



Natural resources and bioeconomy studies 104/2023

The Finnish Bioeconomy Beyond Growth

Rubén Vezzoni and Sabaheta Ramcilovic-Suominen

Natural resources and bioeconomy studies 104/2023

The Finnish Bioeconomy Beyond Growth

Rubén Vezzoni and Sabaheta Ramcilovic-Suominen

Natural Resources Institute Finland 2023

Referencing instructions:

Vezzoni, R. & Ramcilovic-Suominen, S. 2023. The Finnish Bioeconomy Beyond Growth. Natural Resources and Bioeconomy Studies 104/2023. Natural Resources Institute Finland. Helsinki. 43 p.

Disclaimer: The arguments expressed in this report represent the personal view of the two authors, and do not necessarily represent the view of LUKE.

Authorship statement: If not otherwise specified, the two authors share equal credit for the conceptualisation, writing, and editing of the arguments presented in this report. Chapters 2.2, 3 and 4.1 have been mostly curated by Rubén Vezzoni. Chapter 5 has been mostly curated by Sabaheta Ramcilovic-Suominen.



ISBN 978-952-380-816-4 (Printed)

ISBN 978-952-380-817-1 (Online)

ISSN 2342-7647 (Printed)

ISSN 2342-7639 (Online)

URN <http://urn.fi/URN:ISBN:978-952-380-817-1>

Copyright: Natural Resources Institute Finland (Luke)

Authors: Rubén Vezzoni and Sabaheta Ramcilovic-Suominen

Publisher: Natural Resources Institute Finland (Luke), Helsinki 2023

Year of publication: 2023

Cover picture: Pixabay

Abstract

Rubén Vezzoni^{1,2} and Sabaheta Ramčilović-Suominen³

¹ University of Helsinki, Faculty of Social Sciences, Unioninkatu, 33, 00014 Helsinki, Finland

² Natural Resources Institute Finland (Luke), Latokartanonkaari 9, 00790 Helsinki, Finland

³ Natural Resources Institute Finland (Luke), Itäinen Pitkätatu 4A, 20520 Turku, Finland

This report introduces post-growth and degrowth literature and arguments to position the Finnish bioeconomy within the existing alternatives to the increasingly challenged idea of green growth.

The bioeconomy has emerged as a central pillar of Finland's economic policy since the early 2010s. The current Bioeconomy Strategy of the Finnish Government aims to double the bioeconomy by 2035 by shifting the focus from production volumes to value added. Accordingly, the objective is to accelerate the yearly growth of the bioeconomy from 3% up to 6%, without exacerbating environmental degradation. The dominant bioeconomy visions, both in Finland and elsewhere, hinge on the possibility of green economic growth: that is, decoupling ecological destruction from economic growth through technical innovation, circularity, and other forms of process upgrading.

While empirical research shows several cases of relative decoupling, these are often limited to single environmental indicators, short periods of time, and/or territorially defined national economies. On the contrary, absolute decoupling that is global and sufficiently large and fast is empirically unsupported and, therefore, unlikely within the current mindsets, values, praxis and models of development. Drawing on the burgeoning scientific literatures questioning the possibility of green growth, we argue that the Finnish bioeconomy policy targets lack robust empirical evidence, and we call for the relevant actors to revisit the current bioeconomy strategy and reconsider the assumptions of green growth.

In this report, building on postgrowth and degrowth propositions and arguments, we discuss the feasibility, modalities, and desirability of alternative pathways to growth-centred approaches. After having reviewed the main strands of degrowth policy, we introduce them to the Finnish case to lay out the preliminary outline of a transformation from a growth-centred economy to a society free from the imperatives of growth, endless expansion, and accumulation.

To avoid further economic insecurity and deprivation of marginalised groups, a post-growth bioeconomy requires (i) embracing onto-epistemic justice and plurality, together with unlearning oppressive and extractive practices; (ii) rapidly downscaling harmful activities and sectors together with embracing simplicity and slower-paced lifestyles; (iii) re-centring economic provisioning around socio-ecological well-being and economic justice; (iv) democratising economic practices, both nationally and internationally, by pulling the bioeconomy out of the corporate grip.

These suggestions are not to be used as a blueprint, but as guiding principles. Their operationalisation requires fostering public dialogue, democratic deliberation and ground-up institution building to imagine and codesign more realistic, equitable, and collectively desired futures beyond growth and socioecological violence. As a preliminary discussion, introducing the problems of the current bioeconomy based on green growth, and the potential models and paradigms beyond growth, the report lays out the foundation for imagining and codesigning more specific pathways towards socio-ecologically viable and just post-growth bioeconomy and post-growth futures in Finland.

Keywords: Post-growth, bioeconomy, Finland, degrowth, socio-ecological justice, transformations.

Acknowledgments

We are thankful to Principal Research Scientist and Research Manager Katriina Soini for her guidance and support during writing of this report, and to Research Professor and Strategic Research Council Programme Director, Juha Hiedanpää for his valuable comments on the previous draft. We also wish to acknowledge the following participants for their valuable contributions to the "Post-growth Finnish Bioeconomy Roundtable" (23/08/2023, Helsinki), based on which sub-section 5.4 of this report was partially developed (in alphabetical order): Riina Bahtia (University of Helsinki; Rethinking Economics), Mari Granström (OriginbyOcean Oy), Eeva Huttunen (Silva Ry), Joel Lundqvist (Sitra), Susanna Partanen and Mohamed Elamir (Woamy Oy), Sussan Rännäri (Luomuliitto – Finnish Organic Association), Tero Toivanen (Helsinki Collegium for Advanced Studies; BIOS research unit), Ruby van der Wekken (Omamaa cooperative) Verner Välimaa (Wicked Helsinki, co-host of the roundtable).

This report was made possible thanks to the Research Council of Finland funding for the Academy Research Fellowship project: Just Globe: Justice and Politics in Global Bioeconomy (Grant number 332353).

Contents

1. Introduction.....	6
2. Defining the bioeconomy: its content and discontents.....	9
2.1. Contested notions of the Bioeconomy in the current literature.....	9
2.2. Bioeconomy in Finland and the EU.....	10
3. Why moving beyond green economic growth.....	13
3.1. Material foundations: Growth doesn't come out of thin air.....	13
3.2. Energy foundations: The thermodynamics of the circular bioeconomy.....	15
3.3. Scale, Pace and Justice.....	16
3.4. Efficiency paradoxes.....	18
4. Towards Post-growth.....	19
4.1. Post-growth and its origins.....	19
4.2. Degrowth and its origins.....	20
4.3. Degrowth inspired policies.....	23
5. Redirecting Finnish bioeconomy beyond growth: enabling conditions and ways forward.....	25
5.1. Shifting and reinventing values, lexicon and mythologies.....	25
5.2. Ensuring socio-ecological and epistemic justice and plurality.....	27
5.3. Democratizing the economy and ensuring economic justice.....	28
5.4. Post-growth businesses and entrepreneurship.....	30
6. Conclusions.....	33
References.....	34

1. Introduction

The bioeconomy has emerged as a central pillar of Finland’s economic policy since the early 2010s. The latest Bioeconomy Strategy of the Finnish Government (2022, p. 20) defines it as “an economy that relies on renewable, biological natural resources in a resource-wise manner to produce food, energy, products and services”. Similarly, according to the European Commission (2022, p. 1), the bioeconomy encompasses all economic activities “that produce, use, process, distribute or consume biological resources, including ecosystem services”, often related to sectors like forestry, agriculture, and fisheries. In 2022, the Finnish bioeconomy contributed to 13% of the country’s national value added (29 billion euros) and employed about 300,000 workers (11% of total employment). Figure 1 illustrates that the forestry sector takes the lion’s share of the bioeconomy, directly providing providing 36% of the value added and an additional >30% from closely related economic activities, such as construction, energy and recreational services.

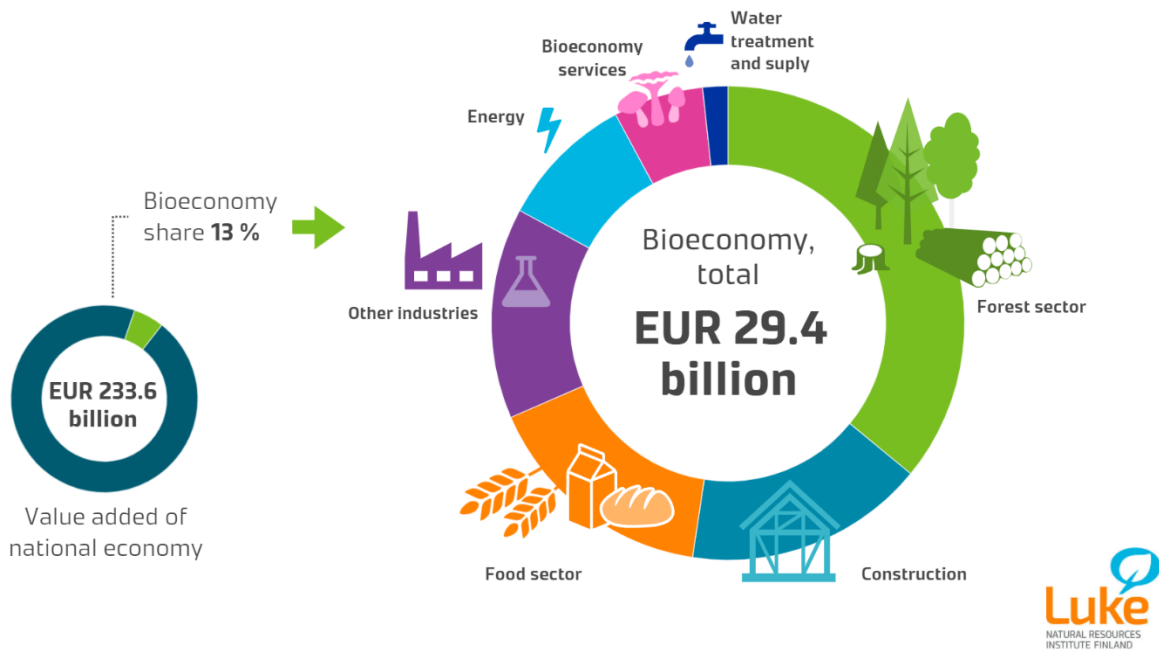


Figure 1. The Finnish bioeconomy in 2022 (preliminary data). Source: LUKE.

According to the latest “Bioeconomy Strategy” published by the Finnish Government in 2022, the main objective is “to accelerate the annual growth of the bioeconomy’s value added from 3% to 4%” per year “for doubling the bioeconomy’s value added by 2035, taking holistic sustainability into consideration” (Finnish Government 2022, p. 7). This is seen as a key step towards achieving carbon neutrality and halting biodiversity loss by 2035 (Finnish Government 2021). Unlike the previous 2014 Bioeconomy Strategy¹, which focused on increasing material production volumes, the new strategy “does not take a stand on the volume of production but aims to create higher value added” (Finnish Government 2022, p. 7). The move from production volumes to value added reveals a strategic shift from quantity to quality, by enhanc-

¹ The inter-ministerial initiative Bioeconomy.fi provides an overview of Finnish Bioeconomy Strategies and related materials at: <https://www.bioeconomy.fi/>

ing productivity based on technological innovation and by fostering market competition in bioeconomy-related sectors (Figure 2). However, the implications of the Finnish Government not taking “a stand on the volume of production” warrant further scrutiny. For instance – how realistic is the ambitious goal of doubling the bioeconomy by 2035? Is it also ecologically viable given the commitment to the (rather unspecified) notion of “holistic sustainability” (Finnish Government 2022, pp. 7,15, Soini & Salo 2022)? Would it stand a research-based “reality check” (cf Eversberg et al. 2023a) of its growth promises?

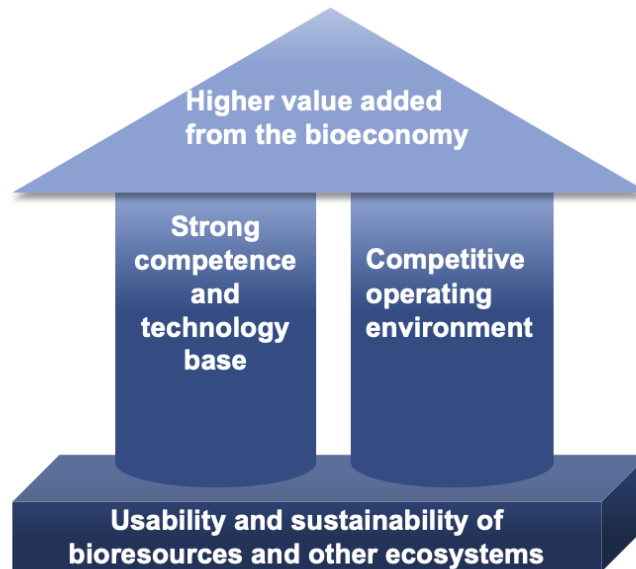


Figure 2. Strategic priorities for the Finnish Bioeconomy. Source: Finnish Government (2022).

As discussed in the following sections, the idea that the bioeconomy can grow 6% annually² without exacerbating environmental degradation, both domestically and globally, lacks robust empirical evidence. In this report, we build on post- and de-growth research to position the Finnish bioeconomy within the existing alternatives to the increasingly challenged idea of green growth (Parrique et al. 2019, Smil 2019, Hickel & Kallis 2020, Haberl et al. 2020, Vadén et al. 2020). We advance an environmental social scientific perspective to re-frame planetary boundaries as collective self-limitation rooted in democratic deliberation over alternative courses of action (Brand et al. 2021). Instead of taking limits to growth as given, this relational (hence, analytically dialectical) understanding of boundaries can guide (i) the identification of entry points for changes in power relations and societal structures and, consequently, (ii) the restructuring of provisioning systems on deeply sustainable socio-ecological foundations, as opposed to profit-driven exponential accumulation.

The evidence and arguments developed in this report point to a widening gap between, on the one hand, the prevalent economic policies and, on the other hand, the gradual transfor-

² The Finnish Government’s objective is to accelerate the yearly increase in bioeconomy value added from 3% to 4% (section 2.3 of the 2022 Strategy). If this target is met, the Strategy claims that “the bioeconomy’s value added will be EUR 50 billion in 2035” (Finnish Government 2022, p. 21). These figures do not add up. Starting with a value of €26 bn in 2019, a growth of 4%/year would bring the bioeconomy’s value added to €42.64 bn in 2035. To double the added value of 2019 by 2035 (Finnish Government 2022, p. 7), the bioeconomy should instead grow at 6% a year (i.e., 5.77% to €50 bn, or 6.25% to €52 bn).

mation of the context in which the bioeconomy should unfold. This speaks of a change in environmental conditions, collective priorities, lifestyles, ideas of “a good life”, business practices, and human relationships to the rest of the natural world (Nightingale et al. 2020, Mehta & Harcourt 2021). Accordingly, we aim to re-orient the current bioeconomy strategy in line with growing demands for more realistic (i.e., evidence-based appreciation of the economy within the biosphere), equitable, and collectively desirable futures beyond the growth paradigm. The bioeconomy policy debate needs updating and extending the horizon of possible economic strategies to the real-world processes at play in the 21st century. This includes the very likelihood that endless economic growth, which sits squarely at the forefront of public policy, could be marginalised, or even dumped, in high-income countries. In its place, the bioeconomy can prioritize socio-ecological well-being and stability, security of livelihoods, local autonomy, or multispecies justice.

Drawing on recent studies debating over competing bioeconomy pathways (among others, Giampietro 2019, Backhouse et al. 2021, Ramcilovic-Suominen et al. 2022, Giuntoli et al. 2023), this report addresses the contradictions of a bioeconomy centred on green growth. Following, it explores possible alternatives in line with calls “to expand the option space” (Giuntoli et al. 2023, p. 14) and to develop “a more sophisticated analysis of the political economy of bioeconomy” (Toivanen 2021, p. 146). In doing so, we give a voice to post-growth concerns and justice perspectives that are often marginalised in mainstream bioeconomy discourses (Ramcilovic-Suominen 2022). Additionally, this report draws on insights gathered during a policy roundtable organised in August 2023 in collaboration with prominent bioeconomy entrepreneurs and scientific experts. Against this background, we explore what are, or should be, the priorities for the Finnish bioeconomy and, more importantly, what an alternative strategy beyond economic growth could look like.

The remainder of the report is structured as follows:

- Section 2 presents the various and contested notions of bioeconomy.
- Section 3 reviews the main flaws in the green growth narrative.
- Section 4 outlines the origins of post-growth, the main tenets of degrowth, and summarises the most common policy proposals.
- Section 5 explores what a transformation towards a post-growth bioeconomy could look like and what needs to be done to get there.
- Section 6 concludes with a summary of the key points and an invitation to mobilise resources and people to bring about post-growth alternatives.

2. Defining the bioeconomy: its content and discontents

2.1. Contested notions of the Bioeconomy in the current literature

Bioeconomy policies have undergone several revisions and broadening of the concept. As a result, there is currently a host of different bioeconomy strategic visions. Bugge et al. (2016), for instance, distinguish three categories of bioeconomy visions: "biotechnology", "bioresource", and "bio-ecology" visions. Similarly, Vivien et al. (2019) draw on institutional economics to identify three bioeconomy ideal-types: "biosphere-based economics", "science-based biotechnology", or "biomass-based economy". A similar tripartite distinction of bioeconomy narratives and visions is portrayed also by other scholars (Befort 2020, Giurca & Befort 2023). Ramcilovic-Suominen et al. (2022), on the other hand, place the "science-based biotechnology" and the "biomass-based economy" vision under the same umbrella type, which they term "pro-economic growth bioeconomy" vision. The authors (Ramcilovic-Suominen et al. 2022, p. 4) further suggest that, while acknowledging the planetary limits and boundaries, the "bio-ecology" and "biosphere-based" visions (Bugge et al. 2016, Vivien et al. 2019) fall short of addressing asymmetries in power relations, the unequal access to benefits and losses, and the politics of domination and hierarchy associated to several forms of social injustice. Therefore, they suggest moving towards building another bioeconomy vision, one that is based on the principles of decoloniality, post-growth, and multiple dimensions of justice (see also Ramcilovic-Suominen 2022, Giuntoli et al. 2023). This can help framing the development of bio-based products and related bioeconomy activities "as part of a broader societal transition to a low-carbon future" (Birch 2016, p. 13).

Despite these attempts to diversify bioeconomy concepts and policies, one set of agendas seems to overshadow the rest. For example, the European Commission's bioeconomy strategy entails a transition to a new socio-technical production regime that incentivises "private investment in biorefinery deployment and market developments of bio-based products (including bio-based chemicals) while ensuring the sustainability of biomass supply and public acceptance" (European Commission 2018, p. 67). A similar policy agenda has been observed, among other countries, also in Finland (Peltomaa 2018, Toivanen 2021), Estonia (Pungas 2023), Germany (Boyer et al. 2023), Canada (Birch 2019), and Brazil (Ollinaho & Kröger, 2021). So far, these mainstream bioeconomy strategic visions do not seem to question the drive for capital accumulation intrinsic in the techno-managerial productivist model of development; that is, the need for green growth. For instance, Hausknot and colleagues (2017) find that most bioeconomy visions in Organisation for Economic Co-operation and Development (OECD) countries are based on the coupled logics of "capitalist growth" and "industrial technology", rather than "sufficiency" and "agroecology". On the contrary, small-scale and democratic ownership of economic processes get side-lined as "the marginal counter-narratives to the dominant elitist visions of the bioeconomy" (Hausknot et al. 2017, p. 7). Accordingly, Giuntoli and co-authors (2023) suggest expanding the option space of bioeconomy policies beyond existing hegemonic narratives. Drawing on Hausknot et al. (2017), they show that the general public, and young generations in particular, may hold different views than the green growth narrative upheld by traditional actors.

This speaks of a fundamental ontological split in the scientific community (Giampietro 2023). On the one hand, growth-centred approaches advocate for a transition in production techniques while maintaining social structures (e.g., institutional arrangements, governance frameworks, property rights, etc.), collective priorities and, above all, economic paradigms essentially unaltered (Hiedanpää et al. 2023). Sufficiency-centred approaches, on the other hand, introduce reflexive concerns about the limits imposed by the biosphere. Giampietro (2019, p. 151) calls this “the entropic or metabolic narrative”, which is “based on the assumption that the stabilization of the flows under human control [...] depends on the stabilization of flows [...] outside human control”. In other words, drawing from non-equilibrium thermodynamics, the entropic narrative allows to distinguish between secondary (and tertiary) flows of resources within the economy or the “technosphere” (e.g., the transformation of energy carriers like electricity or fossil fuels into services and infrastructures like transportation or roads); and primary flows originating and terminating outside of it, in the biosphere (e.g., rainfall entering reservoirs, being collected and used by humans, and eventually being degraded into waste streams). Additionally, alternative bioeconomy visions centred on reflexive sufficiency and post-growth concerns address the implications of socio-environmental issues, such as colonial relationships (Ramcilovic-Suominen 2022, Ramcilovic-Suominen et al. 2022), market-mediated modes of provisioning (Birch 2019, Pungas 2023), different legitimization strategies (Hausknost et al. 2017, Riemann et al. 2022), as well as forms of environmental degradation caused by social dispossession and inequality (Backhouse et al. 2021, Ollinaho & Kröger 2021, 2023). In sum, these alternative approaches try to address societal issues in par with, and not separately from, appeals to the limits of the biosphere.

2.2. Bioeconomy in Finland and the EU

The term “bioeconomy” is increasingly used in policy circles to describe a turn towards more “green”, “sustainable” and, most recently, “circular” usage of biological resources. A key concern and driver of circular bioeconomy programmes is the substitution of fossil fuels for materials of biological origin. The EU Bioeconomy Strategy of 2018, for instance, presents the notion of circularity as a defining feature of the bioeconomy framework in European countries. Advocates argue that the circular bioeconomy maximises the value of materials while minimising waste streams, thus playing a key role in decoupling economic growth from resource use, while ensuring the long-term competitiveness of the economy (European Commission 2018, 2020). The shift from volumes to added value in the latest Finnish Bioeconomy Strategy is a response to this renewed attention to circularity, to the extent that terms like “circular economy” and “bioeconomy” are used almost interchangeably in official communications.

This is interesting and somewhat counterintuitive, since the bioeconomy encompasses economic sectors and activities reliant on biomass and raw material extraction, including industries from the primary sector, such as agriculture and forestry. Significant efforts have been placed onto balancing the tension between extraction and sustainability, mostly through adaptation and mitigation strategies. Hence, the origins and the purpose of the bioeconomy precisely lie in the attempt to reconcile economic growth with environmental sustainability. This strategy is rooted in the notion of ecological modernisation of the economy, aiming to transitions towards environmentally friendly products and sustained green economic growth via market-based technological innovations. Pro-economic growth visions are championed by the European Commission and EU members states alike.

The 2018 EU bioeconomy strategy, for example, “supports the modernisation and strengthening of the EU industrial base through the creation of new value chains and greener, more cost-effective industrial processes” (European Commission 2018, p. 6). Similarly, the 2022 Finnish Bioeconomy strategy emphasises the “Doing More from Less principle of the circular economy”, and that efficiency gains in the production process, “will enable the growth of well-being without increasing the consumption of natural resources” (Finnish Government 2022, p. 16). Over the past decades, the notion of environmental limits and planetary boundaries has gained popularity in the scientific community and in public debate. While these acknowledgments mark a welcomed development, national bioeconomy strategies remain committed to the possibility of green growth, with the risk of relegating other concerns to the margins. As such, loosely defined sustainability concerns seem to be taken en passant, in the Finnish case, as conditional on realising the 100% growth in 13 years of bio-economic output. Moreover, these acknowledgments are often devoid of questions of politics, social purpose (i.e., what is, or should be, the purpose of bioeconomy goods and services?), and unequal share and responsibilities for planetary environmental destruction.

While prevalent bioeconomy visions rely on hard scientific evidence and managerial expertise, they tend to overlook their ideological premises and, with it, their latent corporate bias. In the broader green transition debate, a-critical approaches can leave too much leeway to incumbent actors to shape economic policy according to their agendas (Geels 2014, Newell 2021). In Finland, traditionally dominant actors, mainly from the forestry sector, have harnessed the bioeconomy to regain their central position in national economic policy (Toivanen 2021). This trend has been favoured by ambiguous official communications and policy documents. As a case in point, the 2022 update to the EU strategy makes tautological references to conflict-blind grand narratives, such as:

Bioeconomy policies help to build a **bioeconomy** based on all sustainability dimensions. They enable all people to **enjoy a ‘bio-based’ lifestyle**, providing them with **bio-based material** (food, fibre, **bio-based materials**, energy) and non-material [...] products and services, thus contributing to the objectives of the New European Bauhaus and its **values of sustainability**, inclusion and **quality of experience**. (European Commission, 2022, p. 4, *emphases added*)

The flexibility of the terms in official policy documents is troublesome. It allows traditional industrial operations to be upgraded not only through substantial shifts in production processes, but also via semantic exercises. Thus, while the transformation of traditional extractive practices (e.g., clearcut logging, monocultural crops, intensive animal farming) is left to market drivers and technological innovation, “in the blink of an eye, pulp factories become ‘bio-refineries’” (Toivanen 2021, p. 132). Such cosmetic operations, also observed in other countries like Germany, obscure “the biophysical materiality of nature to the extent that it erases from view particular qualities” in favour of generalizable units, e.g., energy or carbon accounting (Boyer et al. 2023, p. 682). The emergent complexity of biophysical processes is thus reduced to simple accounting metrics. This reproduces a dangerous “tunnel vision” cherry-picking of individual environmental problems, hence neglecting the systemic character of environmental sustainability (Næss 2021, Soini & Salo 2022). First, this “double reductionism” creates allegedly objective causes of concern (Swyngedouw 2018) while, second, it prevents environmental policy “from entering into dialogue with the multiplicity of parallel, intersecting socio-environmental conflicts” (Vezzoni 2023a, p. 2). By keeping demands for systemic

change out of reach, the lure of reductionist metrics lies in providing simple solutions to complex problems. For example, Birch (2019) finds that not only vested interests, but also political appeal and marketability can be drivers of bioeconomy strategies. Industrialists and policymakers alike prioritize those visions that are economically profitable and “politically feasible, because [they involve] like-for-like substitutions (e.g., ethanol for petroleum) rather than the wholesale transformation of societies” (Birch 2019, p. 90, parentheses added). As Eversberg and colleagues (2023b) argue, rather than attempting at fundamental change and transformations, the current bioeconomy strategies uphold the image of sustainability primarily for circumventing or delaying discussions over alternative socio-ecological pathways. In view of the ongoing failure to halt GHG emissions and social-environmental harm, these alternative visions deserve further attention.

The next section explores the option of an alternative pathway for the Finnish bioeconomy based on the notion of “post-growth”: emancipating society from the imperative of material growth as the most effective way, and perhaps the only one, to support the well-being of both humans and the planet that we inhabit.

3. Why moving beyond green economic growth

As shown in the previous chapter, the dominant bioeconomy narratives rely on the possibility of perpetual green economic growth. Green growth hinges both on market-based mechanisms to allocate resources optimally, and on regulatory frameworks to enable growth and innovation in targeted sectors through, for example, a revival of industrial policy (Rodrik 2014). The main objective of mainstream bioeconomy strategies is to transition production towards more “environmentally friendly” commodities than those derived from fossil fuels. Eventually, this substitution process is meant to leave growth trends unaltered, or possibly to even revive growth expectations in the face of peak oil and other environmental limits. To summarise, green growth narratives assume that through technological and scientific innovations the economy can be made “green” by decoupling it from resource use, emissions, pollution, and environmental degradation more broadly.

First of all, it is necessary to distinguish between relative and absolute decoupling. Relative decoupling occurs when GDP (as proxy of economic activity) grows faster than environmental impact, while absolute decoupling requires a decrease in resource use and other environmental indicators alongside GDP growth. Plentiful of empirical cases show periods of relative decoupling, but absolute decoupling remains limited to single environmental indicators and the territorially confined performance of national economies. Several scholars have already engaged with extensive literature reviews showing no evidence in support of adequate absolute decoupling (among others, Haberl et al. 2020, Parrique et al. 2019, Vadén et al. 2020, Wiedenhofer et al. 2020). This points to four unresolved issues in the green growth narrative: (i) the material foundations of the global economy, (ii) the neglect of thermodynamics, (iii) the time and scale of change, and (iv) the paradoxes of efficiency improvements. Each of these issues demands individual consideration.

3.1. Material foundations: Growth doesn't come out of thin air

All economic activities (i.e., the combination of inputs like labour, manufacturing techniques, and capital resources to produce goods and services) require energy and materials. Throughout history, there is a tight and positive correlation between GDP and material use, energy demand, as well as greenhouse gas emissions³. For example, from 1961 to 2021, global CO₂ emissions increased by an average of 2.3% annually, while global GDP grew slightly more, by almost 3.5% year on year⁴. This leads to a GDP to CO₂ emissions ratio of 0.67, indicating a relative decoupling scenario. On the other hand, global material extraction has historically grown at the same pace as GDP (Kallis et al. 2018). This suggests a strong coupling of the two, although the consumption of specific materials, such as biomass, metals, or fossil fuels, varies within regions according to patterns of economic development (Steinberger et al. 2010, 2013). The coupling coefficient is thus affected by various factors, including the struc-

³ This goes from relative decoupling – i.e., exhibiting a coupling coefficient between 0 and 1 (if GDP grows 1%, environmental impact also grows but less than 1%) – to cases of strong coupling – i.e., coupling coefficient >1 (Wiedmann et al. 2015, Krausmann et al. 2017, Haberl et al. 2020).

⁴ CO₂ emissions data from Global Carbon Project (Friedlingstein et al. 2022). GDP growth data from World Bank (data.worldbank.org, “World Development Indicators”, accessed 25/04/23).

tural composition of the economy, but one salient fact remains: more economic activities ask for additional commodities, material infrastructures, and energy to sustain them.

In the past three decades, the mass of materials required to fuel the world economy has grown at an even faster pace than greenhouse gas emissions. Figure 3 shows that while yearly CO₂ emissions have increased by over 60% since 1990, the aggregate mass of all materials used by the world economy has doubled in size, rising from 47 Gt in 1990 to almost 97 Gt in 2019 (+104%).

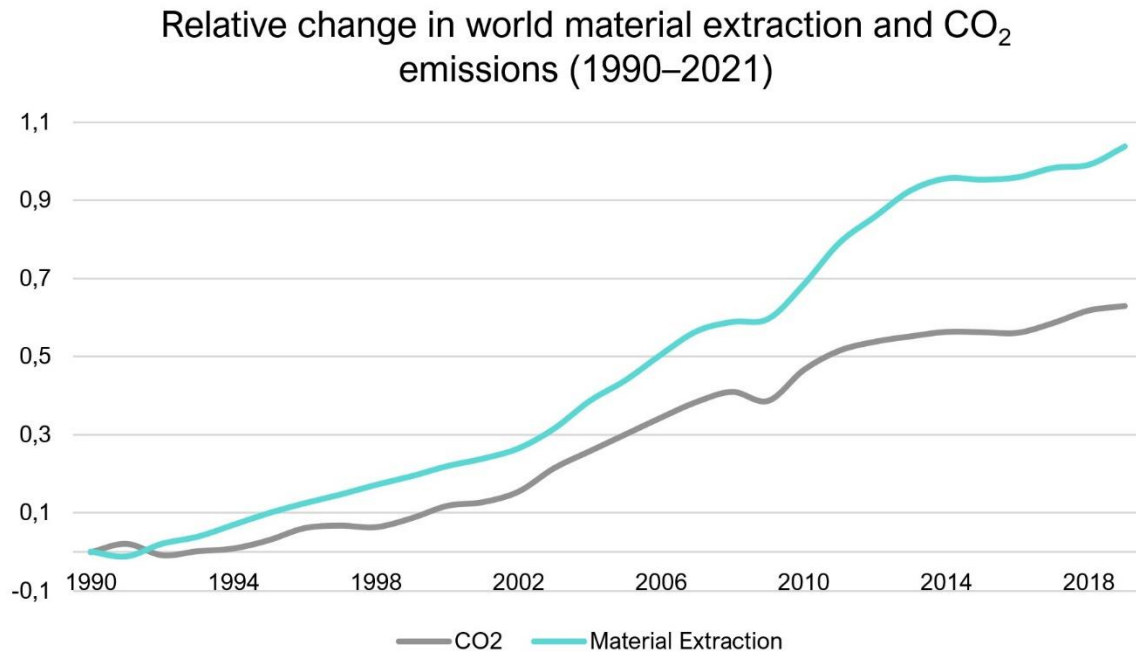


Figure 3. Relative increase in yearly CO₂ emissions compared to relative increase in world material extraction over the period 1990–2019. Values are plotted as $\Delta X = (X_{t2} - X_{t1})/X_{t1}$; where $t_1 = 1990$. Source: CO₂ emissions from Global Carbon Budget (2022) on OWID (OurWorldInData); material extraction flows from UN IRP Global Material Flows Database.

Resource use by national economies is often assessed with the Domestic Material Consumption (DMC) indicator. The DMC measures the total weight of raw materials extracted domestically, subtracting physical exports, and adding physical imports (Hickel & Kallis 2020). Based on DMC, evidence of absolute resource decoupling has been found in several countries, including Finland, Germany, the Netherlands, and the UK (Steinberger et al. 2013), as well as at the aggregate EU level (Sanyé Mengual et al. 2022). While the DMC considers the mass of traded commodities, it overlooks the materials needed for their production and transport, thus underestimating the displacement of material extraction along global production networks (Wiedmann et al. 2015). On the contrary, consumption-based accounts⁵ like the Material Footprint (MF) consider the overall extraction across global supply chains required to sustain an economy's consumption levels. When resorting to consumption-based indicators, a less rosy picture is revealed, particularly for high income countries.

⁵ Consumption-based accounts were developed in response to the limitations of territorially defined production-based accounts, like DMC. Income-based accounting has also been developed as a third type of material flow account.

In line with the evidence in Figure 3, Wiedmann and colleagues (2015) observe that overall material consumption keeps on growing in tandem with the world economy. For every 10% increase in GDP, the average MF rises by 6%. Several countries for which absolute decoupling in DMC has been reported show only relative decoupling when using consumption-based indicators, for example in EU countries (Hickel & Kallis, 2020, Sanyé Mengual & Serenella 2023, Vezzoni 2023a)⁶. In summary, the rare instances of absolute dematerialisation have only been found for small and temporary reductions in production-based indicators.

3.2. Energy foundations: The thermodynamics of the circular bioeconomy

Besides the material requirements of economic activities, proponents of a growth-centred circular bioeconomy tend to overlook the fact that all physical processes dissipate useful energy. According to the first law of thermodynamics (a branch of physics dealing with the properties of matter and energy over time), energy (and matter) cannot be created or destroyed, but only transformed. In other words, “[e]verything has to come from somewhere and go somewhere” (Daly 1991, p. 15). Humans use primary flows of resources to manufacture, exchange, build and demolish products within the “technosphere” (cf. Giampietro 2019). The biosphere, however, is both the source of these material and energy inputs, and the sink for their waste outputs. The flow of energy-matter captured and disposed of by humanity and its artefacts at any point in time defines society’s throughput. Moreover, according to the second law of thermodynamics, energy always moves from useful to increasingly unavailable forms of energy. This principle is known as the “entropy law”. Entropy, it follows, is a measure of chaos and disorder, indicating energy that is not useful to perform work. As such, entropy is always increasing, because any process involves the irreversible dissipation of energy.

Pioneering approaches at the intersection of thermodynamics and social sciences like Georgescu-Roegen’s (1975) bioeconomics or Daly’s (1991) steady-state economics (both foundational works in ecological economics) present highly relevant insights for understanding popular, yet somehow ambiguous, bioeconomy concepts like “circularity” or “sustainability”. In particular, the constant flow of energy and matter towards lower grades of organisation (thus, higher entropy) poses a challenge to the long-term viability of the circular economy model. The dominant neoclassical economic thinking, on the contrary, still assume the substitutability of so-called natural capital with human-made capital. Scholars have addressed the energy-blindness of these models by showing that increases in useful energy (i.e., exergy⁷) “have had an enormous impact on past economic growth” (Ayres et al. 2003, p. 250). Empirical evidence indicates that without unprecedented access to untapped energy sources from fossil fuels, along with increases in primary exergy supply (Warr & Ayres 2012), the exceptional economic growth experienced by industrialised civilisation would have not been

⁶ Sanyé Mengual and Serenella (2023) use the Consumption Footprint, a set of 16 LCA-based indicators use to quantify overall consumption figures by scaling up the environmental impacts of an average citizen.

⁷ Exergy quantifies the maximum amount of work that a source of energy can generate, namely its convertibility to mechanical energy. Different forms of energy have different conversion ratios to exergy. Electricity, for instance, is considered immediately available for production of work (ratio 1:1), meaning that every 1 W of electricity corresponds to 1 W of exergy, while other forms such as heat are more easily degraded to lower grades of useful energy (i.e., higher entropy in the system).

possible (Smil 2019). This implies that high volumes of economic output, as in OECD countries⁸, depend on sustained and large supplies of energy (Belke et al. 2011, p. 787).

When reviewing the evidence from several exergy studies, Haberl and colleagues (2020, p. 32) conclude that “at the useful stage of energy use there is no evidence for relative decoupling”. As postulated by the positive feedback hypothesis, economic growth and energy consumption are often linked by bi-directional causality (Ayres & Warr 2009, chap. 2, Belke et al. 2011, Warr & Ayres 2012), although this may vary by country, sector, and technology (Antonakakis et al. 2017). Not only does a growing economy require more materials and energy (even if marginally decreasing), but these stocks of materials (such as buildings and machinery) also need flows of energy to be operated and maintained (Krausmann et al. 2017, 2020). Put differently, artefacts like buildings, roads, and sawmills are conducive to economic growth and, their maintenance implies path-dependent energy and material requirements.

3.3. Scale, Pace and Justice

Considering both the scale and pace of decoupling, it is essential for it to be not only absolute but also sufficient, global in scope, prolonged and fast enough (Parrique et al. 2019, Vadén et al. 2020, 2021). Scale refers to the overall energy demands and mass of materials that requires by the economy. From a planetary perspective, there are limited minerals, land, water, fossil fuels and other biophysical resources that humans can extract, manufacture, and share. However, over the past two centuries, countries in the Global North have consumed disproportionately higher amounts of resources compared to those in the Global South.

Recently, some countries like China have been catching up with the material and energy consumption levels of high-income economies. Despite this, even China’s remarkable growth only accounts for a fraction of the per capita consumption in Europe or North America. For instance, an average Finnish person consumes twice as much energy every year compared to their Chinese counterpart⁹. Likewise, according to the Global Footprint Network, meeting the consumption levels of the average Indian citizen required 1 global hectare in 2022, while in Finland, the average citizen needs over 5 times that unit of land. Although relying solely on the ecological footprint has its shortcomings (for a thorough review of criticisms, see Galli et al. 2016), this and other environmental indicators emphasize the significant disparity in environmental impact based on income levels. Higher income countries, and affluent citizens within them, are responsible for most of the environmental destruction, irrespective of the metric used.

Considering the time horizon of these adjustments, the latest IPCC report sets the decarbonisation target at a 45% reduction in GHG emissions per year by 2030, and 100% by 2050. This translates to shrinking emissions by almost 7% per year. While some countries, like Sweden or Germany, are often cited as successful examples of decoupling, they are nowhere near these figures. Furthermore, recent emission reductions in other European countries have

⁸ While the focus is often on year-on-year rates, the most relevant measure should be the marginal increase in the volume of economic activities. For an energy demand increase of 1% in t_1 of an economy consuming 1000 TWh in t_0 is twice the energy demand resulting from a 5% increase in a society that consumes 100 TWh in t_0 .

⁹ This figure does not account for international trade, which would most likely exacerbate the divide. Sourced from OurWorldinData.

been accompanied by stagnant economic performance, de-industrialisation with financialisation, and overall deteriorating labour market conditions (Kovacic et al. 2018, Vezzoni 2023a); as a collateral damage, Mediterranean countries and the UK have experienced the unfortunate case of “unwanted degrowth” in living standards. Yet, it remains debatable whether the social disarray caused by economic downturns in growth-dependent societies is an unavoidable feature of human civilisation. In sum, reducing GHG emissions by a couple of percentage points per year in wealthy countries and/or depressed economies does not meet the scale of the challenge (Vadén et al. 2021).

As suggested by Haberl and colleagues (2020, p. 32), “[c]urrent trajectories of material and energy use cannot be correctly interpreted without considering past material and energy flows on which they are also based”. The historical responsibility for the stock of GHGs in the atmosphere largely falls on the Global North. It is thus fair to expect a differential adjustment of emissions levels, requiring faster and greater reductions in high-income countries to provide space for the rest of the world to develop necessary infrastructures to meet essential human needs. Clearly, this implies a normative commitment to equal opportunities and universal prosperity, and as Parrique and colleagues (2019, p. 16) point out, “decoupling is senseless if not connected to concrete environmental targets, which should themselves be based on moral considerations”. This applies also to intragenerational and global dimensions of justice, requiring a significant downsizing of the over-consumptive lifestyles of the wealthy to align with climate change mitigation scenarios.

These issues relate to the temporality of decoupling. The environmental mitigation actions taken today depend (also) on the environmental damage that occurred in the past. In other words, history matters. As such, green transition scholars often recur to the notion of path dependency to explain the selective narrowing of future options due to present decisions. Moving away from short-term thinking should prompt considerations about future steps. For instance, infrastructural development aimed at meeting current industrial targets, such as “doubling the bioeconomy’s value added by 2035”, could imply long payback periods that necessitate more energy and materials supplied to these infrastructures. As Vadén and colleagues at BIOS research group demonstrate, the design and patterns of infrastructural development may slow down the process of change and replacement (e.g., of fossil fuels with low-carbon energy), influence policy decisions, and tilt the playfield towards currently dominant technologies (Vadén et al. 2019, 2021). As a case in point, the anticipated ban on coal in Helsinki’s district heating is leading to higher biomass usage and, at least in the short term, to higher overall greenhouse gas (GHG) emissions (Vadén et al. 2019). This “green paradox” wherein climate policy measures lead to higher overall emissions stems from the modes of operation of previously established energy systems.

The stocks of materials in buildings, machinery, and various infrastructures anchor societies to energy-intensive manufacturing, maintenance, and operational practices, which account for about two-thirds of global material extraction (Krausmann et al. 2020). These structures have long lifespans, thus suggesting that the amount of artifacts and built-up area per capita should be limited to mitigate GHG emissions and broader environmental impacts (Haberl et al. 2023). These challenges emphasise the need for increased attention given to the scale and pace of change in bioeconomy strategies.

3.4. Efficiency paradoxes

It has been observed that improve efficiency does not always result into corresponding linear reductions in energy or material consumption. On the contrary, the decrease in the costs of particular goods and services can paradoxically lead to increased overall consumption. This phenomenon is known as the “Jevons paradox”. In growth-dependent economies, labour productivity increases lead to more total hours worked (as employment grows) rather than less and, by the same token, “[t]he more efficiently we use resources, the lower they cost, and the more of them we end up using” (Kallis et al. 2018, p. 296). More generally, a “rebound effect” occurs whenever the actual resource or energy savings are lower than expected. Although rebounds over the “Jevons paradox” threshold are rare, positive rebound effects are the most common outcome of efficiency improvements (Sorrell et al. 2009, 2020, Chitnis et al. 2014). Rebound effects can also act indirectly on consumption levels, whereas the savings in one domain are redirected to increased demand in another domain (these are also known as “income effects” for consumer and “re-investment effect” for producers) (Parrique et al. 2019, p. 37). Finally, energy demand or material consumption can also rebound at an economy-wide level, altering the overall organisation of production and society (Greening et al. 2000). For example, it would be hardly possible to conceive of urban sprawl and shopping malls without the improvements in private mobility brought by cars. The actual magnitude of these macroeconomic changes is hard to assess due to fundamental uncertain about future scenarios and the irreversibility of the arrow of time (see path dependency in the “Scale and Pace” section above). A lack of time-series data, however, should not discourage from considering the landmark, transformational, serendipitous outcomes of efficiency gains.

Scholars have explored rebound in different areas, including transportation, domestic heating, electricity, and non-energy-related goods. The notion of a circular economy too has been criticised for the possible presence of rebound effects. Zink and Geyer (2017), for instance, conduct a pragmatic analysis of the circular economy, one which operates within economic markets, where secondary goods compete directly with primary goods. The authors draw two important conclusions, contrary to what they call “the circular economy mantra”. First, it is not enough to focus on closing material loops, since circular practices (i.e., reuse, repair, recycle) should start with displacing primary production (i.e., refuse, reduce). Second, it follows that rather than focusing on maximising utility (and cognate standards of productivity, efficiency, etc.), the circular economy should reduce primary production. Otherwise, land-filling is merely deferred rather than displaced. “What is truly required to reduce environmental impact”, conclude the authors, “is less production and less consumption” (Zink & Geyer 2017, p. 600).

4. Towards Post-growth

4.1. Post-growth and its origins

Post-growth explores the potential trajectories for moving beyond a growth-centric economic model. It considers the feasibility, modalities, desirability and, by extension, the need for alternative paradigms and pathways. While drawing on early political economy debates (such as J.S. Mill's (1885) "stationary state" and Marxian critique of capital accumulation), as well as on philosophical traditions from the Global South, the emerging intellectual debate and research agenda on post-growth are most prominently linked to Western intellectuals in the 1970s. In economics, Herman Daly's (1977) "steady-state economics", and the works of his tutor Georgescu-Roegen (1971, 1975) on "bioeconomics", initiated what has now become the heterogenous, and often contradictory, school of ecological economics (Spash 2020). Other seminal contributions considered the environmental limits to growth (Meadows et al. 1972), issues of scale (Schumacher 1973), paradoxes of income growth (Easterlin 1974), and the social impossibility of "keeping up" with the consumeristic trade mill (Hirsch 1977).

Post-growth starts from the notion that while growth has become naturalised as a default state, it should be treated as a historical exception, with a beginning and an end (Fraser 2022). In modern societies, material growth is taken as the natural course of things, while a static economy (in pejorative terms, "stagnant") is a worrisome, abnormal, detrimental state. In growth-based societies, economic stagnation has concrete implications for people's livelihoods. It causes precarious and scarce employment, erosion of the social nets provided by the welfare state, and subordination to the interests of competing economic powers in the international arena. Nevertheless, as discussed above, the growth imperative (e.g., annual growth rates of 2–3%) also translate into *increasing absolute increases* of society's throughput. The energy- and capital-intensive standards of the "modern lifestyle" rest on unprecedented dense reserves of energy in fossil form.

While alternative energy sources could replace fossil fuels usage in the future, world energy demand keeps on growing, and fossil fuels still provide over 80% of final energy consumption¹⁰. In other words, rather than an energy transition, we are effectively witnessing an "energy addition" (cf York 2012, York & Bell 2019). Moreover, low-carbon energy technologies, like solar or hydrogen, are still entrenched within fossil global value chains and extractive production networks (Vezzoni 2023a, b). Post-growth addresses the long-term viability of the material intensification and general acceleration brought about by modern industrial development. These are challenged not only for socio-political and biophysical reasons, but also on ethical and moral grounds. Post-growth research instigates a debate over alternatives to the dominant mode of development, with an emphasis on the plurality of openings, the indeterminacy of ideal scenarios *a priori*, and their contextual relevance. To varying degrees, therefore, this body of literature take issue with the dominant developmentalist paradigm.

The core agenda of mainstream developmentalist policy is currently the sustainable development paradigm: a framework for the harmonisation of economic growth, social welfare, and environmental conservation (Asara et al. 2015). In response, critical development studies

¹⁰ <https://ourworldindata.org/fossil-fuels>.

problematise “globalised”, “neoliberal”, “financialised” forms of industrial modernization and capitalist expansion, besides questioning the perverse notion that “[w]hat is good enough for the United States [and for global North] is good enough for the rest of the world” (Fine 1999, p. 12, brackets added). Furthermore, since the 1990s, alternative development studies have been complemented by research on alternatives to development, or post-development theory (Matthews 2017). Instead of a linear and necessarily progressive view of economic history, post-development advances a pluralistic, path dependent, and possibly regressive understanding of how societies change over time, according to contextual features and social power relations.

These traditions build on and intersects with other critiques of modernization theory, such as dependency theory and broader critiques of under-development, as a discrete historical process based on uneven exploitation of resources and unequal distribution of accumulated wealth (cf Bernstein 1971, Amin 1990, Wallerstein 2000, pp. 139–140). As pointed out also by more recent studies on unequal ecological exchange, the wealth and economic achievements of so-called *advanced economies* “rely on a large net appropriation of resources and labour from the global South, extracted through induced price differentials in international trade” (Hickel et al. 2022b, p. 10). Among the literatures that have cut across post-development themes, degrowth has most recently experienced increasing prominence in academic and public discourse, particularly as a reflexive critique of development within the Global North (Schmelzer & Nowshin 2023). Below we summarise its meaning, main tenets, and implications.

4.2. Degrowth and its origins

Growing out of a predominantly activist-led movement, degrowth is a burgeoning research field. Since the 2010s, its upsurge in policy and political influence has also been associated to mounting dissatisfaction with global climate governance and related grassroots environmental justice movements (Martinez-Alier 2012). Additionally, degrowth scholarship provides an academic space for debating and dissecting “green growth” myths. While it is hard to trace its conceptual roots neatly and comprehensively, degrowth belongs to a broader global intellectual tradition of “progress outside modernity” and beyond capitalism.

But what exactly is degrowth? Degrowth can be defined as “a planned reduction of energy and resource throughput designed to bring the economy back into balance with the living world in a way that reduces inequality and improves human well-being” (Hickel 2021, p. 1106). Degrowth scholars and activists often emphasise the importance of democratic downscaling, while tackling multiple forms of inequality and injustice (Schneider et al. 2010, Dengler & Seebacher 2019, Nirmal & Rocheleau 2019). This also implies a call for reimagining the foundations of a “good life”, and for collectively defined societal boundaries, while fostering societal freedom and liberation from violence and domination (Schmelzer et al. 2022).

As illustrated in Figure 4, degrowth explores the transition from an overgrown economy towards a somewhat dynamic steady-state economy within the regenerative capacities of planet earth. It follows that degrowth is not a discipline, nor an approach or a school of thought, but rather a subject of societal interest, feeding into (and from) social movements and increasingly also into political discourse. Therefore, degrowth “is not the quantitative pursuit of less for less’s sake” (Parrique 2020, p. 326). Whether this de-scaling entails a reduction in

GDP, it is rather irrelevant (although very likely), for the aim is to shrink society's throughput while ensuring an equitable "good life" for all (O'Neill et al. 2018).

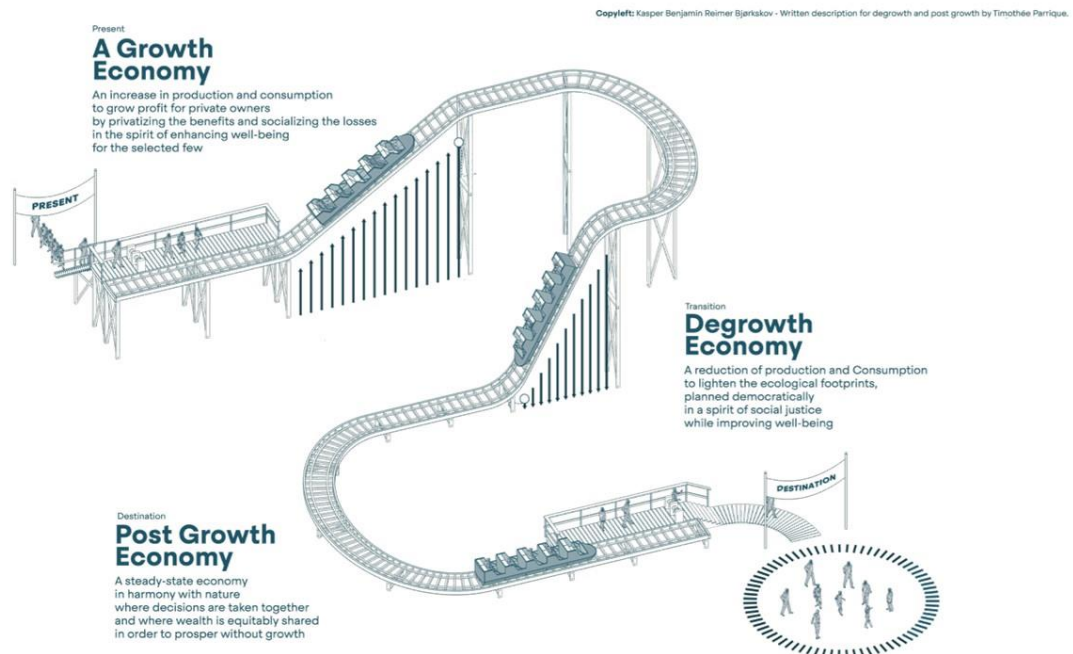


Figure 4. Pathway towards a post-growth economy via degrowth. Source: Kasper Benjamin Reimer Bjørkskov and Timothée Parrique https://www.linkedin.com/posts/kasper-benjamin-reimer-bj%C3%B8rkskov-660a4899_a-pathway-towards-a-regenerative-society-activity-7041297080111235072-xExS?utm_source=share&utm_medium=member_desktop

Degrowth aims first and foremost to shrink the social metabolism of the global economy. Equally important, as a fundamentally emancipatory vision, it addresses the inequalities caused by exploitative market-mediated accumulation, both within and across countries and regions. The modes of operationalising this societal realist utopia are varied, contested, and constitute the essence of the debate in the field (Schmelzer et al. 2022, chap. 4). Nevertheless, most critics fall short of engaging with the subject matter, and rather address the semantics of the term "degrowth" (Spash 2018, Hickel 2021). Despite the critiques, degrowth scholars are not the only ones confronting contemporary forms of harmful, unwanted domination. To varying degrees, these are addressed by all forms of emancipatory social science research (Sayer 2009). To avoid fostering a dialogue of the deaf among contending academic niches, we briefly review the essence of degrowth according to the six "sources" identified by Demaria and co-authors (2013)¹¹:

1. Ecology. Political ecologists have been duelling on different, and possibly conflicting, forms of organising socio-nature arraignments beyond a Cartesian human-nature division (Swyngedouw 2018). While some stress the analytical importance of retaining a dialectical dualism between society and nature (Saitō 2022, pp. 120–125)¹², the globally integrated mar-

¹¹ The order in which the six sources are presented, as well as their description, is adjusted to the structure and scope of this report.

¹² On this respect, see also the longstanding debate on the interpretation of Marx's monism/dualism between Jason Moore and John Bellamy Foster.

ket economy, however, is undermining the integrity of the biosphere precisely because of the illusory separation of “the artificial” and “the natural”, as ostensibly autonomous realms. This dualist turn is a fundamental contribution of modern development theory and policy (Hickel 2020, Oliver 2020). As such, degrowth stands on onto-epistemological grounds often anti-thetical to those of mainstream economics approaches.¹³

2. Bioeconomics. As already expounded in section 3.1, the neglect of the material and energy underpinnings of all forms of economic activity undermines the credibility of growth-centred models. In a nutshell, the thermodynamic theory of economic processes first advanced by Georgescu-Roegen (1971) leads to the logical conclusion that, in the long-run, the world economy (as the emerging system of all its localised forms) is bound to be confined to the energetic flows provided by solar radiation (Kallis et al. 2018), and our limited capacity to capture it. This inevitably leads to lower energy and material throughputs (and thus economic outputs) than those experienced during the fossil fuel bonanza. Degrowth is about how to get us through a global energy descent without social squalor and disarray.

3. Post-development. This source of degrowth has already been addressed in section 3.2.2. Suffice to add here that the envisioning of equitable, non-materialistic, emancipatory (i.e., as radically anti-exploitative) forms of progress is an endeavour that degrowth shares also with other scholarships and social movements (see, Escobar 2015, Kothari et al. 2019, Akbulut et al. 2019, Hanaček et al. 2020, Brand et al. 2021, p. 278). Key questions in these debates revolve around the rights to and meaning of development. Degrowth, it is claimed, can be a historical driver of decolonisation by reducing Northern economic interests and neo-colonial interference with the self-determination of countries in the global South (Hickel 2018, 2021).

4. Democracy. The unprecedented redistribution of economic and political power entailed by post-developmental degrowth policies rests on a renewed centrality of democratic principles. Participation in “radical and plural democracy” through dialogue and negotiation should unfold as the “extension of the democratic struggles for equality and liberty to a wide range of social relations” (Laclau & Mouffe 2001, p. xv). Democratic planning concerning a reduction in social metabolism, therefore, means shifting from market and corporative decision-making to public and citizens-led allocation of productive capacity. As André Gorz puts it: “[the point is] to tie in the goals of the economy with the free public expression of felt needs, instead of creating needs for the sole purpose of enabling capital to expand and commerce to develop” (Gorz, 1994, p. 8, *in* Brand et al. 2021, p. 276).

5. Well-living. The emphasis of degrowth is not on “the less”, but on the different (Asara et al. 2015). This reignites discussions over the meaning of a good life. For this, degrowth scholarship has drawn heavily on non-Western ontologies in the exploration of a so-called “pluriverse” of alternatives to dysfunctional growth models (Kothari et al. 2019, Gills & Hosseini 2022). From quantifying and comparing the well-being performance of societies to re-thinking their underlying values, codes of conduct, and ideals, degrowth scholarship is advancing new understandings of well-living, based on principles like care, health, reciprocity, solidarity, interconnectedness, and conviviality (D’Alisa et al. 2015, Dengler & Seebacher 2019).

¹³ On this note, scholars have started a particularly fruitful debate grounding social-ecological economics, and growth-critical economic provisioning more broadly, in the philosophy of science of critical realism (cf Spash 2012, 2020, Næss 2021, Buch-Hansen & Nesterova 2021, 2023, Elder-Vass & Morgan 2022).

6. Justice. Degrowth is rooted in the struggle of those who are oppressed, marginalised, dehumanised, gendered, racialised, and otherwise made vulnerable and disposable. In other words, it is a concerted, negotiated, ongoing effort to restore and secure for all sentient beings, whether humans or not, the inherent right to a dignified life. This requires addressing not only issues of (re)distributional justice (i.e., between the global North-South, among classes, within social groups), but also procedural (i.e. participation) and recognitional (i.e. onto-epistemological) forms of justice (Ramcilovic-Suominen 2022). To avoid a retrenchment into autarchic provincialism, these justice considerations should be framed within an internationalist agenda (Schmelzer & Nowshin 2023) encompassing feminist, decolonial, and environmental struggles (Martinez-Alier 2012, Nirmal & Rocheleau 2019).

These six sources show that the central proposition of degrowth scholarship is that not only social metabolism needs to shrink for social and environmental reasons, but this descaling can also be made compatible with human progress (Schneider et al. 2010). To this end, the next section explored degrowth policy proposals.

4.3. Degrowth inspired policies

A growing body of literature is developing and reviewing degrowth policy measures (Kallis et al. 2020, Wiedmann et al. 2020, Schmelzer et al. 2022, Fitzpatrick et al. 2022, Hickel et al. 2022a). Many of these policies address the political and economic power structures that are at the root of global inequality and environmental crises. We summarise them in Figure 5 as follows:

- Reimagine society: identifying and unlearning harmful practices that exert coercive domination of other life-forms. As Graeber and Wengrow (2021) suggest, the capacity to reimagine social relations is as an essential social freedom, and the task set forth by degrowth is precisely to foster new types of social arrangements based on alternative attributes like care, reciprocity, and custody. This is a precondition for successfully putting in place other degrowth-inspired policies (as further elaborated upon in chapter 5.1 and 5.2).
- Reduce throughput: scaling down environmentally and socially destructive sectors (e.g., fossil fuels, industrial monocultures, mass-produced meat and dairy, fast fashion, advertising, cars and aviation), while reducing the need for material consumption both by producing better products (which last longer) and by increasing the time free from work (shortening the working week).
- Reshape provisioning systems: promoting beneficial decentralized technologies and modes of provisioning (e.g., decentralised energy cooperatives, local food production, social care work, recreational facilities, green spaces, refurbishing homes, ecological restoration), which improve socio-ecological goals while not necessarily resulting in GDP or economy growth. This also requires de-linking socio-ecological well-being and health from economic growth, by providing accessible and affordable to all public services that are necessary for a decent and fulfilling life (e.g., affordable and adequate housing, healthcare, education, clean water, healthy food, access to renewable and non-profit driven energy, recreational facilities green spaces). In the current economy context this entails de-commodifying many of those services, even in Finland.

Redistribute wealth: economic and political power should be democratically redistributed. Within countries, this could be done for example by targeting wealth inequality, shifting taxation from labour to financial capital, introducing carbon and wealth taxes, and reorienting those towards social objectives. Internationally, this could take the form of foreign debt restructuring, debt cancellation for the formal colonies and otherwise economically poorer countries as a form of reparations for colonial abuses, as well as a mean to curb ecological unequal exchange through climate mitigation policy. This is crucial for liberating the countries and people in the global peripheries from the neo-colonial capture of their natural and social “resources”. Finally, degrowth policies suggest distributing work to reduce unemployment, by promoting a combination of measures such as universal basic (or care) income or a climate job guarantee. These should contribute to curbing the risk of unemployment, while reintroducing slower and more nurturing lifestyles.

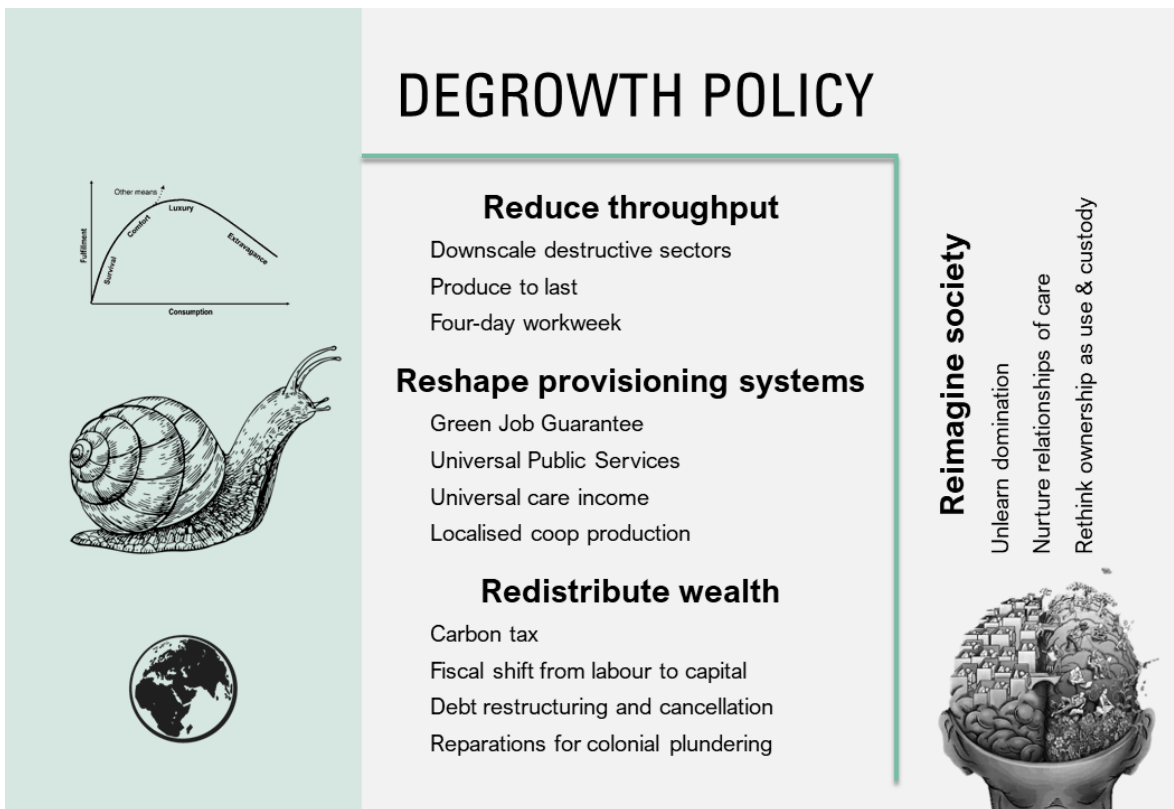


Figure 5. Degrowth inspired policy.

Regardless of how desirable, however, these policies are likely to be unpopular and widely resisted if associated with arbitrary material deprivations, particularly if the costs are borne by marginalised groups and individuals, rather than the powerful elites. Several growth-dependencies are engrained in habits of consumption, lifestyle, and social identities (Buch-Hansen & Nesterova 2023), as well as in corporate boards and the welfare state (Hickel 2020). The generalisation of an individual effort to sobriety and restraint, therefore, remains within the deregulating and disempowering paradigms of the growth regime (Romano 2016). In other words, it does not challenge the primacy of liberal individualism and the emphasis on individual sovereign self-realization which structure modern society (D’Alisa & Romano 2023). On the contrary, degrowth must necessarily be collective, negotiated, and emancipatory to both overthrow and reinstitute new forms of social organization. It should involve a public discussion on the desirability of social boundaries to economic activity (Schmelzer & Nowshin 2023) in the pursuit of collective freedoms “rooted in taking responsibility for the social (and environmental) impacts of actions on others” (Brand et al. 2021, p. 281).

5. Redirecting Finnish bioeconomy beyond growth: enabling conditions and ways forward

Economic growth has been the main objective of modern economies and societies for over a century, as well as the engine of extraordinary, yet highly unequally distributed, material gains, wellbeing and health. In this section, we explore how to re-imagine and refocus the priorities of a post-growth (bio)economy in Finland and what preconditions are needed for the above discussed degrowth and post-growth ideas and policies to be implemented as planned.

The reader should keep in mind that the solutions emerging from the ecological modernisation toolbox (e.g. technological solutions, decoupling), as well as those emerging from the toolbox of planetary limits-based approach (e.g. downscaling of production and consumption) are important and can play a role in the post-growth bioeconomy. Nonetheless, neither of them is sufficient or fit for the purpose, in an economy that is organised around profit making – a capitalist economy – the primary purpose of which is monetary value creation, rather than socioecological value and wellbeing for all. In other words, any benefits generated through improved efficiency and circularity are placed in service of further production and increase in financial value, at the cost of socioecological values, through the economy wide-bound effect.

Furthermore, even if the solutions associated with limit-based approaches (unlike those associated with ecological modernisation) challenge the disproportional accumulation and dis-possession across societal groups (Patel & Moore 2018, Fraser 2022), neither of the two sufficiently acknowledge the political and justice context of biophysical limits and scarcity, and how they are produced and imposed on the less privileged groups. This implies that those solutions risk to once again overburden the marginalised societal groups who are excluded from the debate (Mehta and Harcourt 2021). The suggestions below can to an extent meliorate such risks, enabling just and effective post-growth policies in Finland and broader in the EU.

The way out of the current poly-crises requires us to go beyond the discussion of scaling down the production and consumption, and physical planetary boundaries. It requires us to acknowledge and challenge the (neo)colonial-capitalist nexus, and the forms of violence associated with it. It requires questioning and reinventing the dominant narratives and values, ensuring socioecological and onto-epistemic justice, democratising social and economic provisioning, and it requires policies and regulations that can facilitate rather than obstruct such goals.

5.1. Shifting and reinventing values, lexicon and mythologies

A transition towards a post-growth bioeconomy requires tackling the root causes of current socio-ecological crises. This cannot be done by leaving the current capital-oriented logics, mindsets, and structures intact and taking them for granted and as given (Hiedanpää et al. 2023). Tackling the multiple crises first and foremost requires questioning and reinventing the ontological and epistemological foundations on which our modern European and Finnish societies are built upon. It requires questioning, unlearning, and undoing the logics, values,

belief systems and practices associated with socio-ecological destruction and by extension with the colonial-capitalist nexus. One way of doing that is by identifying, challenging, and actively rejecting or unlearning false and harmful myths and hierarchies that reproduce domination and extractivism, including the following hierarchies and illusions of superiority of:

- human over the rest of nature,
- some humans over others (skin colour, class, gender, etc.),
- material over non-material growth,
- intellectual over spiritual growth,
- Eurocentric, scientific and expert knowledges and science over indigenous, local and citizen knowledges and science; as well as technical and natural sciences over social sciences and humanities,
- private over common property,
- competition over cooperation,
- capital over planet.

Unlearning of these harmful myths and hierarchies needs to be followed by re-learning, and nurturing different values, belief systems and ethics that are based on the principles of unity and human-nature interconnectedness, reciprocity, and care. Such principles and ethics nurture an idea of a good life in reciprocity with one another and with the rest of nature and encourages care of other living beings and forms of life. Seeing ourselves and our lives in connection to others and the rest of nature is central for reimagining societies, economies and eventually bioeconomies that do not exploit (human and other-than-humans), but nurture, support and foster care, interconnectedness and reciprocity (Moriggi et al. 2023).

In Finland cultural closeness and affinity to natural environments like forests are widespread among the population. Yet, being Finland the most densely forested country in Europe, the strong role of forest industry over the years have successfully promoted and widely normalised instrumental and anthropocentric values and relationship to the natural environment and forests. Habitats like forests, meadows, or lakes are often seen as “natural capital” to exploit, or to protect only to allow exploitation elsewhere. Paradoxically, broadly distributed private property of forests among small-holders makes this prevailing view deeply engrained in the Finnish population and hard to change, since a large share of the population draws direct economic benefits from the exploitation of forests (Holz 2023, Friedrich et al. 2023). While forest owners represent around 14% of Finnish citizens, customary laws like the “everyman’s right” grant access to forests’ services to most of the population (Mustalahti 2018). Forests are therefore enjoyed for different purposes by most citizens holding several, and at times conflicting, values. However, forest state authorities and industrial groups often exert a preferential influence on forest industry compared to ordinary citizens (Kröger & Raitio 2017). Treating forests as mere economic resources in policy and industry operations may lock the bioeconomy into unsustainable patterns of exploitation. It conditions citizens into the role of private owners, producers, or consumers, thus omitting the possibility of safeguarding forests as a common good (Mustalahti 2018) and as an integrated part of identity. In Finland, this tension is also evident in the struggle for self-determination of the indigenous Sámi population (Lassila 2021), as we will discuss next.

5.2. Ensuring socio-ecological and epistemic justice and plurality

Finnish and other EU member states' bioeconomy policies have global (Backahouse et al. 2021, Gebara et al. 2023), as well as domestic reach and impacts (Lassila 2021). This includes impacts affiliated with extractivism for green energy and products (Holz 2023, Toivonen 2021). The threat of more intensified forest management and mining that comes with the so called "green transition", for Sámi people appear a shift towards "black transition", as they struggle to ensure continuity of their livelihoods and cultural identity¹⁴. Bioeconomy also impacts the way people, including Indigenous Sámi, define meaning and value (e.g. meaning and/or value of forest, peatland, wilderness, etc.), as well as their right to self-determination and the right to live in accordance with one's own knowledge and legal systems. Those and other impacts are particularly relevant for the Indigenous Sámi's lands and cultures, in the context of their continually contested right for self-determination and self-governance (Lassila 2021, Mustonen 2022).

While bioeconomy strategies are also led by a growing concern for ecological balance and different ways of benefitting from natural environments (such as recreational activities like sports, tourism, or foraging), economic value remains a central drive and concern, thus triggering extractivist practices at the expense of environmental stewardship, local livelihoods and knowledges (Friedrich et al. 2023, Holz 2023, Lassila 2021, Mustonen 2022). Furthermore, profit-driven commodification of local knowledges and species for innovation and production of "green" and "bio-based" products and services, can lead to instances of cultural appropriation and epistemic injustice, as evidence from other countries has shown (see for example, Backahouse et al. 2021, Gebara et al. 2023).

To tackle the injustices associated with green extractivism requires, among others, recognition of and commitment to the Indigenous and local peoples' right to self-determination and self-governing authority. It also requires more input by local actors and citizens more broadly. The complexity and embeddedness of what justice may mean to whom, implies that rather than expert views and scientific evaluation, the lived experiences of people, their stories and their memories of historical and current struggles should be of key consideration when co-defining and co-constructing policy problems and solutions for a just postgrowth bioeconomy in Finland. Finally, the ontological and epistemic plurality needs to be acknowledged and embraced in the debates on bioeconomy in Finland and the more broadly in the EU, as a way of avoiding onto-epistemic injustice and imposition of dominant ideas, worldviews and approaches.

Finnish bioeconomy policy, alongside other relevant policies, needs to create and nurture space for reflexivity, critical thinking, and uncomfortable knowledge (Giampietro & Funtowicz 2020, Giampietro 2023). This could be acted upon by including social scientists, ethicists and philosophers to guide the policy direction (Visseren-Hamakers et al. 2021, Oliver et al. 2023) as well as changing the lexicon when discussing bioeconomy, since the current vocabular tends to reproduce the above-listed hierarchies and values.

¹⁴ Tiina Sanila-Aikio: "Meidän silmin se näyttää mustalta siirtymältä" – vihreän siirtymän aiheuttamat maankäyttöpaineet huolettavat saamelaisalueella <https://www.lapinkansa.fi/tiina-sanila-aikio-meidan-silmin-se-nayttaa-mustal/5805401>

Indigenous knowledges (Arsenault et al. 2019), and feminist and decolonial thinking and methods have also much to offer in the process of rethinking bioeconomy (Ramcilovic-Suominen et al. 2022). Pluralising the current expert-focused knowledge co-creation and policy-making processes can be done by involving the holders of local and Indigenous knowledges (McGregor et al. 2020, West et al. 2022), based on the principles of consent, intellectual and cultural autonomy (Orlove et al. 2023).

Drawing on Ramcilovic-Suominen et al. (forthcoming) proposals for just landscape restoration, we suggest the following questions as a guide to reflect upon when designing a more just bioeconomy initiatives in Finland:

- (i) Linking decision-making and impacts: To what extent an initiative involves those who directly depend on and/or have a special bound with the land, water or other forms of life that will be impacted by the policy initiative in question? To what extent are the modes of operation defined by those who are to be directly affected by them?
- (ii) Linking the policy objectives with those of the people living in the area: To what extent a bioeconomy initiative is in line with the motivations and objectives of the local inhabitants?
- (iii) Centring around the concerns and needs of the affected societal groups: To what extent does the bioeconomy policy or initiative serve the interest, needs and concerns of the made vulnerable groups?
- (iv) Giving meaning to the meaning of costs, benefits, and trade-offs: Who defines what is considered a cost and what a benefit (e.g., goods, services, products, and/or end results)? Who decides how these are provided or denied across scales and among societal groups?
- (v) Pluralising knowledge systems and legal structures: To what extent are the institutional structures and knowledge systems that are used to design, negotiate, and implement the bioeconomy initiative distant from the customary or traditional knowledge systems and institutional structures?

5.3. Democratizing the economy and ensuring economic justice

In the Section 4.3. we introduced a wide range of degrowth inspired policies. Degrowth requires, and at the same time enables major transformations in cultural, political, and institutional terms to allow for a shift from a corporate driven economic system centred around capital accumulation, to a democratic and bottom-up economic system centred around provisioning of socioecological values, wealth and wellbeing. An essential step towards this goal is democratising of the ecological planning and economic production and social provisioning – including the means, quantities and qualities of production (Hickel 2023, Schmelzer & Hofferberth 2023). A firmer direct democratic control over strategic sectors – such as energy, real estate, and agriculture – can re-focus production and consumption to meet social needs and create shared public value. The objective is to deliver and support human and ecological well-being and health, while sharing equally the benefits and burdens among societal groups. Traditionally marginalised or otherwise excluded groups, including Indigenous peoples, local communities, immigrants, working class and trade unions need to be an equal player in this process. This calls for radical democracy and ground up institution building.

The lack of diversity in the Finnish industry and business needs to be addressed in the post-growth bioeconomy debate. In particular, the lobbying of the forestry industry, and a handful

of corporations within it (e.g., UPM, Stora Enso, Metsä Board) significantly influence the Finnish bioeconomy. Their influence extends also beyond national borders. During the drafting of the new EU Biodiversity Strategy between 2019–2021, for instance, Metsäteollisuus ry (the Finnish Forest Industries Federation) is an active corporate lobby group in Brussels (Hadji-Lazaro et al. 2022). As discussed during the policy roundtable with bioeconomy experts (see Introduction), a circle of largely middle-to-late-age Finnish men remains in charge of major developments in policy, businesses, and public discourse. Women have a fair access to higher positions, but they too are conditioned to maintain the status quo. Gender diversity is therefore not a panacea, rather it is departing from a business-as-usual mindset and praxis that brings change.

Pluralizing policymaking beyond corporate actors associated primarily with forest industry, as well as raising awareness about the downsides of the Scandinavian development model, the Nordic forestry model, and the related resource-intensive “green” lifestyles (Holz 2023, Friedrich et al. 2023). This entails a re-politicisation of debates around ownership structures and the commons, as well as consumption and access to the natural environment to motivate citizens to act and organize for collectively defined alternative socioecologically sound and just bioeconomies. Democratic deliberation, direct and radical democracy with local institutions deliberating and deciding about ecological and social limits and social provisioning needs to emerge and to be enabled. Along the same lines, there is a need for better integration of trade unions, workers, citizens, youths, immigrants and other minorities, in the policymaking processes and institutional structures.

Democratising the production and organising it around social needs and socio-ecological amenities is central for decommodifying and therefore securing people’s access to human needs, public goods, commons, as preconditions for social and ecological health and well-being (Hickel 2023). Although difficult to put in practice, due to systemic constrains, “real utopias” or “nowtopias” are already mushrooming around the world, with citizens, communities, and entire cities building on and experimenting with post-growth economies (e.g., Transition Towns, Post Growth Institute, [Doughnut Economics Action Lab \(DEAL\)](#), Postcarbon Institute, La Via Campesina). Such movements are slowly penetrating also political debates within mainstream institutions in the materially wealthy Global North (see for example, Beyond Growth Conference in Brussels, EU Green Social Summit Conference in Madrid).

Finland and other Nordic countries are often referred as social welfare states, supporting societal well-being by subsidised public services, such as education, healthcare and to some extent housing for more vulnerable groups. Challenges exist, however, especially in terms of the environmental impact, both global and local. The material footprint indicators¹⁵ and sustainable development index measures¹⁶ show that per capita material consumption and CO₂ emissions in Finland are amongst the highest in the world, the costs of which are largely “externalized” to other geographies. For instance, Finland is not only one of the highest biodiversity footprints caused by per capita consumption, but it is also a net exporter of biodiversity loss to other regions of the world (Pouta et al. 2023). The much-idealised Nordic lifestyle, therefore, can in no way represent a global “green model”, on the contrary, the hidden consequences of this model should be recognised and tackled.

¹⁵ Statistic per country available at <http://www.materialflows.net/>

¹⁶ Statistic per country available at <https://www.sustainabledevelopmentindex.org/>

In the current historical conjuncture, characterised by high geopolitical tensions and a resurgence of nationalist politics domestically as in EU, reclaiming and re-directing Finnish domestic policy towards socio-ecological well-being and justice is especially needed.

5.4. Post-growth businesses and entrepreneurship

In August 2023 we held a policy roundtable to initiate a dialogue over possible post-growth pathways for the Finnish bioeconomy. A key question we asked to the participants – among which there were researchers, activists, and entrepreneurs – was meant to advance alternative objectives for the bioeconomy, by asking: “Instead of economic growth, what should be the primary focus of the Finnish Bioeconomy strategy? In other words, what else could the Finnish bioeconomy provide? As a tentative and explorative answer, some of the priorities of a post-growth bioeconomy could include:

- (i) **Strengthening life-support systems:** nurturing the integrity and health of socio-ecological systems. This supports the diversity of species, clean water and air, and the functional role of the natural environment as a sink for CO₂ and other excess pollutants.
- (ii) **Securing livelihoods:** securing a safe and healthy environment also translates into good and stable provisioning of material needs and maintenance of material well-being and securing the so-called basic needs, while abandoning the imperative of economic growth. Currently, the need for economic growth is justified as the “rising tide lifts all boats”, a notion which is seriously challenged. In any case, ensuring reliable and better distributed income and employment possibilities is key for post-growth alternatives.
- (iii) **Local solidarity economies:** developing a place-based bioeconomy can support the two priorities listed above, by fostering local ecosystems of post-growth enterprises, dialogue with public authorities, and mutual relationships of kinship among residents. Self-reliance and sufficiency practices can develop together with a culture of acceptance of non-monetary values. As stated by one of the participants in the policy roundtable: “Let forests be forests and not clear-cuts”.

Most importantly, these and other post-growth bioeconomy priorities must be jointly and democratically co-defined. In other words, those who are directly affected by bioeconomy policy measures but have traditionally been excluded from negotiating tables (e.g., rural residents, indigenous people, workers, trade unions, migrants and immigrants) should be given equal access in the decision-making process. This is quite opposed from the top-down approach where a techno-scientific elite lobbied by extractive corporations largely influence the bioeconomy policy in Finland (Korhonen et al. 2018, Kröger & Raitio 2017, Toivonen 2021).

New business models are emerging within the post-growth debate. They are challenging outdated business mindsets, as well as shifting the aims and social roles of entrepreneurship. They are receptive to shifts in production incentives and pricing mechanisms which prioritise long-term socio-ecological health – such as carbon sinks, biodiversity, sustainable food systems, long-term high-quality materials over short-term profit maximisation. Role of consumption is important, but it should be kept in mind that post-growth entrepreneurship moves beyond “conscious consumerism” of individual to the realm of production. In other

words, it replaces the passive choice of consumers from already made products with the active decision of what, how and how much should be produced in the first place.

Yet, these new business practices need to be supported by a shift in the Finnish regulatory framework. The above highlighted priorities require long-term funding and innovative ownership structures supported, first and foremost, by new policy frameworks and strategies. Similarly, the shift in the business culture discussed above should be considered in the policy framework. For example, policies could indicate and incentivise the maximisation of social and ecological targets, while securing financial sustainability as a second-order objective (rather than the other way around). This could set the minimum requirement for any enterprise and business to operate within the bioeconomy domain. Examples include clear policy guidelines concerning carbon credits, pricing mechanisms, tax incentives, and public funding schemes.

For the reasons explored in chapter 3 and 4, bioeconomy policies should, moreover, disincentivise large, homogenous, monocultural, heavily mechanised, and hence energy-intensive, corporations, whose lobbying power often engulfs the engines of democratic decision-making. The task is strenuous, but not out of reach. Policy makers can bend regulation to enable post-growth business practices to emerge, while rendering unsustainable business-as-usual obsolete. Together with the participants at the policy roundtable, we advanced a few suggestions:

These measures should be implemented following a clear roadmap to dismantle ingrained growth dependencies in a systematic fashion. This in turn requires fostering public dialogue and deliberation on post-growth issues and how to tackle them.

- **Simplify regulations for small-scale local enterprises:** regulations should be streamlined and adapted to the capacities of local enterprises (e.g., excessive regulation and standards). This is crucial to favour the viability of enterprises that create more-than-economic benefits, like those offering good quality employment, communal spaces, and social reproduction, or care work, maintaining the wellbeing and health of people and place (Moriggi et al. 2023).
- **Define clear boundaries and metrics:** define economy-wide (i.e., cross-sectoral) metrics for limiting biomass extraction, biodiversity loss and soil fertility loss (as well as clear methodologies for how to measure them), and metrics for mapping of a long-term expansion and protection of vital ecosystems and permanent carbon sinks (e.g., introducing incremental restrictions to clear-cuts). These metrics can be adopted to define a standard minimum requirement for being considered a 'bioeconomy enterprise'. Finally, encourage shared benefits through bioeconomy, such as those related to health, security of livelihoods, safety, social reproduction, and care.
- **Encourage different ownership structures:** promote forms of ownership that incentivise expansion and stewardship of commons rather than their (ab)use and overuse. Examples include steward ownership of cooperatives and trusts. A new regulatory framework beyond profit-maximisation can promote a diversity of business practices to emerge in bioeconomy-related industries.
- **Fund new generations of entrepreneurs creating socioecological value:** regulations should incentivise new generations of purpose-driven entrepreneurs that promote societal equity and ecological care, rather than diverting funding to the same

usual suspects that guarantee profit only. This includes but it is not limited to doing away with the “all eggs in one basket” logic.

- **Discuss and reflect:** foster dialogue with businesses and small landowners to break outdated mentalities about the private property (e.g. “nobody can tell me what to do with my property” logic). This should go hand in hand with the promotion of public dialogue with citizens about post-growth transition issues.
- **Independent and transdisciplinary research:** fund independent and transdisciplinary research to identify barriers to a systemic social transition. This should inform the design of funding and business structures, identify systemic growth dependencies, define sectoral growth (or de-growth, in the case of socially or environmentally harmful activities) strategies, and develop alternative notions of human and planetary well-being.

These measures should be implemented following a clear and democratically codesigned roadmap to dismantle ingrained growth dependencies in a systematic fashion. This in turn requires fostering public dialogue and deliberation on post-growth issues and how to tackle them.

6. Conclusions

Finland has envisioned a bold path towards carbon neutrality and zero biodiversity loss by 2035. The bioeconomy plays a key role in achieving this policy targets. The Finnish government expects it to double in size in the 2022–2035 period, while possibly fostering what the latest Biodiversity Strategy defines “holistic sustainability”. To achieve this, the circular bioeconomy promises to be “Doing More from Less”, largely counting on efficiency gains in production processes, upgrading products, and reusing industrial side streams. Targeting bioeconomy growth rates of over 6% per year while reducing environmental degradation (both domestically and globally), however, represents a historically unprecedented and empirically unrealistic challenge, as we have discussed in Chapter 3 and Chapter 4. In Chapter 5 we paid attention to the justice dimension and to the shift in worldviews and values that is required for moving away from environmentally destructive and socially harmful logics and practices.

The socio-ecological destruction and injustices discussed above are not endemic to the bioeconomy, and neither is the failure of the current prevalent approaches and strategies to cope with the existential crises unfolding in front of us. These shortcomings relate to myopic developmentalism, industrial modernization, (neo)colonial violence and dispossession, and other processes inherent in the global capitalist mode of development. The putatively endless accumulation of capital on a global scale systematically undermines life-support systems and thus, paradoxically, it also erodes its own foundations. Nancy Fraser calls this paradox “cannibal capitalism”, using the metaphor of “the ouroboros that eats its own tail” and thus devours its own substance (Fraser 2022, p. xv). For these reasons, the suggestions proposed in chapter 4 and chapter 5 not only address bioeconomy issues, but also relate to challenges beyond it.

While the state system is the stage of many discontents discussed in this report (e.g., lobbying, entrenched vested interests, growth dependencies, extractive mindsets), it is necessarily also the arena in which to develop a long-term bioeconomy strategy to lock-in socio-ecological benefits and justice. The means of change, however, should not be a prerogative of state bureaucracies, but the result of a collective undertaking involving local owners, post-growth bioeconomy businesses (and those who are not yet, should be bridled into a process of transformation towards it), as well as grassroots initiatives preparing the groundwork for a society-wide transformation towards just, equitable postgrowth alternatives.

Degrowth and post-growth are about envisaging viable alternatives to deliver socio-ecological benefits, widespread well-being, and justice. However, to avoid economic collapse, further economic insecurity, and deprivation of marginalised groups, those policies require (i) embracing onto-epistemic justice and plurality, together with unlearning oppressive and extractive practices; (ii) rapidly descaling harmful activities together with a general slow-down of life rhythms; (iii) re-centring economic provisioning around socio-ecological wellbeing and justice; (iv) democratising economy, both nationally and internationally, and pulling the (bio)economy out of the corporate grip. These guiding principles, summarised also in Figure 5, are both the means to as well as the goals of a (bio)economy beyond growth.

References

- Akbulut, B., Demaria, F., Gerber, J.-F. & Martínez-Alier, J. 2019. Who promotes sustainability? Five theses on the relationships between the degrowth and the environmental justice movements. *Ecological Economics* 165:106418. <https://doi.org/10.1016/j.ecolecon.-2019.106418>
- Amin, S. 1990. *Delinking. Towards a Polycentric World*. Zed Books, London, Atlantic Highlands, Bombay
- Antonakakis, N., Chatziantoniou, I. & Filis, G. 2017. Energy consumption, CO₂ emissions, and economic growth: An ethical dilemma. *Renewable and Sustainable Energy Reviews* 68: 808–824. <https://doi.org/10.1016/j.rser.2016.09.105>
- Arsenault, R., Bourassa, C. & Diver, S., McGregor, D. & Withammet, A. 2019. Including Indigenous Knowledge Systems in Environmental Assessments: Restructuring the Process. *Global Environmental Politics* 19: 120–132. https://doi.org/10.1162/glep_a_00519
- Asara, V., Otero, I., Demaria, F. & Corbera, E. 2015. Socially sustainable degrowth as a social-ecological transformation: repoliticizing sustainability. *Sustainability Science* 10: 375–384. <https://doi.org/10.1007/s11625-015-0321-9>
- Ayres, R., Ayres, L.W. & Warr, B. 2003. Exergy, power and work in the US economy, 1900–1998. *Energy* 28: 219–273. [https://doi.org/10.1016/S0360-5442\(02\)00089-0](https://doi.org/10.1016/S0360-5442(02)00089-0)
- Ayres, R.U. & Warr, B. 2009. *The economic growth engine: how energy and work drive material prosperity*. Edward Elgar, Cheltenham, UK; Northampton, MA
- Backhouse, M., Lehmann, R., Lorenzen, K., Lühmann, M., Puder, J., Rodríguez, F. & Tittoret, A. (eds.) 2021. *Bioeconomy and Global Inequalities: Socio-Ecological Perspectives on Biomass Sourcing and Production*. Springer International Publishing, Cham
- Befort, N. 2020. Going beyond definitions to understand tensions within the bioeconomy: The contribution of sociotechnical regimes to contested fields. *Technological Forecasting and Social Change* 153: 119923. <https://doi.org/10.1016/j.techfore.2020.119923>
- Belke, A., Dobnik, F. & Dreger, C. 2011. Energy consumption and economic growth: New insights into the cointegration relationship. *Energy Economics* 33: 782–789. <https://doi.org/10.1016/j.eneco.2011.02.005>
- Bernstein, H. 1971. Modernization theory and the sociological study of development. *Journal of Development Studies* 7: 141–160. <https://doi.org/10.1080/00220387108421356>
- Birch, K. 2016. Emergent Imaginaries and Fragmented Policy Frameworks in the Canadian Bio-Economy. *Sustainability* 8:1 007. <https://doi.org/10.3390/su8101007>
- Birch, K. 2019. *Neoliberal Bio-Economies?* Springer International Publishing, Cham
- Boyer, M., Kusche, F., Hackfort, S., Prause, L. & Engelbrecht-Bock, F. 2023. The making of sustainability: ideological strategies, the materiality of nature, and biomass use in the bioeconomy. *Sustainable Science* 18 :675–688. <https://doi.org/10.1007/s11625-022-01254-4>

- Brand, U., Muraca, B., Pineault, É., Sahakian, M., Schaffartzik, A. & Novy, A. 2021. From planetary to societal boundaries: an argument for collectively defined self-limitation. *Sustainability: Science, Practice and Policy* 17: 264–291. <https://doi.org/10.1080/15487733.2021.1940754>
- Buch-Hansen, H. & Nesterova, I. 2021. Towards a science of deep transformations: Initiating a dialogue between degrowth and critical realism. *Ecological Economics* 190: 107188. <https://doi.org/10.1016/j.ecolecon.2021.107188>
- Buch-Hansen, H. & Nesterova, I. 2023. Less and more: Conceptualising degrowth transformations. *Ecological Economics* 205: 107731. <https://doi.org/10.1016/j.ecolecon.2022.107731>
- Bugge, M.M., Hansen, T. & Klitkou, A. 2016. What Is the Bioeconomy? A Review of the Literature. *Sustainability* 8: 691. <https://doi.org/10.3390/su8070691>
- Chitnis, M., Sorrell, S., Druckman, A., Firth, S.K. & Jackson, T. 2014. Who rebounds most? Estimating direct and indirect rebound effects for different UK socioeconomic groups. *Ecological Economics* 106: 12–32. <https://doi.org/10.1016/j.ecolecon.2014.07.003>
- D’Alisa, G., Demaria, F. & Kallis, G. (eds.) 2015. *Degrowth: A Vocabulary for a New Era*, 1st edn. Routledge, New York; London
- D’Alisa, G. & Romano, O. 2023. Degrowth: A State of Expenditure. In: Jay Kassiola, J. & Luke T.W. (eds.). *The Palgrave Handbook of Environmental Politics and Theory*. Springer International Publishing, Cham, pp 127–146
- Daly, H.E. 1991. *Steady-State Economics*, Second edition [1977]. Island Press, Washington, DC
- Demaria, F., Schneider, F., Sekulova, F. & Martinez-Alier, J. 2013. What is Degrowth? From an Activist Slogan to a Social Movement. *Environ Values* 22: 191–215. <https://doi.org/10.3197/096327113X13581561725194>
- Dengler, C. & Seebacher, L.M. 2019. What About the Global South? Towards a Feminist Decolonial Degrowth Approach. *Ecological Economics* 157: 246–252. <https://doi.org/10.1016/j.ecolecon.2018.11.019>
- Easterlin, R.A. 1974. Does economic growth improve the human lot? Some empirical evidence. In: David, P. & Reder, M. (eds.). *Nations and Households in Economic Growth: Essays in Honour of Moses Abramovitz*. Academic Press, New York
- Elder-Vass, D. & Morgan, J. 2022. ‘Materially social’ critical realism: an interview with Dave Elder-Vass. *J Crit Realism* 21: 211–246. <https://doi.org/10.1080/14767430.2022.-2028233>
- Escobar, A. 2015. Degrowth, postdevelopment, and transitions: a preliminary conversation. *Sustainable Science* 10: 451–462. <https://doi.org/10.1007/s11625-015-0297-5>
- European Commission 2022. *EU Bioeconomy Strategy Progress Report European Bioeconomy policy: stocktaking and future developments*. European Commission, Brussels
- European Commission 2020. *A new Circular Economy Action Plan For a cleaner and more competitive Europe*. European Commission, Brussels

- European Commission 2018. A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment. Directorate-General for Research and Innovation, Luxembourg
- Eversberg, D., Holz, J. & Pungas, L. 2023a. The bioeconomy and its untenable growth promises: reality checks from research. *Sustainable Science* 18: 569–582. <https://doi.org/10.1007/s11625-022-01237-5>
- Eversberg, D., Koch, P., Lehmann, R., Saltelli, A., Ramcilovic-Suominen, S. & Kovacic, Z. 2023b. The more things change, the more they stay the same: promises of bioeconomy and the economy of promises. *Sustainable Science* 18:557–568. <https://doi.org/10.1007/s11625-023-01321-4>
- Fine, B. 1999. The Developmental State Is Dead—Long Live Social Capital? *Development and Change* 30: 1–19. <https://doi.org/10.1111/1467-7660.00105>
- Finnish Government 2022. The Finnish Bioeconomy Strategy. Sustainably towards higher value added. Finnish Government, Helsinki
- Fitzpatrick, N., Parrique, T. & Cosme, I. 2022. Exploring degrowth policy proposals: A systematic mapping with thematic synthesis. *Journal of Cleaner Production* 365:132764. <https://doi.org/10.1016/j.jclepro.2022.132764>
- Fraser, N. 2022. *Cannibal capitalism: how our system is devouring democracy, care, and the planet - and what we can do about it*. Verso, London; New York
- Friedlingstein, P., Jones, M.W., O'Sullivan, M. et al 2022. Global Carbon Budget 2021. *Earth System Science Data* 14: 1917–2005. <https://doi.org/10.5194/essd-14-1917-2022>
- Friedrich, J., Holz, J., Koch, P., Pungas, L., Eversberg, D. & Zscheischler, J. 2023. Rural bioeconomies in Europe: Socio-ecological conflicts, marginalized people and practices. *GAIA - Ecological Perspectives for Science and Society* 32: 219–224. <https://doi.org/10.14512/gaia.32.2.3>
- Galli, A., Giampietro, M., Goldfinger, S., Lazarus, E., Lin, D., Saltelli, A., Wackernagel, M. & Müller, F. 2016. Questioning the Ecological Footprint. *Ecological Indicators* 69: 224–232. <https://doi.org/10.1016/j.ecolind.2016.04.014>
- Gebara, M.F., Ramcilovic-Suominen, S. & Schmidlehner, M.F. 2023. Indigenous Knowledge in the Amazon's Bioeconomy: Unveiling Bioepistemicide through the case of Kambo Medicine. *Forest Policy and Economics* 154: 103012. <https://doi.org/10.1016/j.forpol.2023.103012>
- Geels, F.W. 2014. Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory Culture & Society* 31: 21–40. <https://doi.org/10.1177/0263276414531627>
- Georgescu-Roegen, N. 1975. Energy and Economic Myths. *Southern Economic Journal* 41: 347. <https://doi.org/10.2307/1056148>
- Georgescu-Roegen, N. 1971. *The Entropy Law and the Economic Process*. Harvard University Press, Cambridge, MA; London, UK

- Giampietro, M. 2019. On the Circular Bioeconomy and Decoupling: Implications for Sustainable Growth. *Ecological Economics* 162: 143–156. <https://doi.org/10.1016/j.ecolecon.2019.05.001>
- Giampietro, M. 2023. Reflections on the popularity of the circular bioeconomy concept: the ontological crisis of sustainability science. *Sustainable Science* 18: 749–754. <https://doi.org/10.1007/s11625-022-01267-z>
- Giampietro, M. & Funtowicz, S.O. 2020. From elite folk science to the policy legend of the circular economy. *Environmental Science & Policy* 109: 64–72. <https://doi.org/10.1016/j.envsci.2020.04.012>
- Gills, B.K. & Hosseini, S.A.H. 2022. Pluriversality and beyond: consolidating radical alternatives to (mal-)development as a Communist project. *Sustainable Science* 17: 1183–1194. <https://doi.org/10.1007/s11625-022-01129-8>
- Giuntoli, J., Oliver, T., Kallis, G., Ramcilovik-Suominen, S. & Monbiot, G. 2023. In Giuntoli, J. & Mubareka, S. (eds.) *Exploring new visions for a sustainable bioeconomy*. Publications Office of the European Union, Luxembourg
- Giurca, A. & Befort, N. 2023. Deconstructing substitution narratives: The case of bioeconomy innovations from the forest-based sector. *Ecological Economics* 207: 107753. <https://doi.org/10.1016/j.ecolecon.2023.107753>
- Graeber, D. & Wengrow, D. 2021. *The Dawn of Everything. A New History of Humanity*. Allen Lane, London
- Greening, L.A., Greene, D.L. & Difiglio, C. 2000. Energy efficiency and consumption — the rebound effect — a survey. *Energy Policy* 28: 389–401. [https://doi.org/10.1016/S0301-4215\(00\)00021-5](https://doi.org/10.1016/S0301-4215(00)00021-5)
- Haberl, H., Löw, M., Perez-Laborda, A., Matej, S., Plank, B., Wiedenhofer, D., Creutzig, F. Erb, K.-H. & Duro, J.A. 2023. Built structures influence patterns of energy demand and CO₂ emissions across countries. *Nature Communications* 14: 3898. <https://doi.org/10.1038/s41467-023-39728-3>
- Haberl, H., Wiedenhofer, D., Virág, D. et al 2020. A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights. *Environmental Research Letters* 15: 065003. <https://doi.org/10.1088/1748-9326/ab842a>
- Hadji-Lazaro, P., Quorning, S., Fröhlich, T., Theine, H. & Forster, T. 2022. *Taking the temperature of the European Green Deal*. Brussels
- Hanaček, K., Roy, B., Avila, S. & Kallis, G. 2020. Ecological economics and degrowth: Proposing a future research agenda from the margins. *Ecological Economics* 169: 106495. <https://doi.org/10.1016/j.ecolecon.2019.106495>
- Hausknost, D., Schriefl, E., Lauk, C. & Kalt, G. 2017. A Transition to Which Bioeconomy? An Exploration of Diverging Techno-Political Choices. *Sustainability* 9: 669. <https://doi.org/10.3390/su9040669>
- Hickel, J. 2021. What does degrowth mean? A few points of clarification. *Globalizations* 18: 1105–1111. <https://doi.org/10.1080/14747731.2020.1812222>

- Hickel, J. 2020. *Less is More: How Degrowth Will Save the World*. Penguin, London
- Hickel, J. 2018. *The divide: a brief guide to global inequality and its solutions*. Penguin Random House, London
- Hickel, J. 2023. On Technology and Degrowth. *Monthly Review* 75
- Hickel, J. & Kallis, G. 2020. Is Green Growth Possible? *New Political Economy* 25: 469–486. <https://doi.org/10.1080/13563467.2019.1598964>
- Hickel, J., Kallis, G., Jackson, T., O'Neill, D.W., Schor, J.B., Steinberger, J.K., Victor, P.A. & Ürge-Vorsatz, D. 2022a. Degrowth can work — here's how science can help. *Nature* 612: 400–403. <https://doi.org/10.1038/d41586-022-04412-x>
- Hickel, J., O'Neill, D.W., Fanning, A.L. & Zoomkawala, H. 2022b. National responsibility for ecological breakdown: a fair-shares assessment of resource use 1970–2017. *Lancet Planet Health* 6: e342–e349. [https://doi.org/10.1016/S2542-5196\(22\)00044-4](https://doi.org/10.1016/S2542-5196(22)00044-4)
- Hiedanpää, J., Ramcilovic-Suominen, S. & Salo, M. 2023. Neoliberal pathways to the bioeconomy: Forest land use institutions in Chile, Finland, and Laos. *Forest Policy and Economics* 155: 103041. <https://doi.org/10.1016/j.forpol.2023.103041>
- Hirsch, F. 1977. *Social limits to growth*. Routledge & Kegan Paul Ltd, London
- Holz, J.R. 2023. Threatened sustainability: extractivist tendencies in the forest-based bioeconomy in Finland. *Sustainable Science* 18: 645–659. <https://doi.org/10.1007/s11625-023-01300-9>
- Kallis, G., Kostakis, V., Lange, S., Muraca, B., Paulson, S. & Schmelzer, M. 2018. Research On Degrowth. *Annual Review of Environment and Resources* 43: 291–316. <https://doi.org/10.1146/annurev-environ-102017-025941>
- Kallis, G., Paulson, S., D'Alisa, G. & Demaria, F. 2020. *The case for degrowth*. Polity, Cambridge, UK Medford, MA
- Korhonen, J., Giurca, A., Brockhaus, M. & Toppinen, A. 2018. Actors and Politics in Finland's Forest-Based Bioeconomy Network. *Sustainability* 10: 3785. <https://doi.org/10.3390/su10103785>
- Kothari, A., Salleh, A., Escobar, A., Demaria, F. & Acosta, A. (eds.) 2019. *Pluriverse: a post-development dictionary*. Tulika Books, New Delhi, India
- Kovacic, Z., Spanò, M., Piano, S.L. & Sorman, A.H. 2018. Finance, energy and the decoupling: an empirical study. *Journal of Evolutionary Economics* 28: 565–590. <https://doi.org/10.1007/s00191-017-0514-8>
- Krausmann, F., Wiedenhofer, D. & Haberl, H. 2020. Growing stocks of buildings, infrastructures and machinery as key challenge for compliance with climate targets. *Global Environmental Change* 61: 102034. <https://doi.org/10.1016/j.gloenvcha.2020.102034>
- Krausmann, F., Wiedenhofer, D., Lauk, C., Haas, W., Tanikawa, H., Fishman, T., Miatto, A., Schandl, H. & Haberl, H. 2017. Global socioeconomic material stocks rise 23-fold over the 20th century and require half of annual resource use. *Proceedings of the National Academy of Sciences* 114: 1880–1885. <https://doi.org/10.1073/pnas.1613773114>

- Kröger, M. & Raitio, K. 2017. Finnish forest policy in the era of bioeconomy: A pathway to sustainability? *Forest Policy and Economics* 77: 6–15. <https://doi.org/10.1016/j.forpol.2016.12.003>
- Laclau, E. & Mouffe, C. 2001. *Hegemony and Socialist Strategy*, Second. Verso, London
- Lassila, M. 2021. The Arctic mineral resource rush and the ontological struggle for the Viianki-aapa peatland in Sodankylä, Finland. *Globalizations* 18: 635–649. <https://doi.org/10.1080/14747731.2020.1831818>
- Martinez-Alier, J. 2012. Environmental Justice and Economic Degrowth: An Alliance between Two Movements. *Capitalism Nature Socialism* 23: 51–73. <https://doi.org/10.1080/10455752.2011.648839>
- Matthews, S. 2017. Colonised minds? Post-development theory and the desirability of development in Africa. *Third World Q* 38: 2650–2663. <https://doi.org/10.1080/01436597.2017.1279540>
- McGregor, D., Whitaker, S. & Sritharan, M. 2020. Indigenous environmental justice and sustainability. *Current Opinion in Environmental Sustainability* 43: 35–40. <https://doi.org/10.1016/j.cosust.2020.01.007>
- Meadows, D.H., Meadows, L., Randers, J. & Behrens, W.W. 1972. *The Limits to Growth*. Universe Books, New York
- Mehta, L. & Harcourt, W. 2021. Beyond limits and scarcity: Feminist and decolonial contributions to degrowth. *Political Geography* 89: 102411. <https://doi.org/10.1016/j.polgeo.2021.102411>
- Mill, J.S. 1885. *Principles Of Political Economy*. D. Appleton And Company, New York
- Moriggi, A., Soini, K., Vehmasto, E., Roep, D., Secco, L. & Uosukainen, M. 2023. Caring for people and nature. A summary report on Green Care and place-based sustainability in Finland. *Natural Resources and bioeconomy studies* 102/2022. 57 p. Natural Resources Institute Finland. Helsinki.
- Mustalahti, I. 2018. The responsive bioeconomy: The need for inclusion of citizens and environmental capability in the forest based bioeconomy. *Journal of Cleaner Production* 172: 3781–3790. <https://doi.org/10.1016/j.jclepro.2017.06.132>
- Mustonen, T., Scherer, A. & Kelleher, J. 2022. We belong to the land: review of two northern rewilding sites as a vehicle for equity in conservation. *Humanities and Social Sciences Communications* 9: 402. <https://doi.org/10.1057/s41599-022-01424-w>
- Næss, P. 2021. Sustainable urban planning – what kinds of change do we need? *Journal of Critical Realism* 20: 508–524. <https://doi.org/10.1080/14767430.2021.1992737>
- Newell, P. 2021. *Power Shift: The Global Political Economy of Energy Transitions*, 1st edn. Cambridge University Press
- Nirmal, P. & Rocheleau, D. 2019. Decolonizing degrowth in the post-development convergence: Questions, experiences, and proposals from two Indigenous territories. *Environment and Planning E Nature and Space* 2: 465–492. <https://doi.org/10.1177/2514848618819478>

- Oliver, T. 2020. *The self delusion: the surprising science of how we are connected and why that matters*. Weidenfeld & Nicolson, London
- Oliver, T.H., Bazaanah, P., Da Costa, J., Deka, N., Dornelles, A.Z., Greenwell, M.P., Nagarajan, M., Narasimhan, K., Obuobie, E., Osei, M.A. & Gilbert, N. 2023. Empowering citizen-led adaptation to systemic climate change risks. *Nature Climate Change* 13: 671–678. <https://doi.org/10.1038/s41558-023-01712-6>
- Ollinaho, O.I. & Kröger, M. 2023. Separating the two faces of “bioeconomy”: Plantation economy and sociobiodiverse economy in Brazil. *Forest Policy and Economics* 149: 102932. <https://doi.org/10.1016/j.forpol.2023.102932>
- Ollinaho, O.I. & Kröger, M. 2021. Agroforestry transitions: The good, the bad and the ugly. *Journal of Rural Studies* 82: 210–221. <https://doi.org/10.1016/j.jrurstud.2021.01.016>
- O’Neill, D.W., Fanning, A.L., Lamb, W.F. & Steinberger, J.K. 2018. A good life for all within planetary boundaries. *Nature Sustainability* 1: 88–95. <https://doi.org/10.1038/s41893-018-0021-4>
- Orlove, B., Sherpa, P., Dawson, N., Adelekan, I., Alangui, W., Carmona, R., Coen, D., Nelson, M.K., Reyes-Carcia, V., Rubis, J., Sanago, G. & Wilson, A. 2023. Placing diverse knowledge systems at the core of transformative climate research. *Ambio* 52: 1431–1447. <https://doi.org/10.1007/s13280-023-01857-w>
- Parrique, T. 2020. *The political economy of degrowth*. Université Clermont Auvergne; Stockholms universitet
- Parrique, T., Barth, J., Briens, F., Kerschner, C. Kraus-Polk, A., Kuokkanen, A. & Spangenberg, J.H. 2019. *Decoupling Debunked. Evidence and arguments against green growth as a sole strategy for sustainability*. European Environmental Bureau
- Patel, R. & Moore, J.W. 2018. *A history of the world in seven cheap things: a guide to capitalism, nature, and the future of the planet*. Verso, London New York, NY
- Peltomaa, J. 2018. Drumming the Barrels of Hope? Bioeconomy Narratives in the Media. *Sustainability* 10: 4278. <https://doi.org/10.3390/su10114278>
- Pouta, E., Hiedanpää, J., Iho A, Kniivilä, M., El Geneidy, S., Kujala, H., Kyllönen, S., Laukkanen, M., Mykrä, N., Nyyssölä, M., Pakarinen, J., Silvola, H., Tynkkynen, N. & Vinnari, M. 2023. *Assessing the economics of biodiversity in Finland: National implications of the Dasgupta Review*. Ministry of the Environment, Helsinki
- Pungas, L. 2023. Invisible (bio)economies: a framework to assess the ‘blind spots’ of dominant bioeconomy models. *Sustainable Science* 18: 689–706. <https://doi.org/10.1007/s11625-023-01292-6>
- Ramcilovic-Suominen, S. Chomba, S., Larson, A.M., Sinclair, F. (forthcoming) Decolonial environmental justice in landscape restoration. Accepted and forthcoming in: Katila, P., Colfer, C.J.P., de Jong, W., Galloway, G., Pacheco, P. & Winkel, G. (eds.). *Restoring forests and trees for sustainable development - Policies, practices, impacts and ways forward*. Oxford University Press, Oxford

- Ramcilovic-Suominen, S. 2022. Envisioning just transformations in and beyond the EU bioeconomy: inspirations from decolonial environmental justice and degrowth. *Sustainable Science*. <https://doi.org/10.1007/s11625-022-01091-5>
- Ramcilovic-Suominen, S., Kröger, M. & Dressler, W. 2022 From pro-growth and planetary limits to degrowth and decoloniality: An emerging bioeconomy policy and research agenda. *Forest Policy and Economics* 144: 102819. <https://doi.org/10.1016/j.forpol.-2022.102819>
- Riemann, L., Giurca, A. & Kleinschmit, D. 2022. Contesting the framing of bioeconomy policy in Germany: the NGO perspective. *Journal of Environmental Policy & Planning* 24: 822–838. <https://doi.org/10.1080/1523908X.2022.2071689>
- Rodrik, D. 2014. Green industrial policy. *Oxford Review of Economic Policy* 30 :469–491. <https://doi.org/10.1093/oxrep/gru025>
- Romano, O. 2016. Coping with the Horizontal Hitch: The “Con-Formism” of the Degrowth Alternative. *Environmental Values* 25: 573–591. <https://doi.org/10.3197/0963271-16X14703858759134>
- Saitō, K. 2022. *Marx in the anthropocene: towards the idea of degrowth communism*. Cambridge University Press, Cambridge; New York, NY
- Sanyé Mengual, E. & Serenella, S. 2023. Consumption footprint and domestic footprint: assessing the environmental impacts of EU consumption and production: life cycle assessment to support the European Green Deal. Publications Office of the European Union, Luxembourg
- Sanyé Mengual, E., Tosches, D. & Sala, S. 2022. Domestic footprint of the EU and Member States: methodology and results (2010-2018). Publications Office of the European Union, Luxembourg
- Sayer, A. 2009. Who’s Afraid of Critical Social Science? *Current Sociology* 57: 767–786. <https://doi.org/10.1177/0011392109342205>
- Schmelzer, M. & Hofferberth, E. 2023. Democratic Planning for Degrowth. *Monthly Review* 75.
- Schmelzer, M. & Nowshin, T. 2023. Ecological Reparations and Degrowth: Towards a Convergence of Alternatives Around World-making After Growth. *Development*. <https://doi.org/10.1057/s41301-023-00360-9>
- Schmelzer, M., Vetter, A. & Vansintjan, A. 2022. *The Future is Degrowth. A Guide to a World Beyond Capitalism*. Verso Books, London, New York
- Schneider, F. Kallis, G. & Martinez-Alier, J. 2010. Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue. *Journal of Cleaner Production* 18: 511–518. <https://doi.org/10.1016/j.jclepro.2010.01.014>
- Schumacher, E.F. 1973 *Small is Beautiful. Economics as if People Mattered*. Blond & Briggs, London
- Smil, V. 2019. *Growth: from microorganisms to megacities*. The MIT Press, Cambridge, Massachusetts

- Soini, K. & Salo, M. 2022. Kestävyyden kolme kehystä. In: Vehmasto, E. Soini, K. & Salo, M. (eds.). Kestävyyden kehukset - Luonnonvaratutkimus kestävyysmuutoksessa. Luonnonvara- ja biotalouden tutkimus 74/2022. Luonnonvarakeskus, Helsinki
- Sorrell, S., Dimitropoulos, J. & Sommerville, M. 2009. Empirical estimates of the direct rebound effect: A review. *Energy Policy* 37: 1356–1371. <https://doi.org/10.1016/j.enpol.2008.11.026>
- Sorrell, S., Gatersleben, B. & Druckman, A. 2020. The limits of energy sufficiency: A review of the evidence for rebound effects and negative spillovers from behavioural change. *Energy Research & Social Science* 64: 101439. <https://doi.org/10.1016/j.erss.2020.101439>
- Spash, C.L. 2020. A tale of three paradigms: Realising the revolutionary potential of ecological economics. *Ecological Economics* 169: 106518. <https://doi.org/10.1016/j.ecolecon.2019.106518>
- Spash, C.L. 2018. Facing the Truth or Living a Lie: Conformity, Radicalism and Activism. *Environmental Values* 27: 215–222. <https://doi.org/10.3197/096327118X15217309300804>
- Spash, C.L. 2012. New foundations for ecological economics. *Ecological Economics* 77:3 6–47. <https://doi.org/10.1016/j.ecolecon.2012.02.004>
- Steinberger, J.K., Krausmann, F. & Eisenmenger, N. 2010. Global patterns of materials use: A socioeconomic and geophysical analysis. *Ecological Economics* 69: 1148–1158. <https://doi.org/10.1016/j.ecolecon.2009.12.009>
- Steinberger, J.K. Krausmann, F. & Getzner, M., Schandl, H. & West, J. 2013. Development and Dematerialization: An International Study. *PLoS ONE* 8: e70385. <https://doi.org/10.1371/journal.pone.0070385>
- Swyngedouw, E. 2018. CO₂ as Neoliberal Fetish: The Love of Crisis and the Depoliticized Immuno-Biopolitics of Climate Change Governance. In: Cahill, D., Cooper, M., Koning, M. & Primrose, D. (eds.). *The SAGE Handbook of Neoliberalism*. SAGE Publications Ltd, London
- Toivanen, T. 2021. A Player Bigger Than Its Size: Finnish Bioeconomy and Forest Policy in the Era of Global Climate Politics. In: Backhouse, M., Lehmann, R., Lorenzen, K. et al. (eds.). *Bioeconomy and Global Inequalities: Socio-Ecological Perspectives on Biomass Sourcing and Production*. Springer International Publishing, Cham, pp 131–149
- Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T., Hakala, E. & Eronen, J.T. 2020. Decoupling for ecological sustainability: A categorisation and review of research literature. *Environmental Science & Policy* 112: 236–244. <https://doi.org/10.1016/j.envsci.-2020.06.016>
- Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T. & Eronen, J.T. 2021. Raising the bar: on the type, size and timeline of a 'successful' decoupling. *Environmental Politics* 30: 462–476. <https://doi.org/10.1080/09644016.2020.1783951>
- Vadén, T., Majava, A., Toivanen, T., Järvensivu, P., Hakala, E. & Eronen, J.T. 2019. To continue to burn something? Technological, economic and political path dependencies in district heating in Helsinki, Finland. *Energy Research & Social Science* 58: 101270. <https://doi.org/10.1016/j.erss.2019.101270>

- Vezzoni, R. 2023a. Green growth for whom, how and why? The REPowerEU Plan and the inconsistencies of European Union energy policy. *Energy Research & Social Science* 101: 103134. <https://doi.org/10.1016/j.erss.2023.103134>
- Vezzoni, R. 2023b. How “Clean” is the Hydrogen Economy? Tracing the Connections between Hydrogen and Fossil Fuels. SSRN Scholarly Paper. 10.2139/ssrn.4543260
- Visseren-Hamakers, I.J., Razzaque, J., McElwee, P. et al 2021. Transformative governance of biodiversity: insights for sustainable development. *Current Opinion in Environmental Sustainability* 53: 20–28. <https://doi.org/10.1016/j.cosust.2021.06.002>
- Vivien, F.D., Nieddu, M., Befort, N., Debref, R. & Giampietro, M. 2019. The Hijacking of the Bioeconomy. *Ecological Economics* 159: 189–197. <https://doi.org/10.1016/j.ecolecon.-2019.01.027>
- Wallerstein, I. 2000. The Essential Wallerstein. *Contemporary Sociology* 29: 819. <https://doi.org/10.2307/2654090>
- Warr, B. & Ayres, R.U. 2012. Useful work and information as drivers of economic growth. *Ecological Economics* 73: 93–102. <https://doi.org/10.1016/j.ecolecon.2011.09.006>
- West, S., Haider, L.J., Stålhammar, S. & Woroniecki, S. 2020. A relational turn for sustainability science? Relational thinking, leverage points and transformations. *Ecosystems and People* 16: 304–325. <https://doi.org/10.1080/26395916.2020.1814417>
- Wiedenhofer, D., Virág, D., Kalt, G. et al 2020. A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part I: bibliometric and conceptual mapping. *Environmental Research Letters* 15: 063002. <https://doi.org/10.1088/1748-9326/ab8429>
- Wiedmann, T., Lenzen, M., Keyßer, L.T. & Steinberger, J.K. 2020. Scientists’ warning on affluence. *Nature Communications* 11: 3107. <https://doi.org/10.1038/s41467-020-16941-y>
- Wiedmann, T.O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J. & Kanemoto, K. 2015. The material footprint of nations. *Proceedings of the National Academy of Sciences* 112: 6271–6276. <https://doi.org/10.1073/pnas.1220362110>
- York, R. 2012. Do alternative energy sources displace fossil fuels? *Nature Climate Change* 2: 441–443. <https://doi.org/10.1038/nclimate1451>
- York, R. & Bell, S.E. 2019. Energy transitions or additions? Why a transition from fossil fuels requires more than the growth of renewable energy. *Energy Research & Social Science* 51: 40–43. <https://doi.org/10.1016/j.erss.2019.01.008>
- Zink, T. & Geyer, R. 2017. Circular Economy Rebound. *Journal of Industrial Ecology* 21: 593–602. <https://doi.org/10.1111/jiec.12545>



**You can find us
online**

luke.fi

