

Towards a Philosophy of a Bio-Based Economy: A Levinassian Perspective on the Relations between Economic and Ecology Systems

ROEL VERAART & VINCENT BLOK

*Department of Philosophy
Wageningen University & Research
Hollandseweg 1
6700 EW Wageningen, Netherlands
Email: roel.veraart@hotmail.com*

ABSTRACT

In this paper we investigate the fundamental idea at stake in current bioeconomies, such as Europe's Bio-Based Economy (BBE). We argue that basing an economy upon ecology is an ambivalent effort, causing confusion and inconsistencies. The dominant framing of the damaged biosphere as a market-failure in bioeconomies such as the BBE is problematic. We present alternative conceptualisations of bioeconomies and indicate which concepts are overlooked. The philosophical perspective of Emmanuel Levinas is employed to develop a more profound understanding of the tensions at stake. We argue that humans necessarily seek to overcome their natural origin, yet can never fully control the biosphere upon which they are dependent. Levinas work is compared with that of Nicholas Georgescu-Roegen and found to be complimentary. We highlight the specific contradictions and discrepancies in the relation between economy and ecology, and work towards a genuine and consistent conceptualization of the BBE. Our hypothesis is that a principal heterogeneity between humankind and nature should be explicitly acknowledged – instead of the impossible, absolute amalgamation of economy and ecology strived for today – if a bioeconomy which truly operates within the carrying capacity of planet Earth is to be accomplished.

KEYWORDS

Sustainability; Bio-Based Economy; Circular Economy; Enjoyment; Levinas, Georgescu-Roegen

1. INTRODUCTION

One of today's most important concepts for addressing environmental problems is the 'Bio-Based Economy' (BBE), a new economic system, intensively invested into by the European Commission (EC) (cf. McCormick, 2013: 2589-2593). This transitional concept, however, faces many difficulties, as it currently remains ambiguous whether the BBE is primarily a

metaphor, e.g. merely inspiring minor recycling practices, or a necessary, *normative*¹ goal to transform the economic system towards one that operates within the carrying capacity of planet Earth (Pfau et al, 2014: 1232f; Asveld et al, 2019b). As this ambiguity is persistently present in the current, dominant understanding of bioeconomies, we seek to ask here after the precise nature of the relation between the biosphere and the economic sphere.

The EC itself repeatedly emphasizes the current need for “clear and unambiguous standards”, including a “common context” for discussing how economic sectors and companies can be engaged in the BBE and an operationalisation of “all pillars of sustainability – environmental, social and economic” (EC, 2012a: 13f). This call stresses, for example, that guiding concepts such as sustainability, Life Cycle Thinking and Circular Economy (CE) are still in need of thorough clarification. In consequence, it can be seen how the general project of establishing a bioeconomy might benefit significantly from the establishment of a common language, including a consensual vocabulary, more transparent conceptualisation and generally accepted semantics (Parada et al, 2018: 32-42). Therefore, providing a philosophy of the BBE will also contribute to understanding the challenges and the developmental potential of the BBE in the natural and social sciences.

In this paper we aim to contribute to a consistent and common understanding of the main idea of a bioeconomy: to base economy upon *bios*. We show how the BBE does not, currently, fulfil its supposed normative role. Recent studies indicate that although the idea of the BBE is promising, actual practices remain marginal. If companies adopt the BBE in their business practices, it is often still a side event and not part of their core-business (Jonker et al 2017: 21). For most contemporary economic actors, the BBE is understood as a new way of doing business-as-usual, in which biomass is primarily understood as a source of added value for economic returns, e.g. ancillary recycling projects. In consequence, the concept of a BBE is still fundamentally determined by economic principles which hinder the transition into a system that is inherently sustainable, i.e. based on the biosphere (Richardson, 2012: 284f). We will outline alternative conceptualisations of the notion of a bioeconomy, such as Nicholas Georgescu-Roegen’s (1971, 1975a), to contrast contemporary bioeconomic models and provide an elaborate analysis of Levinas’s phenomenological perspective on economy to clarify these discrepancies. Our hypothesis is that primary human tendencies towards ‘enjoying life’ conflict with unfolding long-term attention for embedding our living patterns into the carrying capacity of planet Earth. While these tendencies might explain the BBE’s overly narrow focus on a linear economy, in terms of growth, competition, production and consumption, they also provide an insight into the ambiguous character of contemporary policies and principal impediments to mitigating climate change.

This paper starts by displaying the conceptualisation of the BBE by disambiguating it. We position ourselves in current debates and carry out a first, descriptive investigation of the semantics currently at stake regarding the idea of a bioeconomy. Next, we explain our methodology, analyse Levinas’s understanding of economy and hold a comparative discussion on Levinas’s conceptual contribution. The main analysis focuses on the relation

¹ As opposed to guidelines or metaphors, which might merely serve as an inspirational model for sustainable practice, by ‘normativity’ we here mean: to strongly prescribe a norm that should be, but is not yet, realized. A normative bioeconomy, e.g., would imply hard obligations for actors.

between economy and ecology and uncovers a realm of qualitative concepts, absent from current policy. In the final Section we summarize the outcomes of the research and display the main differences between models such as the BBE and the concept of a genuinely bio-based economy, before drawing conclusions.

2. THE BIO-BASED ECONOMY – CURRENT SITUATION

It is evident nowadays that current linear economic systems, based on fossil fuels and other non-renewable resources, are rapidly depleting the Earth's ecological capacities and hitting limits, e.g. human induced climate change. In Europe, one of the major response strategies is the BBE. The EC has defined the BBE as a system of:

“Production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste as all materials discarded by one process are inputs for another process and are reused in the ecosystem” (EC, 2012a: 22).

However, there are many concepts and definitions of importance surrounding the term bioeconomy, such as CE, biomimicry and cradle-to-cradle. Furthermore, the concept of bioeconomy itself has been understood in many different ways.

In order to frame the scope of our inquiry and to make general sense of the main conceptualisation at stake, we must firstly dismantle some ambiguities. The concept of bioeconomy has been recently classified into three types by Vivien et al (2019: 189-190). Type I concerns a degrowth-conceptualisation, coined by Georgescu-Roegen (1971). This type of bioeconomy recognises the explosive nature of our exponentially growing economy and argues we should make fundamental, qualitative changes in our economic system and respect the ecological limits this system is founded upon to survive as a species. Type II is the ‘Science-based bioeconomy’ in which technological innovation is seen as the key factor for solving ecological problems. This perspective is paradigmatic of contemporary tendencies but can also be seen to offer an ‘economy of promises’ (Jasanoff and Kim, 2015; Vivien et al, 2019: 194). Finally, Type III is the ‘biomass-based economy’, which is closest to the strategy put forward by the EC. This type is not as technology-driven as Type II, but focuses on forestry, agriculture, fishing, chemistry and the use of biorefineries, aiming to transform biomass from a diversity of resources. Type III is not yet fully fossil-fuel free but might become sustainable, in the future (cf. Asveld, 2019a: 6f).

Types II and III currently dominate both the vision and practice of Type I. Vivien et al (2019: 195) define this as ‘The Hijacking of the Bioeconomy’. Type II and III fit together closely (both to each other and to contemporary economic tendencies) and oftentimes intertwine or overlap. Though opting for relatively ‘weak’ sustainability, they receive by far the most attention, support, resources, energy and investments. They seek to maintain traditional economic growth as well as general comfort and consumption and put their hopes in potential, future projects (cf. Birch et al, 2010: 2903f). Although this might already give a clear indication as to why people might intuitively prefer II and III over I, we will seek to deepen this understanding and connect it to principal tendencies within the human condition.

In recent years, the policy concept promoted most actively by the EU is the Circular Economy (CE) (EC, 2014). This shift is justified and relevant, as both BBE and CE are design-principles with the shared goal of effectively closing material cycles, just as nature does with biomass. Furthermore, CE in general poses a stronger form of sustainability than bioeconomies of Type II and III (Raworth, 2017; Murray et al, 2017: 373f). Yet, the addition of CE into the general conceptualisation further complicates providing an encompassing definition, because many different people are working on CE in numerous projects from a variety of perspectives. Kirchherr et al (2017) have gathered and analysed 114 existing definitions of CE in 17 dimensions and formulated a definition:

“A circular economy describes an economic system that is based on business models which replace the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations” (Kirchherr et al, 2017: 224).

There are two more concepts of importance here. ‘Biomimicry’ became a common denominator for the imitation of nature’s models in technological designs (cf. Benyus 2002; Blok & Gremmen, 2016; Dicks, 2017). Taking inspiration from nature has become a prevalent strategy in current technological innovation (e.g. surgical instruments based on octopus-arms). The design of any ‘bioeconomy’ is nature-inspired as well, but on the macro-level of global systems. The ‘Cradle-to-cradle’ concept, then, forms an essential aspect within this analogy; it views ecological cycles, in which all resources are cyclically regenerated, as a primary inspiration for economic systems (McDonough, 2002: 13f). These systems should imitate natural patterns in which no energy is lost in the transition from usage to depletion.

This multitude of fundamental concepts creates confusion and inconsistencies, as the EC admits (2012a: 11). There is not yet a single, clearly framed ‘bioeconomy’ to focus joint efforts upon, as each definition has its own shortcomings, whether semantically, conceptually or in practice. In an attempt of conceptual unification, we present Figure 1. This admittedly imperfect, yet both pragmatic and paradigmatic visual representation of the CE provides a first step towards comprehending the general, underlying idea of the concepts of BBE, CE, biomimicry and cradle-to-cradle.

The depiction can be seen as a biomimetic effort to base human designs upon processes in the biosphere; systems of biological and technical nutrients (top) are aimed to function analogously, namely as ecological circularity. The biological ingredients – biomass – (left) can, after consumption (centre), safely be re-introduced into the biosphere, instead of resulting in redundant waste, similar to the energy reuptake from compost by vegetal species (cradle-to-cradle). Technical, non-consumed materials (right) cannot be recovered in the same way, yet the aim is to establish an analogous metabolism in which all used materials provide renewed inlet (far right) for the next production-cycle. Such an objective is typical of Type II

and III bioeconomies which, rather than adapting the internal economic system to fit ecological boundaries, pose a promise of sustainability through technological innovation and biomass-usage.

[INSERT FIGURE 1 HERE]

If we take this idea of reshaping current systems into cyclical and regenerative ones, based on and inspired by ecological processes, we can identify the central, underlying aim of both BBE and CE as *connecting an economy to ecology: basing an economy upon the biosphere*.² The main idea is to make (human) economy similar to biological processes, such as the circularity of natural ecosystems, energy cycles and the Earth's carrying capacity, as these ecological lapses appear to be structurally renewable and in accordance with balanced ecosystems. This idea can be recognised in all projects and aims of describing economic and ecologic cycles, producing and implementing biomass on as many levels as possible (e.g. agriculture, plastics, marine environment) replacing non-renewable resources, improving waste processing, transforming manufacturing, converting waste into value added products, maintaining energy-levels and innovating for technological solutions.

Thus, all types of bioeconomy, CE, cradle-to-cradle and biomimicry, stronger or weaker, involve design-principles in the common goal of closing material cycles, just as nature does with biomass. However, currently these principles mainly provide guidelines for future objectives, i.e. they are not yet optimally realized. The non-circular arrows that end in 'landfill', for example, show how the biosphere is only partially or metaphorically instructive for the technological cycle. This difference between ideas and actual practice demonstrates how *a relation which aims to base the economic sphere on the biosphere* is principally at stake in the transition towards an accomplished bioeconomy.

However, in order to adequately and consistently *base an economy upon the biosphere*, it should be transparent what this 'basing-on' entails. Ecology and economy are certainly related, but the borderlines are blurred, and their exact relation – including a strategy for the BBE – remains unclear because the two spheres at stake in the BBE have both differences (ecology is about systems in nature itself, which humans affect by economic practices: polluting, disturbing biodiversity, depleting resources, etc.) and similarities (both discuss the *oikos*, the house or environment in which a reciprocity between nature and man, nature and nature, or man and man exists). This ambivalence has resulted already in a field of ambiguities and possible questions, such as what exactly it means and entails to operate within the carrying capacity of our *oikos*, planet Earth (Jonker, 2012; Wahl, 2006; Muijsenberg, 2017). This leads us to ask three questions: how is the environment understood in the BBE? How are economic systems and processes understood in the BBE? What can be said about this main idea of combining ecology with economy in bioeconomies?

² A bioeconomy is an economic *system* comprised of economic *processes*. We seek to investigate here the general relation between everything economic and the biosphere, i.e. ecologic systems and processes. We try to clarify each use of the term 'economy' in this paper semantically but some confusion is, as we explain, inevitable. Furthermore, with Levinas's understanding of economy, we will encounter a third, encompassing meaning of 'economy', in the sense of a category of the human condition.

As the BBE is a vast, encompassing project spread over a multiplicity of sectors and fields, comprising a total worth of about 2 trillion euros per year (EC 2012a: 11), a significant amount of discussion already exists. The majority of such discussion consists in analyses of specific parts of the BBE (biomass production, technologies, the food-fuel debate, use of genomics, etc.) with regard to the possibility and details of their practical execution (e.g. Asveld, van Est & Stemerding, 2011: 109). Problems arise regarding internal consistency, general clarity and agreement on key terms within the BBE as a comprehensive undertaking (e.g. Osseweijer, Landeweerd, Pierce, 2010: 27f). Extensive analyses of the varying understandings of the BBE, e.g. bio-technology, bio-resource and bio-ecology have been made in an attempt to reach consensus (e.g. Bugge, Hansen, Klitkou, 2016). Normative research has taken up this general confusion to argue the BBE's consideration of sustainability should be addressed in a more interdisciplinary and therewith more effective manner (e.g. Pfau, Hagens, Dankbaar, Smits, 2016: 1222). This kind of normative conceptualisation is shared in a more fundamental critique on the discontinuity in the BBE's general paradigm, insisting on the vital importance of clarifying the basic relations between natural and economic systems (Bensaude-Vincent, 2018; Dicks, 2017).

The hiatus between economic and ecologic systems is a common topic in BBE-related literature on business ethics (Frazzetto, 2003; Finegold et al, 2005). Ethical literature on the BBE is mostly primarily focused on the social and political aspects of the BBE, such as governance, responsible innovation, and differences between national economies (Benner & Löfgren, 2007; Kitchen & Marsden, 2011). Finally, literature which both investigates the BBE ad hoc and comprises the ethical aspects and fundamental relations at stake in it, e.g. the relation between economy and *energy* (Zwier & Blok, 2015) or nature and technology (Blok & Gremmen, 2016) are still scarce, but upcoming. Especially relevant in this latter category is the work of Giampietro (2019), who argues the panacea sought after in bioeconomies – to simultaneously avert the ecological crisis and enable uninhibited economic growth – is unrealistic and proposes, rather, the entropic perspective of Georgescu-Roegen to develop the necessary theoretical foundation for a true bioeconomy, which understands the difference between economic narratives (business models) and thermodynamic narratives (biophysical constraints).

The relation between the biosphere and the economic sphere is highly complex, which partially explains the confusion and inconsistency in bioeconomy-debates. Already in the three different types of bioeconomy we could see three different conceptualisations of this relation; Type I is eco-/bio-centric, understanding ecology as a realm which encompasses and conditions all economic activity; Type II is techno-centric, considering technological (i.e. economic) innovation the best candidate to solve ecological problems; Type III is biomass-centric, which means it deems a certain ecological resource (biomass) to be of fundamental importance in practicing sustainable economics (Vivien et al, 2019: 191-193). As Type II and III are currently dominant, one might inquire whether they express the relation correctly.

The biosphere and the economic sphere are neither clearly distinct nor clearly similar. Firstly, an economy is subjugated to natural boundaries: financial actors, like all organisms, have biophysical foundations requiring oxygen and nourishment. This reality is, however, reversed in our everyday conceptualisation, which understands the biosphere as mere provider

of resources for economic processes. Secondly, what we deem ‘economic processes’ exists in nature equivalently, as networks of trade, communication, house-holding and even management can be encountered in natural systems. For example: competition for light amongst trees (distribution), elaborate reciprocal reticulations between fungi and vegetation (trade) and cooperation for survival in the animal kingdom (services/manipulation) can be recognised as economic realities (Oudemans & Peeters, 2015). Thirdly, even if the two spheres were to be clearly distinct, economies cannot just blindly mirror ecological principles, as entire species go extinct in evolutionary cycles, which is unacceptable from an ethical perspective in human spheres (Blok & Gremmen, 2016: 207f).

In light of the effect of human economic systems on natural systems through processes of pollution, temperature change, biodiversity decrease, energy depletion, etc., the ecologic and economic sphere seem fundamentally *opposed* (cf. Hamilton, 2017). However, even this distinction is not univocal, for it overlooks a fundamental similarity between the spheres: ‘eco-’, *oikos*, *home*. Both economy (nomos-of-the-oikos) and ecology (logos-of-the-oikos) investigate the reciprocity between actors and their home-environment (oikos), ranging from living within a household to living within the eco-systems of planet Earth.

One cannot demonstrate the failure of an idea in itself. However, specific instances of the realization of an idea *can* be investigated. These specific instances can, accordingly, show which underlying idea is at stake, both semantically and normatively. We choose as an example a quote from BBE-policy:

“To conquer this new frontier [seas and oceans], advanced knowledge on marine living resources is necessary to maximise its exploitable value in a sustainable way, optimise the response to climate change and mitigate human impacts on the marine environment (...)” (EC, 2012a: 33).

From this, it can immediately be seen how the BBE-policies presuppose a very specific understanding of the relation between economics and nature as a language of technological control, efficiency, management and dominance is employed. However, it is clear how those semantics contradict the idea of ‘mitigating human impacts on the marine environment’, put forward in the same sentence which states we must ‘conquer’ the ocean and ‘maximize its exploitable value’. The relation between the biosphere and the economic realm is *asymmetric* here, as economic demands determine the manner in which the biosphere should receive assistance. Assistance, from humans, to help the ecosphere to cope with humanity. The document’s section on sustainable fisheries continues to take this asymmetric approach. For example, consider the following quote:

“It can be expected that applications from blue biotechnology will contribute to the production of sustainable and healthy aquaculture products by ensuring better control of reproduction processes, developing innovative methods for selective breeding, feed ingredient optimisation (...) [and] energy production” (EC, 2012a: 34).

To sustain ocean-life – i.e. to not consume all fish at once, leading species and populations to decrease drastically or even go extinct – the policy suggests *ensuring better control* over these populations. Technology is put forward to establish controlled reproduction processes: managing, overseeing and manipulating the ecosystem will *help* these systems to be exploited

in a repeatable manner. Ecology appears here as a dimension in need of assistance, control, regulation and exploitation, and never as a sphere with any intrinsic value.³ For example, the vassalage of the fish's reproduction cycles is overlooked and implicitly deemed unproblematic.

The *need for help* perceived in ecological systems is consistently addressed with a strategy of manipulation and management. This can be shown by discussing another exemplary case of EU-policy, this time in the context of agriculture:

“Research and innovation will aim at increasing the adaptive capacity of plants, animals and production systems to cope with rapidly changing climate conditions and environments, as well as increasingly scarce resources” (EC, 2012a: 30).

The human reaction of *helping ecology* – in this case, to subsist within a changing climate – is developed and justified in the context of the increasing scarcity of resources. Trees are not discussed as vital components for Earth's life-supporting ecosystem but, rather, deemed scant assets in a market. These semantics of scarcity are evident everywhere in the policies, e.g.:

“An important goal is to mobilise more wood in appropriate areas while safeguarding biodiversity and other public goods delivered by forests” (EC, 2012a: 31).

The biosphere is conceptualized as source of resources and the necessity of sustaining it is motivated predominantly from the perspective of economic return. Unhealthy eco-systems are, first and foremost, a risk of market-failures (Blok, 2018: 205).

Our preliminary analysis of the relation between the economic sphere and the ecologic sphere in the BBE encounters a presupposed, univocal dominance of economic processes over ecological boundaries. The biosphere is consistently and solely discussed in the context of market competitiveness, economic growth, industrial purposes, stakeholder interest and technological innovation (symptomatic of Type II and III bioeconomies). These predominantly economic semantics are, in their context, understandable and sensible. Yet, contemporary strategies harbour a paradox because, on the one hand, the idea of the BBE – becoming ‘bio-based’ – seems to imply a solid or even inherent connection between economics and the biosphere but, on the other hand, the ecologic sphere is understood as an extension of the economic sphere in which market failures are addressed. This onerous ambiguity must be clarified.

3. LEVINAS ON ECONOMY AND ECOLOGY

Emmanuel Levinas's philosophical concepts have been influential in many different disciplines. His notions found an echo in areas such as medicine (Clifton-Soderstrom, 2010), pedagogy (Zembylas & Vrasidas, 2005), business ethics (Tajalli, 2019), business administration (Blok, 2018) and psychoanalysis (Todd, 2003). Although his ethical work has been recognised globally (e.g. Druker, 2006), his *ontological* writings on economy and elementary nature have barely been employed in environmental philosophy. Levinas provides

³ The eco-centric concept of intrinsic value holds that nature has value in itself, independent of any anthropocentric or economic functionality (cf. Hill, 2006; Preston, 2001).

an original account of what ‘economy’ means, directly connected to its biological limits, whilst simultaneously explaining the human tendency to control. Whereas e.g. Heidegger’s ontological-phenomenological analyses have already been broadly used to consider notions such as degrowth and releasement towards threatening technology (cf. Heikkurinen, 2018; Kerschner et al, 2018; von Schomberg & Blok, 2018), Levinas’s most crucial additions to this discourse remain largely untouched.

Edward Casey uses Levinas’s notion of ‘the Other’ to discuss the human attitude towards nature. He writes:

“Whatever the profitability of the situation may be in the eye of a logging company executive, there was undeniable disfigurement in the land: the aesthetic join forces with the ethical in this scene of destruction. My glance was drawn into the heart of its darkness. This is the moment of pain that calls for alleviation by the appropriate action.” (Casey, 2003: 200).

Casey’s straightforward approach to make ethical claims for the sur-face of the Earth from Levinas’s concept of the face of the Other is, however, a much-debated position in contemporary literature on the topic as even in highly similar and related perspectives, it consistently remains problematic whether Levinas’s ethics can be applied to the environment (Nelson, 2013; Diehm, 2000; Welsh, 1998).

Contrary to Casey, the ethical rupture between two human individuals is not the only original structure in Levinas’s work. Between the Self and nature, a similar separation occurs. The ambivalent structure of said gap fundamentally underlies Levinas’s ontological work (Levinas, 1963 & 1998; Derrida, 1978; cf. Cools, 2015) and is more adequate for discussing sustainability and economics. Toadvine (2003, 2012) argues that it is possible to distil from Levinas’s thought a heterogeneous conceptualisation of the relationship between man and nature, relevant today. More such advanced connections between (Levinassian) philosophy and environmental issues can already be found in books such as *Eco-phenomenology* (Brown et al, 2003) and *Facing Nature* (Edelglass et al, 2012). The former project provides the basis for the approach taken here. Our aim is to demonstrate the relevance of Levinas’s philosophy in the concrete context of the problems regarding the concept of a bioeconomy.

Levinas did not, himself, discuss ecological sustainability directly. In fact, one of the only authors that explicitly discussed something like a bioeconomy (Type I) in that time was Georgescu-Roegen. Levinas, then, grants here an elaborate *phenomenological* perspective to strengthen and deepen the concept of these Type I bio-based economic processes. A Levinassian perspective, for example, adds directly into the equation of the relation between the economic sphere and the biosphere a conceptualisation of ‘*enjoyment*’, the qualitative aspect of the human condition.

The second part of Levinas’s *Totality and Infinity* is called “Interiority and Economy” (1969: 109-183). Levinas’s phenomenological discussion of economy is in the context of *the* (ontological) *Self*, or ‘interiority’, as opposed to the vast majority of his writings which aim to address the (ethical) Other, or exteriority. ‘Economy’ appears, consequently, as a matter which must be discussed in the realm of egoic survival, quantitative existence, needs and necessity. Moreover, Levinas’s understanding of economy cannot be complete without considering his reference to the ecological conditions of economic realities.

Between the Self and nature there is, in Levinas, an ontological separation. Nature *an sich* constitutes a dimension from which humans are principally separated because Levinas deems an absolutely eco-central perspective impossible for us, anthropocentric humans. Beyond our view is an unpredictable, unfathomable, interminable (bio-)sphere, nature itself (which Levinas calls the '*il y a*'). Of course, we are dependent upon the biosphere in requiring oxygen and food. However, as humans, we also fundamentally tend to overcome and transcend this dependence by establishing protective habitation, safeguarding resources through labour and other economic activity. The Self is constituted through both a natural metabolism of an economic character and a commerce with an inscrutable biosphere. For Levinas, economy is about the establishment of personal identity – the Self – within the vast biosphere, about securing the presence of nourishment via labour, and about such things as living in a house to protect oneself from the elements of nature. This dual intercourse between economy (here: a category of the human condition) and ecology allows for an analysis of the '*il y a*' as the biosphere itself. With hostile, unknown elementary nature, it is not an (infinitely) different person to be faced, but an ominous ecological enigma.

Economy for Levinas is the process in which the Self conserves its egoic existence, interacting with the world in order to stay alive. Principal interactions consist of acquiring nourishment and safeguarding shelter, which can be achieved through the effort of labour. Levinas describes this economic process with the notion *living-from*. The Self lives *from* its world, from nutrients, oxygen, housing, etc. Living-from indicates a certain 'metabolism': economy for Levinas means living *via* the environment in modes such as consuming other organisms, trading, seeking shelter, and obtaining resources. These economic concerns for self-perseverance originate from the uncertainties inherent to the vast, encompassing biosphere upon which the survival of the Self is dependent: will there be enough to eat tomorrow, will I have a place to live tomorrow, will we be able to breathe tomorrow? As such, Levinas's discussion of economy displays an intrinsic connection between economy and ecology: overcoming fear of shortage through labour, for example, is directly linked to the uncertainties springing from an unpredictable, hostile environment in which only the fittest survive.

The relation between both eco-spheres can, from Levinas's perspective, be more specifically thematised as a reciprocity between "The I and the not-I" (1969: 87;143f). Eating, for example, is the transferral of something from the external biosphere into the sphere of the Self: through metabolism, parts of the surrounding world become part of the Self. This back-and-forth between the Self and all things outside of it is a distinctive characteristic of economy for Levinas, because it is *labour* through which externalities are modified into individual perseverance. By catching fish, to stick with a familiar theme, one takes from the external biosphere. Labour is the economic means in between the raw element ('pure nature', in this case the ocean) and the ultimate consumption of a specific sardine by the Self. In the same way the body processes the fish (or non-I) into energy for the Self, labour translates concerns for the future into controllable systematics. The economic structure of labour exists as a mediation of the biosphere into modes of self-perseverance. Nature in this sense can, indeed, be controlled and translated into resources.

Yet, the back-and-forth between the I and the not-I has clear limits for Levinas. Although seizure is a primordial structure of the Self, not everything can be grasped and usurped within a closed metabolism. For example: systematic fishing establishes a certain dominance over the ocean by helping to overcome fear of shortage. However, ‘the ocean as such’ cannot be controlled in its entirety. As a primary element of the biosphere, the ocean has its own elemental shape and remains exterior, unfit for total human stewardship (NOAA, 2019). For Levinas, this pure nature is never directly, ‘eco-centrally’ visible but, rather, principally beyond human, anthropocentric knowledge. Economy is, certainly, in strict relation with ecology, but they do not fully coincide. The biosphere, from which we originate and upon which we depend for our survival, is conquered by economic practices – but only to a certain degree. The impossibility of full dominance over the biosphere indicates an essential heterogeneity between economically controllable nature and uncontrollable nature itself, making the relation between economy and ecology twofold; the contradictory semantics encountered in literature such as ‘Sustainable Growth’ (EC, 2012a) are symptomatic of this original juxtaposition.

The connection between economy and ecology, and the limits at stake in it, can be sharpened from Levinas’s understanding of *the house*, the place from-which we live (*oikos*). Living-in the ecosphere means being dependent upon oxygen, food, etc. The economic house, on the other hand, is used to protect us from the elements, modifying our place within the ecosystem, and constitutes a fundamental domain of accommodation from which we depart and to which we return in daily, self-evident familiarity. In the same way labour creates the bridge between raw nature and pleasant consumption, the house translates the interminable outside world into structures of exploitation, complacency, possession and seizure. Living in a house is not the objective of labour, but its condition: as the locus *from-which* one lives and works, and even through which one sees and understands the encountered world, the house is a prerequisite for typically human affairs such as coming around, withdrawing, hospitality, to come and go and welcoming. The house shows the necessity of overcoming the anonymous, hostile ecosphere in which we live, altering and controlling it through specific economic structures. Ecology and economy share the aspect of *oikos* (eco-), as both terms indicate a locus of habitation, but Levinas’s understanding of this ‘living-from’ demonstrates, once again, a strict difference between raw, unforgiving nature (*il y a*) and economically established comfort (*oikos*). Living-in a biosphere means being dependent upon an unfathomable outside world; living-from a house means having controlled certain aspects of nature, enabling a more worry-free existence.

Thus, we recognise in Levinas that humans tend to overcome their natural habitat, and that this reciprocity can be seen as a (morally neutral) metabolic process, concerned with the survival of the Self. This means it is implied in our very ecological conditions that we seek to overcome those conditions (hostile, elementary nature), through economic practices. Economy for Levinas is, thus, *sine qua non* of human life, of the constitution of the Self; economic processes are necessary to overcome the anonymous, elemental biosphere, vastly lying behind us as an invisibly constituting origin. Yet, being involved in an economic system does not, therefore, coalesce with being-human. Human life itself here, is always also something more than use, function, sense or objective.

Beyond mere staying-alive, trade and nourishment, Levinas indicates an independent dimension in which pleasantries can be enjoyed, but also in which pain can be felt: the dimension of enjoyment (*jouissance*), fulfilling the egoistic Self with life's content or meaning. Enjoyment is the completion of the constitution of the Self, located before any ethics still: fully innocent. Being a human individual means to originate from a constitutive biosphere, to overcome it through economic practice and, ultimately, to enjoy being human. Levinas marks a difference between nourishment as a mere means to survive, or even the practice of obtaining food and satisfying hunger, and the *enjoyment* of the food in this economic process which cannot be reduced to such an economic process since it does not have any metabolic functionality. Enjoyment emerges from economic commerce, but cannot be reduced to economic labour or survival, as it consists in the very act of the corporeal "me biting into the bread" itself (Levinas, 1996: 111). The concept of sensually experienced eating both transcends the elementary biosphere and the labour aimed at obtaining resources for Levinas, because the act of sinking one's teeth into food as such constitutes an absolute *independency* from any ecological necessity or financial concern. Enjoyment does not have a function, but is certainly valuable because it poses the very independence making us human for Levinas. Summarising, for Levinas, bio-based means: living-from the biosphere, both dependent upon it and away-from it, towards human happiness and enjoyment.

4. COMPARING LEVINAS AND GEORGESCU-ROEGEN ON THE BIOECONOMY

The value of Levinas's analysis can be further understood in a systemic comparison with Georgescu-Roegen's ideas on bioeconomy, for there exist great similarities and complementarities. According to Levinas, we live *from* the world in the sense of originating from a conditional biosphere upon which we, as an organic species, are dependent; in this sense, our economic practices are always already 'bio-based' in the literal sense of the word. Simultaneously, however, living-from means we live *away-from* this biosphere in the sense of *overcoming* the elemental, hostile Earth by transfiguring our natural being through economic structures such as labour. Thus, from Levinas's perspective, we must say that on the one hand, *all* economy is bio-based – and not just in the specific sense of basing processes upon renewable resources. On the other hand, then, we see a system of economy can never be bio-based in a *total* sense, because something like a BBE is conditioned by a *bios* which cannot be absorbed in the economy itself and must be lived away-from: the elementary nature, *il y a*.

Georgescu-Roegen discusses the issue of a bioeconomy when he points out how the (thermodynamic) ecological law of entropy should be taken seriously in economics (Georgescu-Roegen, 1975a). He points out a distinction between the standard, mechanistic (Neoclassical) model of production and consumption and actual biological energy-cycles from geological shifts to our own metabolisms (cf. Giampietro, 2019). He shows the faults of traditional linear thinking by inexhaustibly demonstrating how it relies on a multitude of flawed notions like eternal growth, immortality, stationary states and other such 'Myths' (Georgescu-Roegen, 1975b). He then explains how our economy, rather, exists within an ecological realm of entropic energy, governing everything with an incomprehensible

magnitude. For example, “there is an astronomical difference between the amount of the flow of solar energy and the size of the stock of terrestrial free energy” – all the solar power harnessed in fossil reserves “could produce only two weeks of sunlight on the globe” (Georgescu-Roegen, 1975b: 370). Indeed, biological life evades entropic degeneration – but it *never* controls it in full, not even close. Rather, our behaviour has particular consequences for future availability of energy, resources and humanly inhabitable conditions. As we become increasingly dependent upon and addicted to external processes and continue to use all available and not just the *accessible* resources, Georgescu-Roegen argues we should expect systemic failure of current economic models, as they will never be epistemologically able to answer to the principal, qualitative novelty (including natural and economic laws) bound to arise from the disrupted evolution-process.

Georgescu-Roegen focuses on the disturbed balance between the *natural* process of human evolution and the exosomatic technological objects which disrupt, accelerate and fundamentally alter this natural proceeding (Mayumi, 2001). He indicates as two of the major predicaments of current, traditional economic course (exosomatic evolution) both irreducible social conflict and inequality amongst exosomatic species. He writes that:

“The second change is man's addiction to exosomatic instruments (...). It is because of this addiction that mankind's survival presents a problem entirely different from that of all other species. It is neither only biological nor only economic. It is bioeconomic.” (Georgescu-Roegen, 1975b: 369).

To avoid these predicaments, depending on a multitude of economic asymmetries, would imply altering the course of increasing both production and consumption and produce new economic *processes* rather than mere commodities. For example, constituting a genuine bioeconomy, by taking measures such as reducing population, eliminating waste and luxury, aiding underdeveloped countries and other such drastic reversals of economic patterns (Mayumi, 2009).

As shown in Table 1, there are numerous similarities to Levinas’s viewpoints. First, Levinas takes biological metabolisms of energy-exchange (living-from) as a methodological start to conceive of economic behaviour and, like Georgescu-Roegen, draws analogies in their functionality. Second, Levinas understands this economy-ecology relation from a fundamental notion of separation of mankind from the natural proceeding of time. Third, he indicates an epistemological ceiling when discussing the ecological counterpart of economic systems. Fourth, he understands the human tendency to control and comfort expressed in economic behaviour. Fifth, he recognises a great danger in the unpredictable unknown natural world behind our knowledge. Finally, he thoroughly understands the limits to human control when weighing rapid consumption against a more balanced, sustainable variant, based on the cycles of the Self.

[INSERT TABLE 1 HERE]

A significant difference also exists between these two conceptualisations of ‘bio-based economy’. Georgescu-Roegen explicitly conceives of economic strategies to counter emerging obstacles in the course of transitioning towards a bioeconomy, e.g. by proposing a

dialectical approach to economics, beyond the traditional, arithmetic one. Levinas, operating at the level of fundamental ontology, did not propose such concrete ideas of economic transformation. Rather, the value of his conceptualisation lies in its phenomenological perspective. Levinas, complementary to Georgescu-Roegen, is able to explain how, as humans, it is both necessary to overcome the hostile, natural world by establishing trade, labour and housing (oikos) and – simultaneously – impossible to gain complete control over the biosphere. This juxtaposition can be experienced on a daily basis, e.g. by driving a polluting car to work without intending to do ecological harm. Georgescu-Roegen indeed provides such concrete, everyday examples, but the complete perspective of Levinas's phenomenological analysis is more thorough, substantial, elaborate and incorporates the unique dimension of experienced life.

This is the true value of Levinas's philosophical view: the manner in which he makes these topical, twofold themes comprehensible from an everyday, lifelike consumer-perspective. This qualitative addition to the bioeconomy-debate can be seen most sharply in Levinas's notion of enjoyment; this appreciative dimension of human existence can only exist on the basis of the ambivalent reciprocity between the biosphere and economic practice. Indeed, Georgescu-Roegen mentions such enjoyment explicitly: "the real output of the economic process (or of any life process, for that matter) is not the material flow of waste, but the still mysterious immaterial flux of the enjoyment of life" (Georgescu-Roegen, 1975b: 353) but does not elaborate on the precise meaning of this phrase any further. Levinas does so for chapters, as he explicitly connects to the economic process of self-preservation the *qualitative* dimension of the enjoyment (*jouissance*) of life and thematizes how both the structural, functional economic elements (techno-oikos) and the biological conditions for life are required to constitute the human condition at all. From such a conceptualisation, it can be understood how humans are always already 'bio-based' and what that means today.

Levinas's analysis of economy fits amongst critical, heterodox accounts of economy such as Georgescu-Roegen's. Type I bioeconomies fundamentally argue for the need to shift our conceptualisation: the biosphere is not a subsystem of our economic systems, but an encompassing, unfathomable realm which conditions us always. From this reversal, it follows immediately that future economies should focus much more on the qualitative elements of this system. Born from ecological conditions, man overcomes this nature by practicing economy, in order to ultimately *enjoy life*. In Figure 2 we display a representation of relevant and related concepts in Levinas's analysis of economy. We see how mankind (left), in its economic processes, is intrinsically conditioned by enjoyment and ethics, which are, thus, not directly relevant to the economy-ecology-relation itself. Nature (right), on the other hand, is displayed as twofold: both partially controllable and uncontrollable. As we demonstrated, current bioeconomies, such as Europe's BBE, are located still completely within the boundaries of controllable oikos and are fully conceived of in terms of control, growth and production.

[INSERT FIGURE 2 HERE]

Comparing our model with the Butterfly-diagram in Figure 1, it becomes clear that the two representations (in the two Figures) belong to two non-equivalent descriptive domains. Fig 1.

attempts to depict the relation between flows of technological and biological nutrients in a controlled, economic metabolism which includes the very biosphere. The assumption is that there exists a common system of control based on the shared identity of the two metabolic systems; the biological nutrients on the left are assumed to be controlled by an anthropocentric metabolic cycle and the flow of technological products on the right is presupposed to be controlled by human society. Europe's BBE, e.g., fully ignores the heterogeneity between humanity and nature. It is framed entirely in economic – i.e. human – terms, posing merely a human-based economy without even conceptualising any facet of this humanity but its functionality. This homogeneous, pristine amalgam between economy and ecology is a misapprehension.

From heterodox accounts of bioeconomy such as Georgescu-Roegen's we see that the spheres are vastly distinct (Georgescu-Roegen, 1971). From Levinas's economy-analysis it became clear that the two sets of metabolised flows in Figure 1 refer to radically distinct processes of self-preservation; Levinas, indeed, draws up an analogy between economic processes and ecologic cycles such as our own biological metabolism, making understandable a primary tendency to overcome the natural world – but he also indicates very clear limits to human control (Levinas, 1996). Levinas insists on the existence of a strict (ontological) heterogeneity (or separation) between man and nature. Both the structural, functional economic elements (techno-oikos) and the biological conditions for life are required to constitute the human condition, enjoyment, without which any bioeconomy would be pointless.

Figure 2 then, on the other hand, is an attempt to depict the system of self-preservation in all the categories that are relevant for its success as indicated by Levinas and Type I bioeconomies. We need a consistent view of what (information-)identities are at stake in the transition into an economic system, truly *based-on the biosphere*, aiming to uptake all facets relevant to it, and not just the humanly-controlled ones. From our analysis it can be seen how sensibility, consciousness, appreciation and experienced quality of life (enjoyment) constrain the possibilities of the human oikos being economically practiced. We can never fully control elementary nature and neither should we focus our aim on that sole purpose. The very tendency to overcome natural obstacles is founded in the constitutive aspect of ecology, as Levinas showed. Yet, today, it is time to re-embed behaviour within the limits of the planet, precisely to keep living here.

5. CONCLUSIONS

The argument in this paper consisted of five steps. First, we argued that the idea of the BBE – basing economic systems upon ecological processes – is highly susceptible to confusion, as both fundamental similarities and differences exist between economy and ecology. Second, the problematic consequences of such confusion were shown, by pointing out how the economic sphere dictates ecology in current 'bio-based' economies: the broken biosphere is treated as a market-failure, in need of help and control. This domination of the biosphere overlooked any intrinsic value of nature and is counterproductive in altering contemporary,

problematic economic structures. Third, we brought Levinas's conceptualisation into the equation. Through an analysis of his non-ethical conceptualisation of economy, we gained a more profound understanding of the tensions between economy and ecology. As humans, it is both necessary to overcome the hostile, natural world by establishing trade, labour and housing (oikos), and – simultaneously – impossible to gain complete control over the biosphere (il y a). Fourth, we extrapolated Levinas's conceptualisation into the discussion on bioeconomies, comparing it to Georgescu-Roegen's notions while highlighting complementarities. Fifth, we demonstrated how Type II and III notions of bioeconomy such as the BBE are exceeded on both sides: before any human activity lies the conditional, unfathomable biosphere, and beyond all economic value and functionality lies the human condition (enjoyment).

The relation between economy and ecology is heterogenous, ambiguous and contradictory. Aggregating the two – basing economy upon the biosphere – will pose a major challenge, and not lastly on the conceptual level. Current bioeconomic strategies and actions should consider fundamental dimensions of nature and mankind as a priority, rather than the traditional economic models of growth and exploitation right now. Dominant thought on bioeconomy still seems to presuppose all of the biosphere as an exploitable, controllable resource. Levinas insisted on an account of nature which is principally enclosed, untameable, infinitely far away and beyond any domestication and on an account of qualitative humanity, experiencing and enjoying life at each time, being more than actors within the market trying to survive.

REFERENCES

- Asveld L., R. van Est and D. Stermerding. 2011. *Getting to the core of the bio-economy: A perspective on the sustainable promise of biomass*. The Hague: Rathenau Instituut.
- Asveld, L., Osseweijer, P. and Posada Duque, J. 2019a. 'Societal and Ethical Issues in Industrial Biotechnology'. In *Advances in Biochemical Engineering/Biotechnology*. Springer. https://doi.org/10.1007/10_2019_100
- Asveld, L. 2019b. 'Towards including social sustainability in green and sustainable chemistry'. *Current Opinion in Green and Sustainable Chemistry* **19**: 61–65. <https://doi.org/10.1016/j.cogsc.2019.06.001>
- Benner, M., Löfgren, H. 2007. 'The Bio-economy and the Competition State: Transcending the Dichotomy between Coordinated and Liberal Market Economies'. *New Political Science* **29** (1): 77–95. <https://doi.org/10.1080/07393140601170842>
- Bensaude-Vincent, B. 2019. 'Bio-informed Emerging Technologies and Their Relation to the Sustainability Aims of Biomimicry'. *Environmental Values* **28**: 551–571. <https://doi.org/10.3197/096327119X15579936382392>
- Benyus, J. M. 2002. *Biomimicry: Innovation inspired by nature*. New York: Harper Perennial.
- Birch, K., Levidow, L. and Papaioannou, T. 2010. 'Sustainable Capital? The Neoliberalization of Nature and Knowledge in the European 'Knowledge-based Bio-economy''. *Sustainability* **2**: 2898-2918. <https://doi.org/doi:10.3390/su2092898>
- Blok, V. 2015. 'The Human Glance, the Experience of Environmental Distress and the "Affordance" of Nature: Toward a Phenomenology of the Ecological Crisis'. *Journal of Agricultural and Environmental Ethics* **28** (5): 925-38.
- Blok, V. 2016. 'Biomimicry and the Materiality of Ecological Technology and Innovation: Toward a Natural Model of Nature'. *Environmental Philosophy* **13** (2): 195–214.
- Blok, V. 2018. 'Information Asymmetries and the Paradox of Sustainable Business Models: Toward an Integrated Theory of Sustainable Entrepreneurship'. In *Sustainable Business Models*, pp. 203–225. Edited by L. Moratis and F. Melissen. Dordrecht: Springer Netherlands.
- Blok, V. and Gremmen, B. 2016. 'Ecological Innovation: Biomimicry as a New Way of Thinking and Acting Ecologically'. *Journal of Agricultural and Environmental Ethics* **29** (2): 203.
- Bosman, R. and Rotmans, J. 2017. 'Transition Governance towards a Bioeconomy: A Comparison of Finland and the Netherlands'. *Sustainability* **8** (10): 1017.
- Bugge, M., Hansen, T. and Klitkou, A. 2016. What Is the Bioeconomy? A Review of the Literature. *Sustainability* **8** (7): 691. <https://doi.org/doi:10.3390/su8070691>

- Casey, E. 2003. 'Taking a glance at the environment: Preliminary Thoughts on a Promising Topic'. In *Eco-phenomenology*, pp. 187–211. Edited by Brown, C. and Toadvine, T. New York, NYS: State University of New York Press.
- Clifton-Soderstrom, M. 2010. 'Levinas and the Patient as Other: The Ethical Foundation of Medicine'. *Journal of Medicine and Philosophy* **28** (4): 447–460. <https://doi.org/doi:10.1076/jmep.28.4.447.15969>
- Cools, A. 2015. 'Levinas's Defence of Intellectualism: An Undecidable Ambiguity?' In *Debating Levinas's Legacy*, pp. 3–16. Edited by Breitling, A., Bremmers, C. and Cools, A. Leiden: Brill.
- Derrida, J. 1978. 'Metaphysics and Violence'. In *Writing and Difference*, pp. 97–193. Translated by Bass., A. Chicago, IL: Chicago University Press.
- Dicks, H. 2017. 'The Poetics of Biomimicry: The Contribution of Poetic Concepts to Philosophical Inquiry into the Biomimetic Principle of Nature as Model'. *Environmental Philosophy* **14** (2): 191–219.
- Diehm, C. 2000. 'Facing Nature: Levinas Beyond the Human'. *Philosophy Today* **44** (1): 51–9.
- Druker, J. 2006. 'Ethics and Ontology in Primo Levi's "Survival in Auschwitz": A Levinassian Reading'. *Italica* **83** (3/4): 529–542. <https://www.jstor.org/stable/27669104>
- Edelglass, W., Hatley, J. and Diehm, C. (eds). 2012. *Facing Nature*, Pittsburgh, PA: Duquesne University Press.
- Ellen MacArthur Foundation. 2014. 'Towards the Circular Economy: Accelerating the scale-up across global supply chains'. Vol. 3.
- Ellen MacArthur Foundation. 2015. 'Growth Within: A Circular Economy Vision for a Competitive Europe'. McKinsey Centre for Business and Environment. UK: SUN.
- European Commission. 2012a. 'Innovating for sustainable growth—a bioeconomy for Europe.' http://ec.europa.eu/research/bioeconomy/pdf/bioeconomycommunication_strategy_b5_brochure_web.pdf (last accessed 13-3-2019). Updated version online at: https://ec.europa.eu/research/bioeconomy/pdf/ec_bioeconomy_strategy_2018.pdf
- European Commission. 2012b. Manifesto for a resource-efficient Europe. Online at http://europa.eu/rapid/press-release_MEMO-12-989_en.htm
- European Commission. 2014. *Towards a circular economy: A zero waste programme for Europe*. Brussels: European Commission.
- Finegold et al. 2005. *BioIndustry Ethics*. Orlando, FL: Elsevier Academic Press. ISBN:0123693705
- Frazzetto, G. 2003. 'White Biotechnology'. *EMBO reports* **4**: 835–837. <https://doi.org/doi:10.1038/sj.embor.embor928>

- Georgescu-Roegen, N. 1971. *The entropy law and the economic process*. Cambridge, Mass: Harvard University Press.
- Georgescu-Roegen, N., 1975a. 'Bio-economic aspects of entropy.' In *Entropy and Information in Science and Philosophy*, pp. 125–142. Edited by Kubat, L. and Zeman, J. Amsterdam: Elsevier.
- Georgescu-Roegen, N., 1975b. 'Energy and Economic Myths'. *Southern Economic Journal* **41** (3): 347–381. <http://www.jstor.org/stable/1056148>
- Hamilton, C. 2017. *Defiant earth: the fate of humans in the Anthropocene*. National Library of Australia: Allen & Unwin.
- Heikkurinen, P. 2018. 'Degrowth by means of technology? A treatise for an ethos of releasement'. *Journal of Cleaner Production* **197** (2): 1654–1665. <https://doi.org/10.1016/j.jclepro.2016.07.070>
- Hill, T. 2006. 'Finding Value in Nature'. *Environmental Values* **15**: 331–341.
- Husserl, E. 1970. *The Crisis of European Sciences and Transcendental Phenomenology*. Translated by Carr, D. Evanston, IL: Northwestern University Press.
- Jasanoff, S. and Kim, S-H. 2015. *Dreamscapes of Modernity – Sociotechnical Imaginaries and the Fabrication of Power*. Chicago, IL: University of Chicago Press.
- Joldersma, C. 2013. 'An Ethical Sinngebung Respectful of the Non-Human: A Levinassian Environmental Ethics'. *Symposium* **17** (2): 224–245.
- Jonker, J. 2012. *New Business Models*. Nijmegen School of Management: RU Nijmegen.
- Jonker, J. et al 2017. 'Kringlopenladder voor de Circulaire Economie'. *SIGMA* (1): 18.
- Kerschner, C. et al 2018. 'Degrowth and Technology: Towards feasible, viable, appropriate and convivial imaginaries'. *Journal of Cleaner Production* **197** (2): 1619–1636. <https://doi.org/10.1016/j.jclepro.2018.07.147>
- Kirchher, J., Reiker, D. and Hekkert, M. 2017. 'Conceptualizing the circular economy: An analysis of 114 definitions'. Elsevier: *Resources, Conservation & Recycling* **127**: 221–232.
- Kitchen, L. and Marsden, T. 2011. 'Constructing sustainable communities: a theoretical exploration of the bio-economy and eco-economy paradigms'. *The International Journal of Justice and Sustainability* **16** (8): 753–769. <https://doi.org/10.1080/13549839.2011.579090>
- Levinas, E. 1963. 'The Trace of the Other'. *Tijdschrift voor Philosophie* **25**: 605–623.
- Levinas, E. 1996. *Totality and Infinity*. Translated by Lingis, A. Pittsburgh, PA: Duquesne University Press.
- Levinas, E. 1998. *Otherwise than Being or Beyond Essence*. Translated by Lingis, A. Pittsburgh, PA: Duquesne University Press.

- Mayumi, K. 2001. *The Origins of Ecological Economics – The bioeconomics of Georgescu-Roegen*. London & New York: Routledge.
- Mayumi, K. 2009. 'Nicholas Georgescu-Roegen: His Bioeconomics Approach to Development and Change'. *Development and Change* **40**: 1235–1254. <https://doi.org/10.1111/j.1467-7660.2009.01603.x>
- McCormick, K. and Kautto, N. 2013. 'The bioeconomy in Europe: An overview'. *Sustainability* **5**: 2589–2608.
- McDonough, W. and Braungart, M. 2014. 'Towards a Sustaining Architecture for the 21st Century: The Promise of a Cradle-to-Cradle Design'. *UNEP Industry and Environment* ap-sept: 13–16.
- McDonough, W. and Braungart, M. 2002. *Cradle to Cradle: remaking the way we make things*. New York, NYS: North Point Press.
- Muijsenberg, S. et al. 2017. 'Joint Conference on Bio-Inspiration and Biomimicry'. *Biomimicry Magazine* may (9).
- Murray, A., Skene, K. and Haynes, K. 2017. 'The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context'. *J Bus Ethics* **140**: 369–380. <https://doi.org/10.1007/s10551-015-2693-2>
- Nelson, E. 2011. 'Levinas and Adorno: Can there be an Ethics of Nature?' In *Facing Nature*, pp. 109–135. Pittsburgh, PA: Duquesne University Press.
- NOAA. 2019. Online at: <https://www.ncdc.noaa.gov/sotc/global/201913> and <https://ocean.service.noaa.gov/facts/exploration.html> (last accessed 7-4-2020).
- Osseweijer, P., Landeweerd, L. and Pierce, R. 2010. 'Genomics in Industry: issues of a biobased economy'. *Genomics, Society and Policy* **6** (2): 26–39.
- Oudemans, W. and Peeters, N. 2014. *Plantaardig – Vegetatieve Filosofie*. Zeist: Knvv.
- Parada, M. P., Asveld, L., Osseweijer, P., and Posada, J. A. 2018. 'Setting the design space of biorefineries through sustainability values, a practical approach. Biofuels, Bioproducts and Biorefining'. *TU Delft Research* **12** (1): 29–44. <https://doi.org/10.1002/bbb.1819>
- Pfau, S., Hagens, J., Dankbaar, B. and Smits, A. 2014. 'Visions of Sustainability in Bioeconomy Research'. *Sustainability*, **6** (3): 1222–1249. <https://doi.org/10.3390/su6031222>
- Preston, J. 2001. 'Intrinsic Value and Care: Making Connections through Ecological Narratives'. *Environmental Values* **10**: 243–263.
- Raworth, K. 2017. *The Doughnut Economics*. Chelsea Green Publishing: Vermont.
- Rizos, V. et al. 2016. 'Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SME's): Barriers and Enablers'. *Sustainability* **8**: 1212. <https://doi.org/10.3390/su811212>

- Richardson, B. 2012. 'From a fossil-fuel to a biobased economy: The politics of industrial biotechnology'. *Environ. Plan. C Gov. Policy* **30**: 282–296.
- Schomberg, L. and Blok, V. 2018. 'The turbulent age of innovation'. *Synthese* **9** (18). <https://doi.org/10.1007/s11229-018-01950-8>
- Tajalli, P., and Segal, S. 2019. 'Levinas, weber, and a hybrid framework for business ethics'. *Philosophy of Management* **18** (1): 71-88. <https://doi.org/10.1007/s40926-018-0100-7>
- Toadvine, T. 2003. 'The Primacy of Desire and Its Ecological Consequences'. In *Eco-phenomenology*, pp. 139–155. New York, NYS: State University of New York Press.
- Toadvine, T. 2012. 'Enjoyment and its Discontents: On Separation from Nature in Levinas'. In *Facing Nature*, pp.161–191. Pittsburgh, PA: Duquesne University Press.
- Todd, S. 2003. *Learning from the Other: Levinas, Psychoanalysis, and Ethical Responsibilities in Education*. Albany: State University of New York Press.
- Vivien, F.-D., Nieduu, M., Befort, N., Debref, R. and Giampietro, M. 2019. 'The Hijacking of the Bioeconomy'. Elsevier: *Ecological Economics* 159: 189–197.
- Wahl, D. 2006. *Designing Regenerative Cultures*. Axminster: Triarchy Press.
- Welsh, M. 1998. 'From the Impersonal to the Environmental: Extending the Ethics of Levinas to Human Ecology'. *Human Ecology Review* **5** (2).
- Zembylas, M. and Vrasidas, C. 2005. 'Levinas and the "Inter-Face": The Ethical Challenge of Online Education. *Educational Theory* **55** (1). <https://doi.org/10.1111/j.1741-5446.2005.0005a.x>
- Zwier, J. and Blok, V. 2015. 'The Ideal of a Zero-Waste Humanity: Philosophical Reflections on the Demand for a Bio-Based Economy'. *Journal of Agricultural and Environmental Ethics* **28** (2).

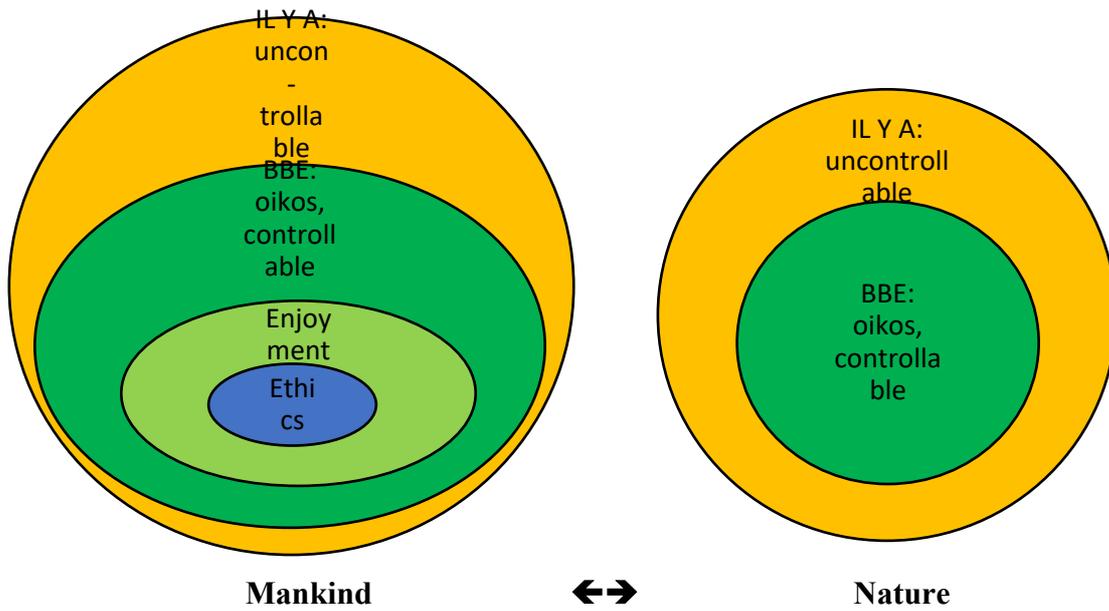


Figure 2: Levinas's concepts displayed relatively and compared with the status of the relevant BBE-concepts.

Conceptual Connection	Levinas	Georgescu-Roegen
Analogy metabolism to understand economy	Living-from	Evading entropic degeneration
Fundamental notion of separation	Il y a	Exosomatic evolution
Epistemological ceiling to our knowledge of nature/the biosphere	Anthropocentric Perspective	Principal novelty of technological advancement
Tendency to control and comfort understandable from humankind	Overcoming nature & establishing house	Addiction to gadgets and exosomatic tools
Unknown nature poses danger	Elementary Nature	Systemic failure
Limits to human control over ecology	Egoic realm	Gaia is infinitely bigger
Focus on qualitative life in bioeconomy	Enjoyment	Anti-extravaganza

Table 1: Conceptual Comparison of Levinas and Georgescu-Roegen