]). In many nations it doesn't actually have to be producing any food, it just has to look as if it is producing food or could be capable of producing food (Monbiot, 2017). And if that land contains what are classified, certainly when translated into United Kingdom law, as "permanent ineligible features", such as ponds, wide hedges, wetlands, reedbeds, recovering woodland, it is disqualified from "Pillar one" subsidies, the basic payment scheme ([20]).

And what this does is to create a massive perverse incentive for the destruction of wildlife habitat and for preventing the recovery of wildlife habitat. And I saw the tragic results first hand in Transylvania, in Romania, in 2016, where the most beautiful wood pastures and woodlands harbouring a vast range of wildlife were being torn down and burnt solely in order that farmers there could claim Pillar 1 payments under the Common Agricultural Policy (Monbiot, 2016). It creates a massive perverse incentive for habitat clearance and habitat destruction. And environmental campaigners have been pressing for years for something to be done about this (see e.g. Birdlife International (2022) and Birdlife International (2021)), but nothing is done. All the citizens of the European Union who pay taxes are contributing to the destruction of the natural world, and also contributing to one of the most regressive public spending policies in the world today: which is the transfer of money to some of the richest people on Earth, not just in the European Union, but on Earth, because people from all over the world have bought into European agricultural land and they get paid for owning it. It's an extraordinary situation and yet somehow it's been normalized and we just accept this as being the way it is!

At the same time, the EU spends money promoting the eating of meat. We know that meat eating is one of the most damaging things we do. The lion's share of the damage that I listed above as caused by farming, is caused by livestock farming. Livestock farming alone, according to a recent paper in Nature Food, produces 20% of the world's greenhouse gas emissions. That means that livestock farming alone produces more greenhouse gases than the global transport system. Most importantly, it uses more land than any other use. We very seldom talk about land use, but I think it is perhaps the most important of all environmental questions, greatly neglected by

([19]) Note from Editors: *Good Agricultural and Environmental Condition (Regulation 1306/2013)*
([20]) Note from Editors: See e.g. pag. 40 of (UK Government, 2022)

environmentalists, by almost everyone. And when we talk about it, we tend to talk about urban land use, and we campaign against urban sprawl. And we're quite right to campaign against urban sprawl: urban sprawl is a blight on cities and a blight on the countryside. But the entire urban area of the world's land surface is 1% of that surface; farming occupies 38% of the world's surface (Ritchie and Roser, 2019), and all the other land is either protected areas, forests, deserts, mountains or snow and ice. And so, the only areas that farming can expand into are protected areas and forests, which unfortunately it is doing. Worldwide agricultural sprawl, sprawling across 38% of the planet, is by far and away the greater threat, much greater than urban sprawl, and yet it's one we scarcely talk about. And that agricultural sprawl is driven entirely by livestock.

So, we talk about 38% of the planet being used for farming. Only 12% of the planet's land surface is used for growing crops, and almost half of that land is used for growing crops for animal feed (Ramankutty et al., 2008); 26% of the planet's land surface is used for grazing. Now we have a lot of deep-rooted old beliefs about grazing: that it's the seat of innocence and purity, that it's in harmony with the natural world, that it's the way things ought to be. But pasture-fed meat and other products are the most damaging of all the foods we eat by a very long way because of the vast amount of land required to support them (Monbiot, 2022b). It is a really profligate and wasteful way of using land. And because pastures occupy so much land, they have enormous ecological and carbon opportunity costs. What that means is that the land being occupied by grazing livestock is not being occupied by wild ecosystems. And those wild ecosystems are obviously much richer in wildlife abundance and diversity than livestock pastures are, and also they are much richer in carbon. And there's a huge weight of evidence showing both of these things (Monbiot, 2022a), evidence which is ignored and denied not just by livestock farmers, but by officials as well around the world. And people believe fairy tales about livestock being good for the planet and sequestering carbon and looking after wildlife. It's just nonsense, but it's nonsense that has travelled far and wide.

The great majority of the world's species depend on wild ecosystems, ecosystems from which we are not extracting products. Those wild ecosystems, in turn, sustain our wider life support systems, our Earth systems. And in fact, it's very hard to see how we're going to get through this century unless we protect and restore wild ecosystems, which are now being lost, bring back wild ecosystems in places where the ecosystem has been reduced to a few bare threads. By far and away the biggest opportunity to achieve this is by reducing livestock farming and leveraging those ecological and carbon opportunity costs. But far from trying to discourage the production and consumption of livestock products, not only is €30 billion a year of European money spent directly on livestock farming through subsidies (Greenpeace, 2019), the majority of EU subsidies are spent on livestock farming. But there's also these advertising campaigns sponsored by the European Union in a separate budget to promote meat to consumers. In three years, the EU has spent €71 million encouraging its citizens to eat more meat (Teffer, 2019). So, for instance, it's got these advertisements saying “Become a Beefetarian” (Campbell, 2020). And TV ads saying that we should support sustainable farming by choosing European beef. And the EU “sheep meat reflection group” (you can picture them sitting cross-legged on the floor contemplating a leg of mutton) saying that it's vital to appeal to and convert younger consumers to eating lamb as their everyday protein choice ([21]). It's like saying it's vital to convert people to burning coal. That's how bad it is. That's how perverse this is. These promotional materials were still being circulated in the UK after we voted to leave, but before Brexit actually happened. And among them was this wonderful document talking about how sheep farming protects wildlife and sequesters carbon ([22]), which is a direct lie. I mean it was simply mendacious and false. And it went on to say the following: ‘Without sheep breeding, these abandoned meadows would evolve into unproductive forests for human consumption. It would also mean that the land is solely being used for breeding, thus preventing the usage of this land for other activities, such as tourism’. Now, I've no idea what this means, but it seems to be arguing that tourists will be deterred by people having sex in the woods. It's just so wrong and so perverse, such a fantastic waste of public money!

And so here we are discussing what ought to be done and what the right policies should be, and here we have taxpayers’ money channelled through the European Union being squandered on this nonsense, and at the same time there's a massive deficit in research and development funding for genuinely sustainable agriculture. Almost no money at all is being put into looking at how we can better mediate the relationship between plants and bacteria and fungi in the soil, for instance. If we get this right, as practice by certain innovative farmers shows, you can greatly reduce the fertilizer or the manure that you use for fertilizing the soil because you can use the

([21]) Note from Editors: https://ec.europa.eu/chafea/agri/en/campaigns/eu-lamb-campaign

([22]) Note from Editors: https://www.youtube.com/watch?v=p5UN0qMtKD0, the actual website for UK (www.trylamb.co.uk) seems to be offline by now.

bacteria and fungi to release nutrients when plants need them and to lock those nutrients up when plants don't. Some farmers have succeeded in doing this, others haven't. And we don't know why yet, and we don't know why because there's been so little research done. It's got something to do with what's going on in the soil, but we've no idea what that thing is. And generally, research and development seem to follow the big corporate money: if the corporations want a particular area of research, they don't want to spend their own money on it, and they will persuade the European Commission to spend its money instead on that area, and often that's exactly the opposite to the areas that we should be investing public money in. We should be filling the gaps in research that the corporations are not interested in, but that could provide the basis of a whole new agriculture which enables us to pursue high yields and low impacts.

Now the European Union, again perversely, is very heavily invested in low-yield agriculture. This third compartment model that it has, which I think it's an absolute catastrophe because it's so hostile to many forms of wildlife and indeed to carbon sequestration. And as I see it, low yield agriculture is not environmentally friendly because it requires more land use. And this is the crucial environmental issue, as I said. But we do need low impact agriculture. We do need massively to be reducing the pesticides, the herbicides, the fertilizers, the irrigation water that we use, but at the same time maintaining yields that are comparable to the highest we get today. Because in doing so we ensure that agriculture doesn't sprawl across a vast area of land. But there's so little research which helps us to get there. And there's so little research, also funded by Europe, or indeed by anyone else, into the entirely new food sources that we could be developing as far more environmentally-friendly substitutes for the foods that we currently consume. So, for example, I believe that the most important of all environmental technologies is something called “Precision Fermentation”, which is a refined form of brewing. It is basically multiplying up microorganisms to produce protein rich foods and some of these microorganisms require no farm inputs at all (Linder, 2019). In other words, they don't require any feedstocks produced by farming. They feed on hydrogen or methanol, and these can be produced by renewable energy without requiring any land use. When scaled up, we could see the impacts of producing protein rich foods minimised to an extraordinary degree with a tiny fraction of the land use, a tiny fraction of the water use, a tiny fraction of the fertilizer use, to produce protein rich flowers, about 65% protein, which are then far more adaptable than plant based proteins and far easier to turn into substitutes for animal products as well as perhaps to create a whole new cuisine. And there are several European start-ups working in this space and some of them have a little bit of European money to help them along their way, but mostly they're either privately funded or funded by universities. Here we are, on the cusp of potentially revolutionary change, and governments and administrators just don't seem to be interested in it. It's as if renewable technologies were left entirely to the market, rather than being supported by European funds, as they have been. But these technologies, particularly precision fermentation I think, are far more important than renewables, because not only do they permit enormous carbon saving, but they also permit enormous ecological savings.

If we were to obtain our protein this way instead of through animals, or through soy, coconut, other highly damaging plant products, we could rewild vast tracts of the world, drawing down much of the carbon that's already been released (which we know we now have to do because we've left it too late merely to decarbonise our economies) and allowing ecosystems to return. We could stop the 6th great extinction in its tracks. We could see a new flourishing of nature, in fact our survival might be dependent on this.

So where is the money? Where's the interest? Well, it's not materializing because of the lobbying power of legacy industries. And this is always the greatest threat that democracy faces, which is the power of those who are already producing in a particular sector, who want to maintain business as usual. Because business as usual is what leads to their profits, and so they try to impede that change. And we've certainly seen a great deal of lobbying within the European Union to prevent plant-based foods from being recognisable to consumers, or attracting consumers; with lobbyists trying to prevent plant-based products from being called sausages or burgers (but rather “tubes” or “discs”), and all these other stupid attempts to prevent people from buying the new products ([23]). Unfortunately, corporate lobbying has a tremendous grip over European policy, just as it has a tremendous grip over UK policy and U.S. policy, and policy everywhere. It's a straight fight between democracy and plutocracy, and democracy is everywhere losing. And I guess the question I have to you is: how do we penetrate this? How do we change this? Because, for years now, environmental groups have tried to lobby to change European policy on these crucial issues right across Europe, some of the biggest and best funded environmental groups, and they've got absolutely nowhere. What happens with every new subsidy round, for

([23]) Note from Editors: see e.g. https://www.euractiv.com/section/agriculture-food/news/meps-save-veggie-burger-from-denomination-ban/ and https://en.wikipedia.org/wiki/Plant_milk

example, is that the European Commission says “yes, everything's going to change now” and lots of environmental groups get involved, taking them at their word, believing that they're sincere, that things are going to change. And we get to the end of the round, and we find it was all stitched up before the environmentalists even got involved. And it's either exactly the same as it was before, or it's even worse. Nothing seems to change for the better. So, how do we make that change? How do we break the power of legacy industries and their extraordinary ability to lobby the European Commission, as well as governments directly, and, of course, many other bodies around the world? What do we do to break this impasse? And I believe that this is not just, potentially the biggest of all political questions, but it's also the biggest of all environmental questions. Because what counts environmentally is not the new things we do so much as the old things we stop doing. We can develop endless wind turbines and solar arrays, but if we're still burning fossil fuels, it's not going to make any difference. It's like saying: “I've eaten two giant tubs of ice-cream today, but I also had a salad, so why aren't I losing weight?”. And it's the same with food and farming: we have to stop producing livestock, we have to stop tearing the soil off the land, we have to stop these terrible, damaging activities just as much as we need to start the new technologies that might replace them. But stopping seems to be impossible when we have this tremendous lobbying power, directed at blocking any change and at maintaining the business as usual that is pushing us towards planetary tipping points. So I'm going to end with a question to you. What do we do?

7 Linking degrowth, justice and human-nature relations with a common thread of transformations

Sabaheta Ramcilovic-Suominen

Key messages – Chapter 7

- Existential socioecological crises are *systemic* (i.e. driven by the political and economic system dependent on perpetual economic growth) and *relational* (i.e. crises of a lack of connection and relation), and have common causes.
- Addressing these causes requires: i. dismantling power and economic relations that drive violence, extractivism and exploitation; ii. ontological reflection, including reimagining human roles, relations and responsibilities in the web of life; and iii. reinventing structures and ontologies to integrate principles of care, respect, and reciprocity.
- Degrowth, justice and transformations are not metaphors, silver bullets, or blueprints. They embedded in the cultural and the political contexts.

This chapter connects the above introduced concepts and ideas of degrowth, justice, human-nature relations and the idea of relationality (a worldview that all living beings, plants and animals, are connected and that one's personal wellbeing depends on that of the other living beings). This is done in the context of transformations, where they are framed as means and preconditions for transformations.

7.1 Transitions and Transformations

The literature on transformative change tend to distinguish between transitions and transformations (Hölscher, Wittmayer, and Loorbach, 2018). This distinction is fluid, and we should think of it as a spectrum of different approaches, rather than as two distinct separate entities or concepts. Yet, and while there might not be a general agreement among scholars about it, this distinction is analytically useful. The literature on transitions often deals with minor or incremental changes with have a narrower sectoral, policy or geographic focus. They are also often framed as processes of change that are structured and managed by the existing epistemic community and/or political leadership; changes that are embedded within the current ontological traditions, institutional and political structures (see e.g. Geels (2019)). They focus on shifts and adjustments in technologies, policies and practices, with a strong focus on innovation and pathways for reaching the desired well-defined goals, and finally they commonly include social engineering interventions, such as customer acceptance and behavioural change (Geels, 2019). Transformations, on the other hand, are understood as fundamental shifts away from the ordinary, mainstream, and hegemonic onto-epistemological understandings and institutional structures (Ramcilovic-Suominen, 2022; Feola, 2015). Hence, in addition to shifts of practices, structures and policies, they require onto-epistemological shifts. Commonly understood as large-scale societal shifts of planetary dimensions - even when actions are local - they question the systemic root causes and challenges including the economic and political power relations and systems (Feola, Vincent, and Moore, 2021). Transformations are by definition anti-hegemonic (Hamilton and Ramcilovic-Suominen, 2023). The role of social movements, resistance, civil disobedience are seen as important triggers of change (Pelenc et al., 2019). Unlike transitions, transformations are uncertain, emerging, heterodox, and multi-faceted processes of change which transcend the existing structures, forms of knowledge, categories, binaries, and definitions.

7.2 Selective degrowth, multidimensional justice and relational ontology as tenants of transformations

Selective degrowth, multiple dimensions of justice and relational worldview on human-nature relations are key and intertwined elements of transformations. For example, selective degrowth warns about overshooting of ecological or planetary boundaries, which in turn directly relates to existential crises, triggered by ecological destruction, pollution, GHG emissions. It also relates to inequality crises, due to unequal access and distribution of 'goods and bads', and the unequal shares of responsibility and contributions to those crises. Finally, the crises can be described as relational (Whyte, 2020b), where some humans have forgotten that their own wellbeing depends on the wellbeing of other humans and other-than-human species, and have forgotten their responsibility to reciprocate, respect and replenish them.

At present, we know that 'no country meets basic needs for its citizens at a globally sustainable level of resource use' (O'Neill et al., 2018) and that the countries transgress biophysical boundaries at an increased rate, and faster than they manage to provide social thresholds for its citizens (Fanning et al., 2022). We also know that this transgression and associated pollution, waste and emissions are immensely unequally distributed across time, space and societal groups (Hickel, O'Neill, et al., 2022; Wiedmann et al., 2015). For example, Hickel (2020) finds that the United States alone is responsible for 40% of excess emissions, which refer to the emissions that are beyond the countries' fair and sustainable share of emissions. The Global North, including the US, Canada, Europe, Australia and Japan, collectively are responsible for a total of 92% of the total excess emissions. Meanwhile the entire continents of Africa, Asia, including China and South America, constituting the GS where most of the world population is based, contribute to about 8% of excess emissions (i.e. emissions beyond the sustainable and fair share).

Stressing further the issue of inequality and inherent injustice evidenced by these figures, we should keep in mind that while it is the Global North countries that historically as today are more responsible for resource extraction, excess emissions and associated crises, the most vulnerable countries (for a variety of reasons, including colonisation and pertaining unequal economic and power relations) are the countries in the Global South. As the line between responsibility vis-à-vis vulnerability crosses the equator and the colonial bordering lines, various scholars and activists, including Jason Hickel, Kyle Whyte, Farhana Sultana, Naomi Klein, and others have suggested that we need to talk about climate and atmospheric colonisation, rather than climate change and even climate (in)justice.

Climate apocalypse is a reality for many in the Global South already at the current scale of change in climate, as we witness devastating effects year after year, from heatwaves, to droughts, wildfires and storms displacing millions of people every year. The responsibility to act now and to act faster is with the high-income, Global North countries. The current policies and even pledges are incompatible with the life on earth as we know it and with the Paris Agreement, with a significant emission gap ([24]). The emission gap is also accompanied by a land gap, as the privileged corporate and governmental actors have committed vast amounts of land globally to various climate mitigation measures (including tree planting), relying on land and forests for carbon removal projects, to an extent that the land committed to climate mitigation pledges is equivalent to the land area used for global food production (Dooley et al., 2022). Meanwhile the corporate and governmental action to reduce the activities that drive climate change and biodiversity loss are lagging behind.

These interrelated crises, such as inequalities, biodiversity loss and climate change, have the same origins inherent and embedded in the extractivist and colonial logics that underpin the global capitalist system; a system where non-human species and marginalised and impoverished segments of human society are exploited for financial profit (Patel and Moore, 2018). They are structural or systemic crises, since the individuals and communities lifestyles and actions for change are conditioned and limited by the system that promotes consumerism and capital accumulation.

These existential crises are also increasingly seen as primarily relational crises, implying that they have origin in the interpersonal relations (i.e. the way humans relate to one another) and in inter-species relations (i.e. the way humans relate to other-than-humans). This relational approach has gained attention in sustainability and transformation research, where relational ontology (Gram-Hanssen, Schafenacker, and Bentz, 2022; Whyte, 2020a), ancestral knowledge and/or spiritual ecology (Gebara, 2020; Kimmerer, 2020) have emerged as key concepts. Drawing on indigenous cosmologies and epistemologies this body of literature calls for rethinking of human-nature dichotomy assumed in the Westphalian philosophy and thinking. Such philosophies of life call for transformations from within outwardly, for remembering and maintaining reciprocal relations between human and their non-human relatives; relations based on kinship and mutual prosperity and cooperation, rather than competition and domination.

Life-long education within and outside classrooms and formal education can help reimagine our relations with the rest of nature, but policies too can reflect and encourage such views and value systems. This is not a call for adopting and adapting indigenous and traditional cosmologies and traditions (knowledges, values and legal traditions) into the modern western ones. Rather, it is a call for critical self-reflection, soul-searching and questioning our Cartesian onto-epistemological, philosophical and ethical foundations and remembering Spinoza's teachings and ethics in the face of existential crises caused by predatory "cannibal capitalism" (Fraser,

([24]) Climate Action Tracker https://climateactiontracker.org/global/cat-emissions-gaps/

2022). The increased interest in conviviality (Büscher and Fletcher, 2020) and regenerative relations and practices (e.g. agroecology) are important steps in this direction and need to be encouraged and promoted, including through research funding and support for intercultural exchange in knowledge production. Supporting critical social science that question status quo, call out (green) capitalism and mainstream solutions are important ways in which policy can enable transformational change.

Degrowth, as introduced by one of its most known proponents (Chapter 4), is another foundational pillar for transformative change. It acknowledges the limits and the myths of green growth, trickle-down economics and innovation and technology fixes as solutions to our socioecological crises. It highlights that while important, they are insufficient to balance the ecologically destructive consequences that come with the compound growth and extractivist global economic system; for reasons like economy-wide rebound effect (Brockway et al., 2021) and other limits of decoupling (Giampietro, 2019a). Increasingly the available research suggests that the only feasible scenarios compatible with the 1.5°C target are those that include degrowth strategies (Keyßer and Lenzen, 2021).

Finally, concerning justice and transformational change, much of what I argue above has direct positive implications to global justice. First, shifting from an economy concerned with financial exchange to one that is concerned with nurturing of life and caring for wellbeing of all living beings, human and other-than-human, is likely to be more just. Considering the unequal exchange and vast appropriation by the Global North from the Global South countries (see the work by Jason Hickel and colleagues referred here), reducing the economic growth in high-income countries of the Global North reduces pressure on the web of life, economic and human resources in the Global South countries, which in turn implies reduction in root causes of injustice and violence. Second, recognition and promotion of currently marginalised philosophies of life is on the one hand a precondition for epistemic justice (McGregor, Whitaker, and Sritharan, 2020; Whyte, 2020a), and an inspiration for reimagining of dominant worldviews. Keeping in mind the plurality of knowledge systems when defining policy problems and solutions, can reduce the current practice of epistemic domination and imposition of Eurocentric knowledges through, among other means, international policies and programmes. Such policies can also upgrade their commitment to justice by shifting from "doing no harm" principle to "undoing the harm" principle. Addressing the existing and being mindful of the risks of creating new forms of violence could be prioritised in policy design processes, alongside and/or above the scientific quality and supposed scientific neutrality, as well as in policy monitoring and evaluations in EU and other international policies. Actively avoiding policy problems and solutions that relocate the costs to those who have least contributed to it, including future generations – human and non-humans – in places that are least responsible for the problems aimed to be tackled is another transformational change, together with discontinuing policies and programmes that divert attention from systemic causes.

7.3 Contemplating transformations

It is important to note that while necessary, transformations are also risky (Blythe et al., 2018) and a step into the unknown (Hamilton and Ramcilovic-Suominen, 2023). The shift from consumerism to sufficiency, from competition to reciprocity, dominance to conviviality, from inequality to equality is prone to conflict and uprising, testing the democratic structures and principles. The processes of deep change need to be deeply democratic and voluntary. Democracy is central, since by default transformations imply redistribution of wealth, power, and privilege, which can easily lead to repression in the name of transformations. Transformations are personal, painful, and full of contradictions (Hamilton and Ramcilovic-Suominen, 2023). They are also context specific and should not be promoted as panaceas across different geographies, societal, political and ideological spaces, as the intentions, the institutional settings, and the socioecological and socio-political realities which they are engaged with are context sensitive.

The concepts and ideas emerging from degrowth, justice and transformations are crucial, but they should not be romanticised, taken as metaphors, or blueprints. These ideas are also highly susceptible to co-optation by actors favouring the status quo and business as usual. Hence, more often than not radical ideas once entering the institutional and political domain are reduced and narrowed down sometimes to their determinant, as in the case of sustainable development concept (Brown, 2016; Demaria and Kothari, 2017). Without addressing the root causes, including power and wealth inequalities, racism, (neo)colonial logics and an economic system that profits from the other two and which is dependent on perpetual growth, transformations will remain rhetoric or used for wrong purposes (Bentz, O'Brien, and Scoville-Simonds, 2022; Blythe et al., 2018; Ramcilovic-Suominen, 2022).

Finally, the role of social movements and activism, including science and research activism should be highlighted as important drivers of change. Synergies between different movements, initiatives, solidarities and actions for change are all key components. They are not only crucial for change, but also lead to social learning and exchange between different initiatives and groups, and therefore sow plurality and diversity. As scientists, especially those of us in the Global North, we have a moral responsibility to speak out and be allies for marginalized and disposed. We also need to rethink our supposed “neutrality”, because not speaking out and not questioning the dominant positions, myths and actions, rather than neutral is legitimising.

8 Conclusions and implications for bioeconomy research and governance

Jacopo Giuntoli and Sabaheta Ramcilovic-Suominen

Literature shows that the current dominant imaginaries for the bioeconomy are mainly in the "sustainable capital" quadrant: characterized by green growth, decoupling objectives, and anthropocentric perspectives.

Hegemonic narratives can consolidate into a "common sense" (Chomsky and Waterstone, 2021) which, appearing as inevitable, can diminish our capacity to imagine different futures and visions. Since the current hegemonic narratives and status-quo are fuelling and exacerbating the on-going social and ecological crises, we must question them and ready ourselves to imagine and explore new ways of thinking, as presented by the authors of the chapters in this report.

For instance, Tom Oliver in Chapter 3 stresses the crucial role of individual and societal values to mitigate the on-going ecological breakdown. Defining a safe and just space for self-identity and values, where ecocidal attitudes and values are emarginated, and "sustainability-aligned values" like care, unity, responsibility, justice are actively promoted could be a first step in addressing this crucial aspect. The words, imaginaries and metaphors we use to describe concepts have important consequences in reinforcing specific framings (Lakoff and Johnson, 1980). Shifting the current narratives and language used can support development of more sustainability-aligned values, as the current one embeds values which reinforce environmental degradation (IPBES, 2022).

Similarly, Sabaheta Ramcilovic-Suominen in Chapter 5 highlights the importance of historically embedded and current injustices, including material unequal exchange, economic and power asymmetries, but also epistemic domination and imposition of one way of knowing and being in the world (i.e. epistemic injustices). She further stresses the need for acting upon those injustices, including through calls for climate reparations, debt cancelation for post-colonial states, improving the position of vulnerable groups in the EU and beyond, as well as actively reducing the causes for their vulnerability. She identifies the reduction of over-consumption in the EU, and ending Eurocentric epistemological imposition and domination as the most urgent and single most effective actions for addressing global environmental injustice.

Giorgos Kallis in Chapter 4 shows that absolute decoupling of global resource use and GHG emissions from economic growth has not yet taken place and appears to be unlikely, if not outright impossible, to be achieved in the future. The current societal "common sense" leads well-meaning people to think that challenging growth is impossible, and thus green growth and absolute decoupling must be possible or must be made possible. But what if green growth isn't possible? Degrowth scholarship can offer some possible alternatives to green growth and Kallis presents four main political proposals: A Green New Deal without growth, Universal Care Income, a four-day work week, and wealth tax. Kallis highlights that political acceptability is a central obstacle to establishing a new economic paradigm compatible with planetary boundaries: only through a coevolutionary change of personal/everyday practices, social mobilization and institutional change can new transformative politics emerge.

This report is just a first step towards envisioning new possible directions for the EU bioeconomy and the society it will support. We hope that the ideas and perspectives explored in this report can support the process of deliberation on new visions and trajectories, where broader range of actors and their concerns are included (e.g. youth and activists) to collect and integrate their concerns to define a vision which is truly shared and embraced.

The following sections present a potential new vision which is located in the "unexplored" bottom and top left quadrants of Figure 2, and then venture into analysing what potential consequences embracing this new vision could have for bioeconomy research and governance. The challenges we face in achieving the Green Deal transition are unprecedented, and our goal for these rather bold proposals is to stimulate a constructive discussion so that the bioeconomy can really be a pillar of a new sustainable society.

8.1 A new vision to explore: 'green, just and sufficient bio-economy'?

Based on the arguments laid out in this report and the key messages emerging from the various chapters, in Figure 8 we offer a potential vision for a new "**green, just and sufficient bioeconomy**".

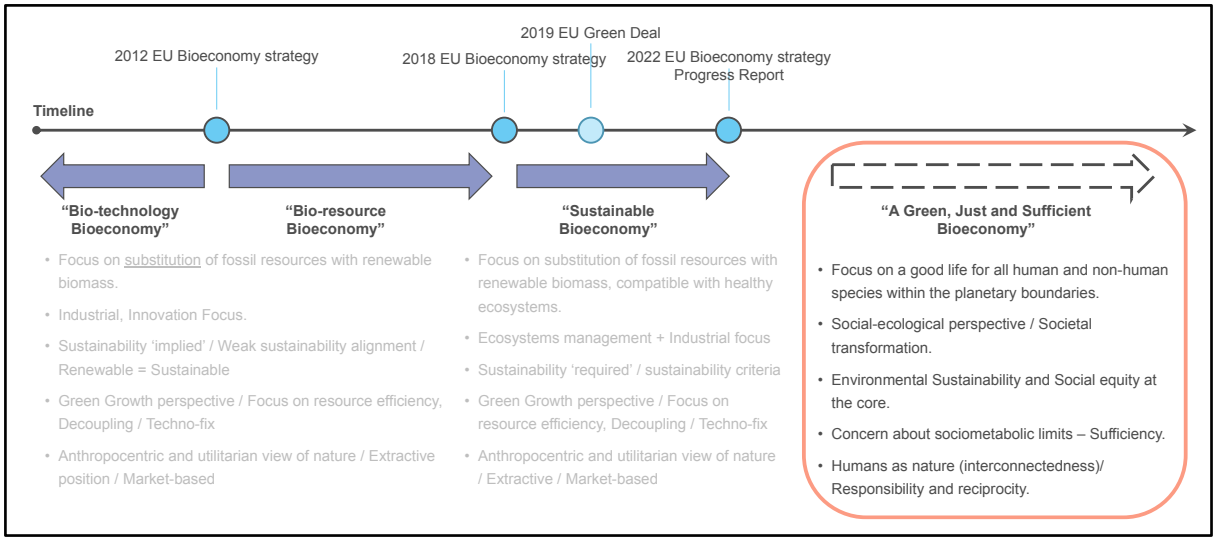

Figure 8: Updated timeline of bioeconomy visions in the EU including a potential new vision for a future "Green, Just and Sufficient Bioeconomy".

Instead of focusing on promoting biomass extraction with the goal to decouple economic growth from fossil resources use and their climate impacts, this new vision, in line with the sustainability principles provided in section 2.1, places environmental sustainability and social equity at its core, regardless of economic growth (Raworth, 2017). On the contrary, since absolute decoupling is highly unlikely or unlikely to take place at the speed required to avoid climate breakdown (Hickel and Kallis, 2020), this vision focuses on sufficiency and frugality rather than aiming for perpetual economic growth. The underlying goal of the bioeconomy in this vision is to support 'a good life for all within planetary boundaries' (O'Neill et al., 2018). The vision has an inclusive perspective, whereby the moral community includes humans as well as other-than-humans (Beatley, 1994), leading to a moral reckoning of the place of humans in the web of life (Moore and Nelson, 2022). Care, respect and reciprocity for and with others are core values within this vision. Reliance on technology and technological solutions is not a core tenet in this vision, but the role and potential of technology to deliver on the green and just objectives is recognized, and ethical considerations on new technologies are openly debated in the public (Monbiot, 2022a). It is worth pointing out that several of the characteristics in this vision appear also in the recent "Ecotopia" imaginary produced by the European Environment Agency (2022).

8.2 Implications for bioeconomy research

If we accept that a large unexplored option space exists, including this new vision but also many other variants, then we argue that this has two main consequences for bioeconomy research:

1. This broad option space should be explored: this could be as simple as designing and including new scenarios in policy Impact Assessments, in modelling activities, in scenario analysis, etc. For instance, calls for expanding the solution space in climate mitigation studies have been frequent in the last years (Hickel et al., 2021; Otero et al., 2020): Keyßer and Lenzen (2021) have shown that considering degrowth scenarios, climate neutrality could be achieved with much lower reliance on future negative emissions technologies compared to most other decarbonization pathways from IPCC. More radically, different knowledge framings and modelling approaches could be embraced within bioeconomy research: e.g. Quantitative Storytelling approaches (Giampietro and Bukkens, 2022; Renner and Giampietro, 2020), indigenous knowledges (Arsenault et al., 2019), methods from systems thinking, sociometabolic approaches etc..
2. Since what we measure affects what we do (Stiglitz, Sen, and Fitoussi, 2009), we argue that the conceptual framework for the BMS would need to be revised as described below, to be well-defined and well-calibrated to capture a different vision for a green, just and sufficient bioeconomy.

Implications for the Bioeconomy Monitoring System: compass definition

The first task would be to evaluate how the objectives and normative criteria that constitute the conceptual framework could be amended to capture the new vision. For instance, an initial and illustrative list of possible changes could include:

- One of the normative criteria in the conceptual framework currently states: "Economic development is fostered". In view of a sufficient bioeconomy which is agnostic to economic growth, this criterion would likely need to be eliminated or amended. For instance, this criterion could be amended to include a new holistic 'well-being' criterion, although the definition of well-being is in itself not a straightforward exercise.
- Section 2.3 discussed how bioeconomy visions have moved beyond the original interpretation of supporting innovative bio-technologies. Nonetheless, research & innovation, as well as the development of new bio-based products remain key pillars of the EU Bioeconomy and its industries. Innovation and progress within specific bio-based industries could have a specific objective within the framework, thus providing a dedicated focus on the 'emerging activities' within the bioeconomy (Biomonitor, 2020).
- Similarly, given the recent focus on ecosystems restoration and nature-based solutions (European Commission, 2022), indicators concerning conservation, restoration and rewilding activities could be assigned a specific criterion within Objective 2.

The second task consists in exploring whether the compass might be excluding important aspects concerning this new vision. As shown in this chapter, we argue that a specific objective capturing aspects of **Justice and Equity** within the bioeconomy would be needed. Several aspects are already included in the Bioeconomy Monitoring System list of indicators, as indicated in Table 1.

Table 1: Indicators already present in the EU Bioeconomy Monitoring System dashboard related to Justice and Equity aspects.

Objective	Normative Criterion	Key Component	Indicator
1) Ensuring Food and Nutrition Security	Food security and nutrition are supported	Utilisation	Animal welfare (GAP)
1) Ensuring Food and Nutrition Security **&** **3) Reducing dependence on non-renewable, unsustainable resources**	Local economies, societies and environmental conditions of countries exporting food to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	Social impact of trade in exporting countries of food & non-food (to EU)	Social impacts of biomass (food and non-food) trade
5) Strengthening European Competitiveness and Creating Jobs	Inclusive economic growth is strengthened	Working conditions related to the bioeconomy	Occupation health and safety in bioeconomy sectors (GAP)
		Equality & Inclusiveness in the bioeconomy	Employment by age in bioeconomy sectors (GAP)
			Employment by educational level in bioeconomy sectors (GAP)
			Employment by gender in bioeconomy sectors (GAP)
			Income by gender by sector (GAP)

			Income distribution along bioeconomy value chains (GAP)

However, other aspects might be missing and should be considered, for instance:

- Ownership structure of Bioeconomy businesses
- Land ownership
- Land grabs
- Land access (Right-to-roam, access to Nature-Based Interventions)
- Intellectual property and data ownership in bioeconomy
- Human rights respect in bioeconomy sectors
- Protection of traditional knowledge systems
- Presence and usage rights of Commons
- Perceptions on human-nature relations.

An issue, as illustrated by the list in Table 1, is that many of the aspects in this new objective are either hard to quantify because of the nature of the issue considered, or simply useful datasets/proxies do not yet exist. While the Bioeconomy Monitoring System in its monitoring component is ultimately a quantitative exercise (Mubareka et al. 2023), the risk exists for issues that are not easily quantifiable to be simply forgotten or under scrutinized. It will be important therefore to consider whether these issues are best tackled through inclusion into the quantitative Bioeconomy Monitoring dashboard (as indicators) or rather as a separate qualitative exercise, where less tangible issues can be captured.

8.3 Implications for bioeconomy governance

It is beyond the scope of this report to produce any detailed policy recommendations, although these are included in some individual chapters. Nonetheless, embracing a new vision for a sustainable bioeconomy has some clear implications for bioeconomy governance which can be summarized in the following ten points:

1. **Democratizing the bioeconomy**: policy decisions in bioeconomy-related sectors have enormous consequences for citizens everywhere. For instance, decisions on land use and land ownership affect directly and indirectly not only people in Europe, but globally. A green and just bioeconomy would embrace a global governance perspective and ensure participatory approaches and citizen engagement where feasible ([25]). This could ensure better integration of multiple perspectives and interests in Bioeconomy-related policies.
2. **Preventing neo-coloniality and exploitation in global bioeconomy**: Considering the pressures associated with a continually increasing demand for biobased materials and commodities, the heightened risks of exploitation and the modern-day slavery (e.g. in agricultural and monocultural forest sector), as well as the land grabs associated with bioeconomy expansion, cannot be overstated (Chapter 5). A green and just bioeconomy would make it a priority to ensure human dignity, fair working conditions and the respect of human rights for the historically and the currently exploited and marginalised groups, and small-scale producers in the global peripheries of the bioeconomy sectors. Similarly, self-sufficiency and food sovereignty for these communities would be ensured.
3. **Global decolonial environmental justice perspective:** A green and just bioeconomy would ensure that the bioeconomy policy does not (re)produce the existing injustices, such as for example, epistemic domination, by imposing Eurocentric visions and philosophies of life, and political denial, by considering and recognizing only state legal and political structures, ignoring therefore traditional indigenous legal systems and authorities (Chapter 5). Rather, the right to self-determination and, where applicable, to

([25]) The JRC is active in this field through its Competence Centre on Participatory and Deliberative Democracy (https://knowledge4policy.ec.europa.eu/participatory-democracy_en)

self-governance of indigenous territories, and recognition and the right to follow their knowledge and legal systems would be ensured.

4. **Nature's value and Sustainability hierarchy:** A green and just bioeconomy would recognize that not everything can be turned into a commodity. Confronted with existential threats of climate and ecological breakdown, it appears evident that some things cannot be substituted with other things or with money, and therefore cannot and should not be measured solely in monetary terms: What is the price of a whale (Buller, 2022)? Or of life on Earth? What is the price of survival of the human civilization? What is the price of a human life lost or displaced because of climate change? A green and just bioeconomy would thus adopt a new definition of sustainability which establishes a clear hierarchy of priorities in which the integrity of the biosphere and our life-support systems provides non-negotiable limits; economic and social inequities are morally unacceptable; economic profit is not the main or only moral compass and objective for decision making.

5. **Ethics and values:** Individual and societal values have a crucial role in driving transformations but are rarely openly debated or discussed (Mair et al., 2019; Scharfbillig et al., 2021). The governance for a green and just bioeconomy could involve more actively disciplines in the social sciences and humanities: for instance, Oliver et al. (2022) suggest involving ethicists to discuss and define a safe and just space for self-identity and values, where ecocidal attitudes and values are emarginated, and "sustainability-aligned values" like care, unity, responsibility, justice are actively promoted. A starting point to promote more sustainability-aligned values could be to change the vocabulary used when talking about the bioeconomy since the current one embeds values which reinforce environmental degradation (IPBES, 2022).

6. **Public access to nature**: as described in Chapter 3, access to nature is crucial to mental and physical well-being, therefore a green and just bioeconomy would focus on preserving and restoring natural ecosystems, but also on expanding access to public green areas and natural spaces for everybody, halting processes of enclosure. George Monbiot has summarized these approaches as aiming for: 'public luxury, private sufficiency' (Kenny, 2019).

7. **Commons**: A green and just bioeconomy would support and promote commons both for material and immaterial goods. As an example, Monbiot's call for farm-free food (Chapter 6 and Monbiot (2022a)) as an important contributor to lowering the environmental footprint of food production, comes with a warning that new technologies should be as much as possible openly available (Broad, 2019).

8. **Labour and economic policy**: As discussed in Chapter 4, degrowth scholarship has proposed several measures to lower resource consumption and climate change caused by developed countries, such as taxing carbon and non-renewable resources rather than work. A sufficient bioeconomy would consider and apply these measures to bioeconomy sectors (as presented in Chapter 7).

9. **Systemic perspective**: While several bioeconomy-related policy areas are still treated as sectorial policies, the bioeconomy policy project could be embraced as a space to discuss broad visions and transitions, to work collaboratively across policy-domain silos, across academic disciplines, and across knowledge domains. A space for real transdisciplinary thinking and approaches.

10. **Reflexivity:** The governance of a green and just bioeconomy would embrace reflexivity (Giampietro, 2023), create spaces for oppositional critique, and actively seek uncomfortable knowledge that could falsify its main narratives.

References

Abson, D.J., J. Fischer, J. Leventon, J. Newig, T. Schomerus, U. Vilsmaier, H. von Wehrden, et al., 'Leverage Points for Sustainability Transformation', *Ambio*, Vol. 46, 2017, pp. 30–39.

Álvarez, L., and B. Coolsaet, 'Decolonizing Environmental Justice Studies: A Latin American Perspective', *Capitalism Nature Socialism*, Vol. 31, No. 2, April 2, 2020, pp. 50–69.

Anderson, C.B., S. Athayde, C.M. Raymond, A. Vatn, P. Arias-Arévalo, R.K. Gould, J. Kenter, et al., 'Chapter 2: Conceptualizing the Diverse Values of Nature and Their Contributions to People.', *Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*, Balvanera, P., Pascual, U., Christie, M., Baptiste, B., and González-Jiménez, D. (eds). IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.6493134, 2022.

Anderson, K., J.F. Broderick, and I. Stoddard, 'A Factor of Two: How the Mitigation Plans of 'Climate Progressive' Nations Fall Far Short of Paris-Compliant Pathways', *Climate Policy*, Vol. 20, No. 10, November 25, 2020, pp. 1290–1304.

Anderson, K., and G. Peters, 'The Trouble with Negative Emissions', *Science*, Vol. 354, No. 6309, October 14, 2016, pp. 182–183.

Arsenault, R., C. Bourassa, S. Diver, D. McGregor, and A. Witham, 'Including Indigenous Knowledge Systems in Environmental Assessments: Restructuring the Process', *Global Environmental Politics*, Vol. 19, No. 3, August 1, 2019, pp. 120–132.

Ashford, N., and G. Kallis, 'A Four-Day Workweek: A Policy for Improving Employment and Environmental Conditions in Europe', *The European Financial Review*, April 30, 2013. https://www.europeanfinancialreview.com/a-four-day-workweek-a-policy-for-improving-employment-and-environmental-conditions-in-europe/ .

Backhouse, Maria, Rosa Lehmann, Kristina Lorenzen, Malte Lühmann, Janina Puder, Fabricio Rodríguez, and Anne Tittor, eds., *Bioeconomy and Global Inequalities: Socio-Ecological Perspectives on Biomass Sourcing and Production*, Springer International Publishing, Cham, 2021.

Backhouse, M., and K. Lorenzen, 'Knowledge Production and Land Relations in the Bioeconomy. A Case Study on the Brazilian Sugar-Bioenergy Sector', *Sustainability*, Vol. 13, No. 8, January 2021, p. 4525.

Bastos Lima, M.G., 'Just Transition towards a Bioeconomy: Four Dimensions in Brazil, India and Indonesia', *Forest Policy and Economics*, Vol. 136, March 1, 2022, p. 102684.

Beatley, T., *Ethical Land Use. Principles of Policy and Planning.*, The Johns Hopkins University Press, Baltimore, 1994.

Bennett, N.J., J. Blythe, A.M. Cisneros-Montemayor, G.G. Singh, and U.R. Sumaila, 'Just Transformations to Sustainability', *Sustainability*, Vol. 11, No. 14, 2019, pp. 1–18.

Benton, T.G., and R. Bailey, 'The Paradox of Productivity: Agricultural Productivity Promotes Food System Inefficiency', *Global Sustainability*, Vol. 2, ed 2019, p. e6.

Bentz, J., K. O'Brien, and M. Scoville-Simonds, 'Beyond "Blah Blah Blah": Exploring the "How" of Transformation', *Sustainability Science*, Vol. 17, No. 2, 2022, pp. 497–506.

Berkes, F., 'Environmental Governance for the Anthropocene? Social-Ecological Systems, Resilience, and Collaborative Learning', *Sustainability*, 2017.

Berners-Lee, M., *The Carbon Footprint of Everything*, 2nd edition., Greystone Books, Vancouver Berkeley London, 2022.

Biomonitor, *Task 1.1: Setting the Scope for the Bioeconomy*, 2020. http://biomonitor.eu/wp-content/uploads/2019/10/BioMonitor_Deliverable_1.1_Update_1.pdf

Birch, K., L. Levidow, and T. Papaioannou, 'Sustainable Capital? The Neoliberalization of Nature and Knowledge in the European "Knowledge-Based Bio-Economy"', *Sustainability*, Vol. 2, No. 9, September 13, 2010, pp. 2898–2918.

Birdlife International, *Space for Nature on Farms in the New CAP: Not in This Round*, Policy Briefing, Birdlife; European Environmental Bureau, April 2022. https://www.birdlife.org/wp-content/uploads/2022/04/Analysis-Space-For-Nature-CAP-strategic-plans-April2022.pdf

Birdlife International, *Will CAP Eco-Schemes Be Worth Their Name? An Assessment of Draft Eco-Schemes Proposed by Member States*, Birdlife International, November 2021. https://www.birdlife.org/wp-content/uploads/2021/11/CAP-report-eco-schemes-assessment-Nov2021.pdf

Blühdorn, I., 'Post-Capitalism, Post-Growth, Post-Consumerism? Eco-Political Hopes beyond Sustainability', *Global Discourse*, Vol. 7, No. 1, January 2017, pp. 42–61.

Blühdorn, I., 'Sustainability: Buying Time for Consumer Capitalism and European Modernity', in L. Pellizzoni, E. Leonardi, and V. Asara (eds.), *Handbook of Critical Environmental Politics*, Cheltenham, 2022, pp. 141–155.

Blythe, J., J. Silver, L. Evans, D. Armitage, N.J. Bennett, M.-L. Moore, T.H. Morrison, and K. Brown, 'The Dark Side of Transformation: Latent Risks in Contemporary Sustainability Discourse', *Antipode*, Vol. 50, No. 5, 2018, pp. 1206–1223.

Borras, S.M., J.C. Franco, S.R. Isakson, L. Levidow, and P. Vervest, 'The Rise of Flex Crops and Commodities: Implications for Research', *The Journal of Peasant Studies*, Vol. 43, No. 1, January 2, 2016, pp. 93–115.

Borràs, S., 'Colonizing the atmosphere: a common concern without climate justice law?', *Journal of Political Ecology*, Vol. 26, No. 1, January 4, 2019.

Box, G.E.P., 'Robustness in the Strategy of Scientific Model Building', in R.L. Launer and G.N. Wilkinson (eds.), *Robustness in Statistics*, Academic Press, 1979, pp. 201–236.

Boyce, J.K., *The Case for Carbon Dividends*, 1st edition., Polity, Cambridge, UK ; Medford, MA, 2019.

Bristow, J., R. Bell, and C. Wamsler, *Reconnection: Meeting the Climate Crisis Inside Out*, The Mindfulness Initiative and LUCSUS, May 4, 2022. https://www.themindfulnessinitiative.org/Handlers/Download.ashx?IDMF=8d56bcb4-15a0-4b39-9236-064eb302ef99

Broad, G.M., 'Plant-Based and Cell-Based Animal Product Alternatives: An Assessment and Agenda for Food Tech Justice', *Geoforum*, Vol. 107, December 1, 2019, pp. 223–226.

Brockway, P.E., S. Sorrell, G. Semieniuk, M.K. Heun, and V. Court, 'Energy Efficiency and Economy-Wide Rebound Effects: A Review of the Evidence and Its Implications', *Renewable and Sustainable Energy Reviews*, Vol. 141, May 1, 2021, p. 110781.

Brown, T., 'Sustainability as Empty Signifier: Its Rise, Fall, and Radical Potential', *Antipode*, Vol. 48, No. 1, 2016, pp. 115–133.

Bruna, N., *The Rise of Green Extractivism: Extractivism, Rural Livelihoods and Accumulation in a Climate-Smart World*, *Rethinking Globalizations*, Routledge, 2023.

Bugge, M., T. Hansen, and A. Klitkou, 'What Is the Bioeconomy? A Review of the Literature', *Sustainability*, Vol. 8, No. 7, July 19, 2016, p. 691.

Buller, A., *The Value of a Whale: On the Illusions of Green Capitalism*, Manchester University Press, Manchester, 2022.

Büscher, B., and R. Fletcher, *The Conservation Revolution: Radical Ideas for Saving Nature Beyond the Anthropocene*, Verso Books, 2020.

Campbell, M., ''Become a Beefatarian' Says Controversial EU-Funded Red Meat Campaign', *Euronews*, November 25, 2020. https://www.euronews.com/green/2020/11/25/become-a-beefatarian-says-controversial-eu-funded-red-meat-campaign .

Chen, D., and J. Haviland-Jones, 'Human Olfactory Communication of Emotion', *Perceptual and Motor Skills*, Vol. 91, No. 3, December 1, 2000, pp. 771–781.

Chomsky, N., and M. Waterstone, *Consequences of Capitalism: Manufacturing Discontent and Resistance*, Haymarket Books, Chicago, IL, 2021.

Clark, W.C., and A.G. Harley, 'Sustainability Science: Toward a Synthesis', *Annual Review of Environment and Resources*, Vol. 45, 2020, pp. 331–386.

Dabi, N., A. Maitland, M. Lawson, H. Stroot, A. Poidatz, and A. Khalfan, *Carbon Billionaires: The Investment Emissions of the World's Richest People*, Oxfam International, November 7, 2022.

Davelaar, D., 'Transformation for Sustainability: A Deep Leverage Points Approach', *Sustainability Science*, Vol. 16, No. 3, May 2021, pp. 727–747.

Demaria, F., and A. Kothari, 'The Post-Development Dictionary Agenda: Paths to the Pluriverse', *Third World Quarterly*, Vol. 38, No. 12, December 2, 2017, pp. 2588–2599.

Dieken, S., M. Dallendörfer, M. Henseleit, F. Siekmann, and S. Venghaus, 'The Multitudes of Bioeconomies: A Systematic Review of Stakeholders' Bioeconomy Perceptions', *Sustainable Production and Consumption*, Vol. 27, July 2021, pp. 1703–1717.

Dietz, T., J. Börner, J.J. Förster, and J. von Braun, 'Governance of the Bioeconomy: A Global Comparative Study of National Bioeconomy Strategies', *Sustainability*, Vol. 10, No. 9, 2018.

Directive (EU) 2018/2001 of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources, European Parliament & Council of the European Union, Bruxelles, 2018.

Dooley, K., H. Keith, A. Larson, G. Catacora-Vargas, W. Carton, K.L. Christiansen, O. Enokenwa Baa, et al., *The Land Gap Report 2022*, 2022.

Escobar, A., *Encountering Development: The Making and Unmaking of the Third World*, STU-Student edition., Princeton University Press, 1995.

European Commission, *A Sustainable Bioeconomy for Europe : Strengthening the Connection between Economy , Society and the Environment. Updated Bioeconomy Strategy.*, European Commission, Bruxelles, 2018.

European Commission, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. The European Green Deal, 2019.

European Commission, *EU Bioeconomy Strategy Progress Report*, European Commission - DG Research & Innovation, Bruxelles, 2022.

European Commission, *Innovating for Sustainable Growth: A Bioeconomy for Europe*, Publications Office of the European Union, LU, 2012.

European Commission, Proposal for a Regulation on Nature Restoration, 22.6.2022, COM(2022) 304.

European Court of Auditors, *Special Report 16/2021: Common Agricultural Policy and Climate: Half of EU Climate Spending but Farm Emissions Are Not Decreasing*, European Court of Auditors, Bruxelles, June 21, 2021.

European Environment Agency, *Imagining Sustainable Futures for Europe*, European Environment Agency, October 2022. https://www.eea.europa.eu/publications/scenarios-for-a-sustainable-europe-2050

Eversberg, D., and M. Fritz, 'Bioeconomy as a Societal Transformation: Mentalities, Conflicts and Social Practices', *Sustainable Production and Consumption*, Vol. 30, 2022, pp. 973–987.

Eversberg, D., and J. Holz, *Empty Promises of Growth: The Bioeconomy and Its Multiple Reality Checks*, *BMBF Junior Research Group*, University of Jena, Jena, Germany, November 2020. https://www.flumen.uni-jena.de/wp-content/uploads/2021/06/Working-Paper-Nr.-2_Eversberg-Holz_Empty-Promises-of-Growth-The-Bioeconomy-and-Its-Multiple-Reality-Checks-1.pdf

Eversberg, D., J. Holz, and L. Pungas, 'The Bioeconomy and Its Untenable Growth Promises: Reality Checks from Research', *Sustainability Science*, November 1, 2022.

Fanning, A.L., D.W. O'Neill, J. Hickel, and N. Roux, 'The Social Shortfall and Ecological Overshoot of Nations', *Nature Sustainability*, Vol. 5, No. 1, January 2022, pp. 26–36.

Feola, G., 'Societal Transformation in Response to Global Environmental Change: A Review of Emerging Concepts', *Ambio*, Vol. 44, No. 5, September 2015, pp. 376–390.

Feola, G., O. Vincent, and D. Moore, '(Un)Making in Sustainability Transformation beyond Capitalism', *Global Environmental Change*, Vol. 69, July 1, 2021, p. 102290.

Folke, C., R. Biggs, A.V. Norström, B. Reyers, and J. Rockström, 'Social-Ecological Resilience and Biosphere-Based Sustainability Science', *Ecology and Society,* Vol. 21, No. 3, 2016.

Foster, J., 'Hope after Sustainability – Tragedy and Transformation', *Global Discourse*, Vol. 7, No. 1, January 2017, pp. 1–9.

Fowler, J.H., and N.A. Christakis, *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives -- How Your Friends' Friends' Friends Affect Everything You Feel, Think, and Do*, Reprint edition., Little, Brown Spark, New York, 2011.

Fraser, N., *Cannibal Capitalism: How Our System Is Devouring Democracy, Care, and the Planet and What We Can Do About It*, Verso, London ; New York, 2022.

Frisvold, G.B., S.M. Moss, A. Hodgson, and M.E. Maxon, 'Understanding the U.S. Bioeconomy: A New Definition and Landscape', *Sustainability*, Vol. 13, No. 4, February 3, 2021, p. 1627.

Fuchs, R., C. Brown, and M. Rounsevell, 'Europe's Green Deal Offshores Environmental Damage to Other Nations', *Nature*, Vol. 586, No. 7831, October 2020, pp. 671–673.

Gebara, M.F., 'Thinking beyond Human-Nature Dichotomy: On the Cosmopolitics of the Amazon.', *Frontiers of Development in the Amazon: Riches, Risks and Resistance*, Lexington Books, 2020, p. 233.

Geels, F.W., 'Socio-Technical Transitions to Sustainability: A Review of Criticisms and Elaborations of the Multi-Level Perspective', *Current Opinion in Environmental Sustainability*, Vol. 39, *Open Issue 2019*, August 1, 2019, pp. 187–201.

Giampietro, M. (2019a), 'On the Circular Bioeconomy and Decoupling: Implications for Sustainable Growth', *Ecological Economics*, Vol. 162, pp. 143–156.

Giampietro, M. (2019b), 'The Quality of Scientific Advice for Policy: Insights from Complexity', p. 25. https://magic-nexus.eu/documents/quality-scientific-advice-policy-insights-complexity

Giampietro, M., 'Reflections on the Popularity of the Circular Bioeconomy Concept: The Ontological Crisis of Sustainability Science', *Sustainability Science*, January 10, 2023.

Giampietro, M., and S.G.F. Bukkens, 'Knowledge Claims in European Union Energy Policies: Unknown Knowns and Uncomfortable Awareness', *Energy Research & Social Science*, Vol. 91, September 2022, p. 102739.

Giuntoli, J., N. Robert, T. Ronzon, J. Sanchez Lopez, M. Follador, I. Girardi, J. Barredo Cano, et al., *Building a Monitoring System for the EU Bioeconomy. Progress Report 2019*, European Commission's Joint Research Centre, EUR 30064 EN, Publications Office of the European Union, Luxembourg, 2020. https://op.europa.eu/s/xSnN

Goleman, R., and D. Davidson, *The Science of Meditation: How to Change Your Brain, Mind and Body*, Penguin Life, London, 2018.

Gram-Hanssen, I., N. Schafenacker, and J. Bentz, 'Decolonizing Transformations through 'Right Relations'', *Sustainability Science*, Vol. 17, No. 2, March 1, 2022, pp. 673–685.

Green, F., and N. Healy, 'How Inequality Fuels Climate Change: The Climate Case for a Green New Deal', *One Earth*, Vol. 5, No. 6, June 2022, pp. 635–649.

Greenpeace, *Feeding the Problem: The Dangerous Intensification of Animal Farming in Europe*, Greenpeace, Bruxelles, February 2019. https://www.greenpeace.org/eu-unit/issues/nature-food/1803/feeding-problem-dangerous-intensification-animal-farming/

Hamilton, R.T.V., and S. Ramcilovic-Suominen, 'From Hegemony-reinforcing to Hegemony-transcending Transformations: Horizons of Possibility and Strategies of Escape', *Sustainability Science*, 2023. Doi: 10.1007/s11625-022-01257-1.

Hanssen, S.V., Z.J.N. Steinmann, V. Daioglou, M. Čengić, D.P. Van Vuuren, and M.A.J. Huijbregts, 'Global Implications of Crop-Based Bioenergy with Carbon Capture and Storage for Terrestrial Vertebrate Biodiversity', *GCB Bioenergy*, Vol. 14, No. 3, 2022, pp. 307–321.

Hausknost, D., E. Schriefl, C. Lauk, and G. Kalt, 'A Transition to Which Bioeconomy? An Exploration of Diverging Techno-Political Choices', *Sustainability*, Vol. 9, No. 4, April 23, 2017, p. 669.

Hickel, J., 'Quantifying National Responsibility for Climate Breakdown: An Equality-Based Attribution Approach for Carbon Dioxide Emissions in Excess of the Planetary Boundary', *The Lancet Planetary Health*, Vol. 4, No. 9, September 1, 2020, pp. e399–e404.

Hickel, J., 'The Contradiction of the Sustainable Development Goals: Growth versus Ecology on a Finite Planet', *Sustainable Development*, Vol. 27, No. 5, 2019, pp. 873–884.

Hickel, J., *The Divide: A Brief Guide to Global Inequality and Its Solutions*, William Heinemann, London, 2017.

Hickel, J., P. Brockway, G. Kallis, L. Keyßer, M. Lenzen, A. Slameršak, J. Steinberger, and D. Ürge-Vorsatz, 'Urgent Need for Post-Growth Climate Mitigation Scenarios', *Nature Energy*, Vol. 6, No. 8, August 2021, pp. 766–768.

Hickel, J., C. Dorninger, H. Wieland, and I. Suwandi, 'Imperialist Appropriation in the World Economy: Drain from the Global South through Unequal Exchange, 1990–2015', *Global Environmental Change*, Vol. 73, March 2022, p. 102467.

Hickel, J., and G. Kallis, 'Is Green Growth Possible?', *New Political Economy*, Vol. 25, No. 4, June 6, 2020, pp. 469–486.

Hickel, J., D.W. O'Neill, A.L. Fanning, and H. Zoomkawala, 'National Responsibility for Ecological Breakdown: A Fair-Shares Assessment of Resource Use, 1970–2017', *The Lancet Planetary Health*, Vol. 6, No. 4, April 1, 2022, pp. e342–e349.

Hickel, J., D. Sullivan, and H. Zoomkawala, 'Plunder in the Post-Colonial Era: Quantifying Drain from the Global South Through Unequal Exchange, 1960–2018', *New Political Economy*, Vol. 26, No. 6, November 2, 2021, pp. 1030–1047.

Holmgren, S., A. Giurca, J. Johansson, C.S. Kanarp, T. Stenius, and K. Fischer, 'Whose Transformation Is This? Unpacking the 'Apparatus of Capture' in Sweden's Bioeconomy', *Environmental Innovation and Societal Transitions*, Vol. 42, March 1, 2022, pp. 44–57.

Hölscher, K., J.M. Wittmayer, and D. Loorbach, 'Transition versus Transformation: What's the Difference?', *Environmental Innovation and Societal Transitions*, Vol. 27, June 2018, pp. 1–3.

IPBES, *Summary for Policymakers of the Methodological Assessment of the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.*, IPBES, July 2022.

Kallis, G., V. Kostakis, S. Lange, B. Muraca, S. Paulson, and M. Schmelzer, 'Research On Degrowth', *Annual Review of Environment and Resources*, Vol. 43, No. 1, October 17, 2018, pp. 291–316.

Kallis, G., S. Paulson, G. D'Alisa, and F. Demaria, *The Case for Degrowth*, Polity Press, Cambridge, 2020.

Kenny, T., 'Land for the Many and a New Politics of Land', *Planning Theory and Practice*, Vol. 20, No. 5, 2019, pp. 763–768.

Keyßer, L.T., and M. Lenzen, '1.5 °C Degrowth Scenarios Suggest the Need for New Mitigation Pathways', *Nature Communications*, Vol. 12, No. 1, December 2021, p. 2676.

Kimmerer, R.W., *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*, Milkweed Editions, Minneapolis, 2020.

Korhonen, J., A. Giurca, M. Brockhaus, and A. Toppinen, 'Actors and Politics in Finland's Forest-Based Bioeconomy Network', *Sustainability*, Vol. 10, No. 10, October 2018, p. 3785.

Kröger, M., 'The Political Economy of 'Flex Trees': A Preliminary Analysis', *The Journal of Peasant Studies*, Vol. 43, No. 4, July 3, 2016, pp. 886–909.

Kumeh, E.M., B. Kyereh, A. Birkenberg, and R. Birner, 'Customary Power, Farmer Strategies and the Dynamics of Access to Protected Forestlands for Farming: Implications for Ghana's Forest Bioeconomy', *Forest Policy and Economics*, Vol. 133, December 1, 2021, p. 102597.

Kurki, S., and J. Ahola-Launonen, 'Bioeconomy in Maturation: A Pathway Towards a "Good" Bioeconomy or Distorting Silence on Crucial Matters?', in E. Koukios and A. Sacio-Szymańska (eds.), *Bio#Futures: Foreseeing and Exploring the Bioeconomy*, Springer International Publishing, Cham, 2021, pp. 165–199.

Lakoff, G., 'Why It Matters How We Frame the Environment', *Environmental Communication*, Vol. 4, No. 1, March 1, 2010, pp. 70–81.

Lakoff, G., and M. Johnson, *Metaphors We Live by*, University of Chicago Press, Chicago, USA, 1980.

Leach, M., B. Reyers, X. Bai, E.S. Brondizio, C. Cook, S. Díaz, G. Espindola, M. Scobie, M. Stafford-Smith, and S.M. Subramanian, 'Equity and Sustainability in the Anthropocene: A Social–Ecological Systems Perspective on Their Intertwined Futures', *Global Sustainability*, Vol. 1, 2018, p. e13.

Legrand, T., A. Jervoise, C. Wamsler, C. Dufour, J. Bristow, J. Bockler, K. Cooper, et al., *Cultivating Inner Capacities for Regenerative Food Systems. Rationale for Action*, United Nations Development Programme, June 2022. https://www.undp.org/publications/cultivating-inner-capacities-regenerative-food-systems

Linder, T., 'Making the Case for Edible Microorganisms as an Integral Part of a More Sustainable and Resilient Food Production System', *Food Security*, Vol. 11, No. 2, April 1, 2019, pp. 265–278.

Loades, M.E., E. Chatburn, N. Higson-Sweeney, S. Reynolds, R. Shafran, A. Brigden, C. Linney, M.N. McManus, C. Borwick, and E. Crawley, 'Rapid Systematic Review: The Impact of Social Isolation and Loneliness on the Mental Health of Children and Adolescents in the Context of COVID-19', *Journal of the American Academy of Child and Adolescent Psychiatry*, Vol. 59, No. 11, November 2020, pp. 1218-1239.e3.

Mackay, C.M.L., and M.T. Schmitt, 'Do People Who Feel Connected to Nature Do More to Protect It? A Meta-Analysis', *Journal of Environmental Psychology*, Vol. 65, October 1, 2019, p. 101323.

Mair, D., L. Smillie, G. La Placa, F. Schwendinger, M. Raykovska, Z. Pasztor, and R. van Bavel, *Understanding Our Political Nature: How to Put Knowledge and Reason at the Heart of Political Decision-Making*, 2019. https://op.europa.eu/s/xSnX

Masood, E., 'The Battle for the Soul of Biodiversity', *Nature*, Vol. 560, No. 7719, August 22, 2018, pp. 423–425.

Mastini, R., G. Kallis, and J. Hickel, 'A Green New Deal without Growth?', *Ecological Economics*, Vol. 179, January 1, 2021, p. 106832.

McGregor, D., S. Whitaker, and M. Sritharan, 'Indigenous Environmental Justice and Sustainability', *Current Opinion in Environmental Sustainability*, Vol. 43, *Indigenous Conceptualizations of 'Sustainability'*, April 1, 2020, pp. 35–40.

Meadows, D., 'Leverage Points: Places to Intervene in a System - The Donella Meadows Project', *Academy for Systems Change*, 1999, pp. 1–20. https://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

Meadows, D.H., D.L. Meadows, J. Randers, and W.H. Behrens III, *The Limits to Growth*, The Club of Rome, New York (US), 1972.

Mehta, L., S. Srivastava, S. Movik, H.N. Adam, R. D'Souza, D. Parthasarathy, L.O. Naess, and N. Ohte, 'Transformation as Praxis: Responding to Climate Change Uncertainties in Marginal Environments in South Asia', *Current Opinion in Environmental Sustainability*, Vol. 49, 2021, pp. 110–117.

Millward-Hopkins, J., 'Inequality Can Double the Energy Required to Secure Universal Decent Living', *Nature Communications*, Vol. 13, No. 1, August 26, 2022, p. 5028.

Monbiot, G., 'Leave Well Alone', *The Guardian*, June 22, 2016. https://www.monbiot.com/2016/06/21/leave-well-alone/

Monbiot, G. (2022a), *Regenesis. Feeding the World Withour Devouring the Planet.*, 1st ed., Penguin Random House, UK, 2022.

Monbiot, G. (2022b), 'The Most Damaging Farm Products? Organic, Pasture-Fed Beef and Lamb', *The Guardian*, August 16, 2022. https://www.theguardian.com/environment/2022/aug/16/most-damaging-farm-products-organic-pasture-fed-beef-lamb

Monbiot, G., 'The Hills Are Dead', January 4, 2017. https://www.monbiot.com/2017/01/04/the-hills-are-dead/

Moore, K.D., and M.P. Nelson, 'Did Western Philosophy Ruin Earth? A Philosopher's Letter of Apology to the World', *Salon*, November 27, 2022. https://www.salon.com/2022/11/27/did-western-philosophy-ruin-earth-a-philosophers-letter-of-apology-to-the-world/

Mubareka, S., J. Giuntoli, J. Sanchez-Lopez, J. Lasarte-Lopez, R. M'Barek, T. Ronzon, A. Renner and M. Avraamides, *Bioeconomy Progress Report*, European Commission's Joint Research Centre, EUR 31434 EN, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/835046.

Mubareka, S., J.I. Barredo, J. Giuntoli, G. Grassi, M. Migliavacca, N. Robert, and M. Vizzarri, 'The Role of Scientists in EU Forest-Related Policy in the Green Deal Era', *One Earth*, Vol. 5, No. 1, 2022, pp. 10–13.

Mujica-Parodi, L.R., H.H. Strey, B. Frederick, R. Savoy, D. Cox, Y. Botanov, D. Tolkunov, D. Rubin, and J. Weber, 'Chemosensory Cues to Conspecific Emotional Stress Activate Amygdala in Humans', *PLOS ONE*, Vol. 4, No. 7, July 29, 2009, p. e6415.

Mushtaq, R., S. Shoib, T. Shah, and S. Mushtaq, 'Relationship Between Loneliness, Psychiatric Disorders and Physical Health ? A Review on the Psychological Aspects of Loneliness', *Journal of Clinical and Diagnostic Research : JCDR*, Vol. 8, No. 9, September 2014, pp. WE01–WE04.

OECD, *Towards Green Growth*, Organisation for Economic Co-operation and Development, Paris, 2011. https://www.oecd-ilibrary.org/environment/towards-green-growth_9789264111318-en

Oliveira, G. de L.T., and M. Schneider, 'The Politics of Flexing Soybeans: China, Brazil and Global Agroindustrial Restructuring', *The Journal of Peasant Studies*, Vol. 43, No. 1, January 2, 2016, pp. 167–194.

Oliver, T.H., *The Self Delusion: The Surprising Science of Our Connection to Each Other and the Natural World*, Hatchette, UK, 2020.

Oliver, T.H., L. Benini, A. Borja, C. Dupont, B. Doherty, A. Iglesias, A. Jordan, G. Kass, and T. Lung, 'Knowledge Architecture for the Wise Governance of Sustainability Transitions', *Environmental Science and Policy*, Vol. 126, 2021, pp. 152–163.

Oliver, T.H., E. Boyd, K. Balcombe, T.G. Benton, J.M. Bullock, D. Donovan, G. Feola, et al., 'Overcoming Undesirable Resilience in the Global Food System', *Global Sustainability*, Vol. 1, ed 2018, p. e9.

Oliver, T.H., B. Doherty, A. Dornelles, N. Gilbert, M.P. Greenwell, L.J. Harrison, I.M. Jones, et al., 'A Safe and Just Operating Space for Human Identity: A Systems Perspective', *The Lancet Planetary Health*, Vol. 6, No. 11, November 1, 2022, pp. e919–e927.

O'Neill, D.W., A.L. Fanning, W.F. Lamb, and J.K. Steinberger, 'A Good Life for All within Planetary Boundaries', *Nature Sustainability*, Vol. 1, No. 2, February 2018, pp. 88–95.

Otero, I., K.N. Farrell, S. Pueyo, G. Kallis, L. Kehoe, H. Haberl, C. Plutzar, et al., 'Biodiversity Policy beyond Economic Growth', *Conservation Letters*, Vol. 13, No. 4, 2020, pp. 1–18.

Oxfam, 'Extreme carbon inequality. Why the Paris Climate Deal Must Put the Poorest, Lowest Emitting and Most Vulnerable People First.', Oxfam International, December 2, 2015. https://policy-practice.oxfam.org/resources/extreme-carbon-inequality-why-the-paris-climate-deal-must-put-the-poorest-lowes-582545/

Patel, R., and J.W. Moore, *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet*, Verso, 2018.

Pelenc, J., G. Wallenborn, J. Milanesi, L. Sébastien, J. Vastenaekels, F. Lajarthe, J. Ballet, et al., 'Alternative and Resistance Movements: The Two Faces of Sustainability Transformations?', *Ecological Economics*, Vol. 159, May 1, 2019, pp. 373–378.

Peltomaa, J., 'Drumming the Barrels of Hope? Bioeconomy Narratives in the Media', *Sustainability*, Vol. 10, No. 11, 2018.

Persson, L., B.M. Carney Almroth, C.D. Collins, S. Cornell, C.A. de Wit, M.L. Diamond, P. Fantke, et al., 'Outside the Safe Operating Space of the Planetary Boundary for Novel Entities', *Environmental Science & Technology*, Vol. 56, No. 3, February 1, 2022, pp. 1510–1521.

Polimeni, J.M., K. Mayumi, M. Giampietro, and B. Alcott, *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, Taylor & Francis, New York (US), 2012.

Purvis, B., Y. Mao, and D. Robinson, 'Three Pillars of Sustainability: In Search of Conceptual Origins', *Sustainability Science*, Vol. 14, No. 3, May 2019, pp. 681–695.

Ramankutty, N., A.T. Evan, C. Monfreda, and J.A. Foley, 'Farming the Planet: 1. Geographic Distribution of Global Agricultural Lands in the Year 2000', *Global Biogeochemical Cycles*, Vol. 22, No. 1, 2008.

Ramcilovic-Suominen, S., S. Chomba, and AM. Larson, 'Decolonial Environmental Justice in Landscape Restoration.', in P. Katila, J. Carol, P. Colfer, W. de Jong, G. Galloway, P. Pacheco, and G. Winkel (eds.), *Restoring Forests and Trees for Sustainable Development - Policies, Practices, Impacts and Ways Forward.*, Oxford University Press, 2023.

Ramcilovic-Suominen, S., 'Envisioning Just Transformations in and beyond the EU Bioeconomy: Inspirations from Decolonial Environmental Justice and Degrowth', *Sustainability Science*, 2022. https://doi.org/10.1007/s11625-022-01091-5 .

Ramcilovic-Suominen, S., S. Carodenuto, C. McDermott, and J. Hiedanpää, 'Environmental Justice and REDD+ Safeguards in Laos: Lessons from an Authoritarian Political Regime', *Ambio*, Vol. 50, No. 12, December 1, 2021, pp. 2256–2271.

Ramcilovic-Suominen, S., M. Kröger, and W. Dressler, 'From Pro-Growth and Planetary Limits to Degrowth and Decoloniality: An Emerging Bioeconomy Policy and Research Agenda', *Forest Policy and Economics*, Vol. 144, November 2022, p. 102819.

Ramcilovic-Suominen, S., and H. Pülzl, 'Sustainable Development - A 'Selling Point' of the Emerging EU Bioeconomy Policy Framework?', *Journal of Cleaner Production*, Vol. 172, 2018, pp. 4170–4180.

Raworth, K., *Doughnut Economics. Seven Ways to Think like a 21st-Century Economist*, Penguin Random House, 2017.

Rayner, S., 'Uncomfortable Knowledge: The Social Construction of Ignorance in Science and Environmental Policy Discourses', *Economy and Society*, Vol. 41, No. 1, 2012, pp. 107–125.

Regulation (EU) No 1306/2013 of the European Parliament and of the Council of 17 December 2013 on the Financing, Management and Monitoring of the Common Agricultural Policy and Repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008, *OJ L*, 17.12.2013.

Renner, A., and M. Giampietro, 'Socio-Technical Discourses of European Electricity Decarbonization: Contesting Narrative Credibility and Legitimacy with Quantitative Story-Telling', *Energy Research & Social Science*, Vol. 59, January 2020, p. 101279.

Richardson, M., H.-A. Passmore, L. Barbett, R. Lumber, R. Thomas, and A. Hunt, 'The Green Care Code: How Nature Connectedness and Simple Activities Help Explain pro-Nature Conservation Behaviours', *People and Nature*, Vol. 2, No. 3, 2020, pp. 821–839.

Riemann, L., A. Giurca, and D. Kleinschmit, 'Contesting the Framing of Bioeconomy Policy in Germany: The NGO Perspective', *Journal of Environmental Policy & Planning*, No. May, 2022, pp. 1–17.

Ritchie, H., and M. Roser, 'Land Use', *Our World in Data*, September 2019. https://ourworldindata.org/land-use

Robert, N., J. Giuntoli, R. Araujo, M. Avraamides, E. Balzi, J.I. Barredo, B. Baruth, et al., 'Development of a Bioeconomy Monitoring Framework for the European Union: An Integrative and Collaborative Approach', *New Biotechnology*, Vol. 59, No. June, 2020, pp. 10–19.

Rockström, J., W. Steffen, K. Noone, Å. Persson, F.S. Chapin, E.F. Lambin, T.M. Lenton, et al., 'A Safe Operating Space for Humanity', *Nature*, Vol. 461, No. 7263, September 2009, pp. 472–475.

Rutazibwa, O.U., 'Chapter 15: On babies and bathwater: Decolonizing International Development Studies', in S. de Jong, R. Icaza and O.U. Rutazibwa (eds.), *Decolonization and Feminisms in Global Teaching and Learning*, Routledge, 2018.

Saltzman, L.Y., T.C. Hansel, and P.S. Bordnick, 'Loneliness, Isolation, and Social Support Factors in Post-COVID-19 Mental Health', *Psychological Trauma: Theory, Research, Practice and Policy*, Vol. 12, No. S1, August 2020, pp. S55–S57.

Santos, H.C., M.E.W. Varnum, and I. Grossmann, 'Global Increases in Individualism', *Psychological Science*, Vol. 28, No. 9, September 1, 2017, pp. 1228–1239.

SAPEA, *A Sustainable Food System for the European Union*, Evidence Review Report No. 7, Science Advice for Policy by European Academies, Berlin, 2020. https://doi.org/10.26356/sustainablefood

Scharfbillig, M., L. Smillie, D. Mair, M. Sienkiewicz, J. Keimer, R. Pinho Dos Santos, H. Vinagreiro Alves, E. Vecchione, and L. Scheunemann, *Values and Identities - a Policymaker's Guide*, European Commission, Luxembourg, 2021. https://publications.jrc.ec.europa.eu/repository/handle/JRC126150

Schlosberg, D., *Defining Environmental Justice: Theories, Movements, and Nature*, 1st edition., Oxford University Press, Oxford, 2009.

Schlosberg, D., 'Reconceiving Environmental Justice: Global Movements And Political Theories', *Environmental Politics*, Vol. 13, No. 3, September 1, 2004, pp. 517–540.

Schoop, J.F., 'Conditions for an Ethically Responsible and Sustainable Bioeconomy Based on Hans Jonas' Ethics of Responsibility', in D. Lanzerath, U. Schurr, C. Pinsdorf, and M. Stake (eds.), *Bioeconomy and Sustainability*, Springer International Publishing, Cham, 2022, pp. 281–305.

Scordato, L., M. Bugge, and A. Fevolden, 'Directionality across Diversity: Governing Contending Policy Rationales in the Transition towards the Bioeconomy', *Sustainability*, Vol. 9, No. 2, February 3, 2017, p. 206.

Singh, P.B., A. Young, S. Lind, M.C. Leegaard, A. Capuozzo, and V. Parma, 'Smelling Anxiety Chemosignals Impairs Clinical Performance of Dental Students', *Chemical Senses*, Vol. 43, No. 6, July 5, 2018, pp. 411–417.

Sovacool, B.K., B. Turnheim, A. Hook, A. Brock, and M. Martiskainen, 'Dispossessed by Decarbonisation: Reducing Vulnerability, Injustice, and Inequality in the Lived Experience of Low-Carbon Pathways', *World Development*, Vol. 137, January 1, 2021, p. 105116.

Steffen, W., K. Richardson, J. Rockstrom, S.E. Cornell, I. Fetzer, E.M. Bennett, R. Biggs, et al., 'Planetary Boundaries: Guiding Human Development on a Changing Planet', *Science*, Vol. 347, No. 6223, February 2015, pp. 1259855–1259855.

Steinberger, J.K., F. Krausmann, M. Getzner, H. Schandl, and J. West, 'Development and Dematerialization: An International Study', *PLOS ONE*, Vol. 8, No. 10, October 21, 2013, p. e70385.

Stiglitz, J.E., 'Rethinking Macroeconomics: What Failed, and How to Repair It', *Journal of the European Economic Association*, Vol. 9, No. 4, August 1, 2011, pp. 591–645.

Stiglitz, J.E., A. Sen, and J.-P. Fitoussi, *Report by the Commission on the Measurement of Economic Performance and Social Progress*, 2009.

Stoddard, I., K. Anderson, S. Capstick, W. Carton, J. Depledge, K. Facer, C. Gough, et al., 'Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?', *Annual Review of Environment and Resources*, Vol. 46, No. 1, 2021, pp. 653–689.

Teffer, P., 'EU Spends €71m Promoting Meat, despite Climate Goals', *EUobserver*, March 12, 2019. https://euobserver.com/green-economy/144364

Temper, L., 'Blocking Pipelines, Unsettling Environmental Justice: From Rights of Nature to Responsibility to Territory', *Local Environment*, Vol. 24, No. 2, February 1, 2019, pp. 94–112.

The Green New Deal for Europe, *Blueprint For Europe's Just Transition.*, The Green New Deal for Europe, December 2019. https://report.gndforeurope.com/cms/wp-content/uploads/2020/01/Blueprint-for-Europes-Just-Transition-2nd-Ed.pdf

Twenge, J.M., and J.D. Foster, 'Birth Cohort Increases in Narcissistic Personality Traits Among American College Students, 1982–2009', *Social Psychological and Personality Science*, Vol. 1, No. 1, January 1, 2010, pp. 99–106.

Twenge, J.M., and J.D. Foster, 'Mapping the Scale of the Narcissism Epidemic: Increases in Narcissism 2002–2007 within Ethnic Groups', *Journal of Research in Personality*, Vol. 42, No. 6, December 1, 2008, pp. 1619–1622.

Udall, A.M., J.I.M. de Groot, S.B. De Jong, and A. Shankar, 'How I See Me—A Meta-Analysis Investigating the Association Between Identities and Pro-Environmental Behaviour', *Frontiers in Psychology*, Vol. 12, 2021.

UK Government, 'Basic Payment Scheme 2022 - Rules for 2022', 2022. https://www.gov.uk/guidance/basic-payment-scheme-2022-rules-for-2022/print-or-download-this-guidance

UNEP, *Making Peace With Nature*, United Nations Environment Programme, February 18, 2021. http://www.unep.org/resources/making-peace-nature

UNFCCC, 'COP27 Reaches Breakthrough Agreement on New "Loss and Damage" Fund for Vulnerable Countries', November 20, 2022. https://unfccc.int/news/cop27-reaches-breakthrough-agreement-on-new-loss-and-damage-fund-for-vulnerable-countries

United Nations, *Harmony with Nature. Report of the Secretary-General*, United Nations, July 15, 2022. https://documents-dds-ny.un.org/doc/UNDOC/GEN/N20/199/25/PDF/N2019925.pdf?OpenElement

Vermeylen, S., 'Special Issue: Environmental Justice and Epistemic Violence', *Local Environment*, Vol. 24, No. 2, February 1, 2019, pp. 89–93.

Vivien, F.D., M. Nieddu, N. Befort, R. Debref, and M. Giampietro, 'The Hijacking of the Bioeconomy', *Ecological Economics*, Vol. 159, No. January, 2019, pp. 189–197.

Vogelpohl, T., 'Understanding the Bioeconomy through Its Instruments: Standardizing Sustainability, Neoliberalizing Bioeconomies?', *Sustainability Science*, January 6, 2023.

Walker, G., *Environmental Justice: Concepts, Evidence and Politics*, 1st ed., Routledge, London, 2011.

Weber, G., and I. Cabras, 'The Ecological Economy of Georgescu-Roegen', in T. Hoerber and A. Anquetil (eds.), *Economic Theory and Globalization*, Springer International Publishing, Cham, 2019, pp. 221–238.

Whitburn, J., W. Linklater, and W. Abrahamse, 'Meta-Analysis of Human Connection to Nature and Proenvironmental Behavior', *Conservation Biology*, Vol. 34, No. 1, 2020, pp. 180–193.

Whyte, K. (2020a), 'Chapter 20: Indigenous Environmental Justice: Anti-Colonial Action through Kinship', In: B. Coolsaet (ed.), *Environmental Justice*, 1st ed., Routledge, 2020, p. 13.

Whyte, K. (2020b), 'Too Late for Indigenous Climate Justice: Ecological and Relational Tipping Points', *WIREs Climate Change*, Vol. 11, No. 1, 2020, p. e603.

Wiedmann, T.O., H. Schandl, M. Lenzen, D. Moran, S. Suh, J. West, and K. Kanemoto, 'The Material Footprint of Nations', *Proceedings of the National Academy of Sciences*, Vol. 112, No. 20, May 19, 2015, pp. 6271–6276.

Winter, C.J., *Subjects of Intergenerational Justice: Indigenous Philosophy, the Environment and Relationships*, *Routledge Environmental Humanities*, Routledge, 2021.

Wolff, F., 'The German Bioeconomy Discourse', In: D. Thrän and U. Moesenfechtel (eds.), *The Bioeconomy System*, Berlin, Heidelberg, 2022.

World Bank, *Inclusive Green Growth: The Pathway to Sustainable Development*, World Bank, Washington, DC, 2012. https://openknowledge.worldbank.org/handle/10986/6058

Zeug, W., A. Bezama, U. Moesenfechtel, A. Jähkel, and D. Thrän, 'Stakeholders' Interests and Perceptions of Bioeconomy Monitoring Using a Sustainable Development Goal Framework', *Sustainability*, Vol. 11, No. 6, 2019.

Zylstra, M.J., A.T. Knight, K.J. Esler, and L.L.L. Le Grange, 'Connectedness as a Core Conservation Concern: An Interdisciplinary Review of Theory and a Call for Practice', *Springer Science Reviews*, Vol. 2, No. 1, December 1, 2014, pp. 119–143.

List of abbreviations and definitions

BECCS	BioEnergy with Carbon Capture and Storage
BMS	Bioeconomy Monitoring System
CAP	Common Agricultural Policy
CoFSA	Conscious Food System Alliance
DMC	Domestic Material Consumption
EGD	European Green Deal
EJ	Environmental Justice
EU	European Union
GDP	Gross Domestic Product
GN	Global North
GS	Global South
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
MS	Member State
NETs	Negative Emission Technologies
PNS	Post-Normal Science
SDG	Sustainable Development Goals
UN	United Nations
UNDP	United Nations Development Programme

List of boxes

List of figures

List of tables

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