

# Chapter 7

## Open Biofutures: The Challenge of Maintaining Agency for Long-Term Futures



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**Abstract** The world is complex, and its developments are always uncertain. In this context, the bioeconomy represents a framework for innovating solutions which can enable a global transformation to a sustainable future. However, bioeconomy developments can also serve to repackage problematic or even unjust economic patterns from the past. This chapter proposes a heuristic of *open futures* and *closed futures* which can be used as lenses useful for ethically evaluating future imaginaries such as the bioeconomy. These lenses help actors imagine possible consequences of various developments on ecology or nature. Therefore, *open* and *closed biofutures* can serve as tools for engaging the ethicality of various development trajectories. These lenses also encourage actors to seek wider inclusion when considering who has agency and transformative agency in the bioeconomy conjecture. This chapter presents how this tool for thinking has been utilized in the Bioeconomy and Justice Project (BioEcoJust) to imagine long-range futures that represent particular complex challenges. As a research tool these lenses have enabled us to envisage a diverse range of futures and evaluate what is closing or opening about them. We conclude that the lenses of opened and closed biofutures can be used by innovators and decision-makers of all sectors for consideration of the ethicality of the work they choose to pursue today.

### 1 Introduction

In this chapter we propose a framing approach of ‘open’ vs. ‘closed’ futures and then demonstrate how this framing can be applied to illuminate ethical pathways in biofutures. We propose that impacts on agency of people in the future are a significant distinguishing factor between ‘open’ and ‘closed’ futures and a potential source

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for motivation in taking action to develop the bioeconomy. Due to the difficulties of overcoming lock-ins of existing regimes of being, transformative agency is needed in attempts to open closed futures. We then discuss the implications of pursuing ‘open futures’ as a source of ethicality in biofutures, especially in considering long-range futures.

Today, from multiple sources, there is great pressure for humanity to undergo a transition in one way or another, due to the current challenges we face ranging from climate change to economic recovery. These forces suggest a shift from unsustainable to sustainable, from a high carbon economy to a low carbon economy, from high consumption to low consumption, from imbalance to balance with nature and from fossil-based single-use goods to renewable and circular based ones. The future imaginary of a widespread bioeconomy, or biofutures, has been proposed as one such mechanism to bring us to a more ecologically sound future (Bell et al. 2018; VTT 2018).

The bioeconomy represents a particular challenge for the field of futures studies when considered more widely and openly and for longer time periods. Likewise, the arena of the future bioeconomy concept is stretched when it is considered more holistically. The bioeconomy can be interpreted as an open, diverse and changeable concept that spans multiple converging sectors. It is itself complex and hard to define definitively, and its interpretations change over time. Each of these interpretations can replicate old meanings or produce new meanings beyond the mainstream industry-oriented interpretation. Often these meanings describe new societal and regionally specific formulations of bioeconomy (‘Global Visions for the Bioeconomy’ 2015; Taylor et al. 2019). The bioeconomy can be conceptually pinned down using the concept of sociotechnical imaginary from Science and Technology Studies (Jasanoff 2015; Jasanoff and Kim 2009). A futures studies perspective would go further and call the bioeconomy a *future imaginary* (cf. Clark 2011) that is being deployed by various actors to focus action of governments and industries to drive change and achieve specific objectives. In a sense, the task we are proposing here is to rigorously engage the variety of forms this future imaginary offers, in order to identify aspects that close or open what can emerge next. The aim of doing so is to illuminate just and ethical pathways for bioeconomy development.

## 2 Bioeconomy and Justice Approaches to Long-Range Futures

The Bioeconomy and Justice Project (BioEcoJust) aims to explore the long-term potential developments of the bioeconomy and their ethical implications. The project is funded as part of the Academy of Finland’s BioFuture2025 program which includes many largely technical and business innovation-focused projects. Ours is given a mandate to explore the long-term potential developments of bioeconomy from a wide range of vantage points.

BioEcoJust combines futures research approaches from Finland Futures Research Centre at the University of Turku with Applied Ethics approaches from Aalto University. The goal is to identify justice-related issues arising from the development of the bioeconomy and ethical frameworks by which to address them. It is in this setting that we developed many sensemaking tools including the one presented in this chapter, open and closed biofutures (see, Taylor et al. 2019). This tool is based upon several perspectives concerning ethics from the field of futures studies.

### 3 A Future Studies Perspective

The futures field offers its own set of ethical perspectives concerning what is important to consider when exploring futures, and it gives insight concerning the interplay between future imaginaries and decision-making. We ask questions like: Who's desirable future is it? In what contexts? Who wins? Who loses? What impacts cascade to later generations? What assumptions are behind an *ethical stance*, and do they stand up to wider scrutiny when stated plainly? These kinds of questions can reveal key perspectives and situational framings regarding what should or should not be done today for the future.

Futures studies can be seen to have a clear emphasis on generating and exploring alternative and preferable futures rather than creating a singular official future. Eleonora Masini (1993) has called this aspect the 'third rule of futures studies', where futures are plural and that there is always an implied indirect colonization of the futures of others and thus require alternative options. Ilkka Niiniluoto describes this work as a tree of alternatives, where a futurist's role should be to construct alternative possible futures, assess the probability of alternative futures and evaluate the preferability or desirability of alternative futures (2001, 2017). With the general underlying virtuous aim of 'improving the freedom and welfare of humankind', he sees it as a design science which attempts to help the rational planning of the future (Niiniluoto 2001, 2017, 26). We can interpret this field as trying to actively affect positive change through action, utilizing science and theory, philosophy and critical discussion.

Anita Rubin (2017, 252) explains another crucial aspect of this, that there are contradictory images of the future that are built upon different worldviews – with their own interpretations and rationales. In this arena, rational decision-making and choices regarding the future that is dependent on, for example, cultural habits, language, values and beliefs are highly ambiguous and not necessarily rational at all. In this critical futures studies perspective, a person would take a step back to consider the complexity of a proposed future, not only to see what opportunities and options lie ahead but to comprehend their own values and reaction to it. By engaging these contradictions and viewpoints, it is possible to create futures that 'open up from new and different starting points' (Rubin 2017, 253).

What does this field contribute to this debate? Andersson who by critically looking at the history of futures studies arrives at a sobering assessment of the field as a whole; she poignantly describes its characteristics as (emphasis added):

[...] how contemporary societies attempt to manage questions relating to the long term, and how societies produce visions, knowledge, and means of intervention aimed at future change and future control. It would seem that there are moments in which the future is future no more, but present—in other words, *when the future acquires a presence and requires urgent action*. (Andersson 2012, 1430)

The above conceptualizations regard the heritage of futures studies, exploring the very nature of how we explore and consider futures. An emerging conceptualization of what futures are and how people use them is recently ascending into focus – anticipation (e.g. Poli) and futures literacy (e.g. Miller 2018). Anticipation proposes that all life utilizes anticipatory systems (ala Robert Rosen 2012). Futures literacy refers to the capability to diversify how and why we *use the future* by deepening our understanding of anticipatory systems. These offer what can be called ‘the bioeconomy project’, new approaches to achieve reflexivity and ethical awareness in their work. It proposes that people can become skilled at noticing and questioning the futures they use to understand their options. It promotes challenging assumptions to critically assess futures, highlighting the distinct difference between anticipation *for* the future as well as anticipation *for* emergence.

An inherent feature of complex and adaptive systems is that it is difficult or impossible to foresee alternative paths in a paradigm shift (Kuhmonen 2017). Objectively engaging this type of system by seeing its closing or opening potentials suggests an approach to ethically engage a rapidly changing environment without fully itemizing its inner workings, but appreciate and evaluate it externally. Bussey has a similar use of the thematic categories of open and closed futures, concerning organizations and foresight, where closed futures ‘correspond to a dominant pattern’ of maintaining coherence and that this is why they ‘risk all tomorrows for the stability of today’. On the other hand, ‘Open futures by contrast are pluralistic, inclusive and participatory’ (Bussey 2014). This represents for the BioEcoJust project a functioning ethical approach to engaging and making-sense of futures and comparatively also the consequences of the present. ‘Openness to alternative futures is one of the defining factors of [...]contemporary futures studies’ (Minkinen et al. 2019).

Open futures are future imaginaries which seek to identify the innovations we can pursue in the present that open options for future people (including ourselves depending on the time horizon) to thrive. When this mode of imagining is directed toward generating futures of humans in the ecosystems to which they belong, we have open biofutures and their opposite closed biofutures.

## 4 Closed Biofutures Versus Open Biofutures as Prompts for Imagining

In a sense, this period of the fossil fuel-dominant world and any scenario of climate change that includes average global temperatures above 1.5C are *closed futures*, where the future is all used up (see, e.g. Smith et al. 2018). Closed futures are often driven by what Sohail Inayatullah (Inayatullah 2008) calls ‘used futures’ – the imagined futures ‘created by others in the past’ which we continue to use in unquestioning and unexamined ways. There are many climate change impacts of decisions made according to these ‘used futures’. Investments in speculated fossil resources have to recapture their investment while outdated fossil industries are locked-in for the long haul to receive a return on their investment for the next 40–50 years. They become ‘closed futures’ when the choices already made by previous generations are radically limiting the choices of those living in the future. When imagining what our descendants will need, a necessity will be life-sustaining ecosystems. However, closed futures instead give future people ecological systems that have reached their limits, biodiversity that is radically reduced and eroded agricultural land with top-soil that no longer sustains food production.

Closing the future reduces agency for those in the present by blinding them to a fuller range of options concerning which projects to apply their time and resources, and for future generations by removing opportunities to live differently than inscribed by people of the past. When seeing options through a closed futures lens, the problems become the most predominant features of the landscape, choices for action tend toward incremental manoeuvring around these problems, and transformative change is left unimagined. Actions of people acting from closed futures include postponing radical changes, manipulating public opinion and lobbying for the business as usual. When these actors produce ‘new’ futures, they tend to come up with yet more socio-technological imaginaries capable of perpetuating conventional industrial concerns and creating previously understood notions of value within the existing neo-liberal economic order.

During the Covid-19 global pandemic (in 2020), closed futures have also appeared. Decisions to prioritize conventional mundane futures, such as ‘going to work’, ‘going to school’ and ‘taking summer holidays’ over those futures where the problem is fully addressed before we move on, have cost many nations hundreds, thousands or even hundreds of thousands of lives. These COVID-19 deaths permanently close the options, for those of us who survive this pandemic, to enjoy our relationships with any family and friends who died from this disease. On the other hand, the moment of crisis feels like it is already closed or is closing. As one group of actors after another fail to prevent the spread of the disease, futures others imagined they would be enjoying now evaporate. Freedoms are minimized, movement is restricted, employment compromised, and financial limitations are felt. This situation is a suitable example of what we mean by closed futures – some futures can appear to be positive, but in fact carry consequences for others.

This example further introduces issues of human interrelations to our Earth's ecosystems. The source of the virus is argued to be a direct result of human encroachment onto wild nature systems (see, e.g. Everard et al. 2020; Hockings et al. 2020)<sup>1</sup>. In other words, it is the closing in on animal habitats that has enabled greater contact between the illnesses of the wild and human populations. Actions of others in the past, to increase built-up land and establish human habitats in previously wild ecosystems, have produced a closed present.

An *open future* on the other hand offers new modes of imagining the unexplored, uncertain and unthought futures (Sardar and Sweeney 2016) in addition to those that are desirable, possible or probable (Amara 1981; Niiniluoto 2001). To a large extent, 'normal times' are synthetic framings of what is happening in our world, while 'post-normal times' are always happening for some people somewhere and can be thought of as a persistent condition (Mayo 2020; Sardar and Sweeney 2016). While many widely discussed future imaginaries emphasize fixed endpoints demarked by clear indicators and goals, these emphases can limit our imaginations to 'what is' versus 'what is becoming' (De Roo 2018). Beyond focusing on fixed points in time when a sustainable future end state could be achieved, our imaginations about what could happen in the future benefit from remaining open and compatible with the fact that ideal end states never materialize as time continues regardless. For example, one can ask questions like what happens beyond the Paris Agreement? Or beyond the current UN Sustainability Development Goals? Questions such as these invite space for dynamic imagination involving stories in motion and future narratives that leave room for the yet to be expressed, named or considered.

Thinking beyond incremental sets of alternative futures which are necessarily bounded by the positionality, situation and worldviews of the actors imagining them, the practices we propose involve constant identification and critical exploration of closed and open futures while engaging agency and the interplay between diverse complex perspectives. Efforts to develop a global bioeconomy potentially provide both opportunities for opening future possibilities as well as radically closing them, or just a continuation of *used future* narratives. These three kinds of futures can be used as lenses through which we see dichotomies of bioeconomy choices: building human habitat vs. preserving non-human habitats, growing biomass for food vs. fuel, prioritizing ecological objectives vs. economic growth, etc. *Open* or *closed bio-futures* thus include in them, not only the relationship between resources, technology and society but also considerations of the rights of humans and non-humans to a future and general well-being of living nature, ecologies and biodiversity. The openness and closedness of this often-neglected consideration, of the priorities of *non-human life*, thus provides where bioeconomy-related future imaginaries can act as a 'a bridge to a better future' for a wider range of species (see

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<sup>1</sup> <https://www.theguardian.com/world/2020/jun/17/pandemics-destruction-nature-un-who-legislation-trade-green-recovery>. Accessed 24 September 2020.

Matti Häyry<sup>2</sup>). A bioeconomy future imaginary which also considers impacts on the rest of the living nature changes our range of choices and sense of agency. They raise the question of what the next sequences of change in the development of bioeconomies could be that would potentially follow such a transition, or what other desirable futures have we bypassed in the choosing or encouraging of one path over another. It is not satisfactory to take the visions proposed, the ‘official futures’ (see Dator 2009) of the bioeconomy at face value because doing so comes with a risk of advancing another closed future (e.g. neo-colonialism, or human-species-centrism). To break away from these ‘official futures’ requires exploring the potentiality landscape anew, especially when considering the long-term future where multiple generations, multiple new waves of economies and societies as well as multiple new trajectories and innovative paradigms are involved. A more holistic perspective is thus demanded when imagining open biofutures, and the opening vs. closing framing serves to incorporate follow-on effects.

## 5 Open Biofutures

The publishing of the *Limits to Growth* offers a first popular-facing introduction to the concept that economic growth as conventionally implemented entails systemic impacts on our planet’s resources and ecosystems and there are limits which would be dangerous to cross (1972). It highlighted the need to question the effects of how we live and its implications on the planet and its occupants. It functioned as a warning and spurred ethical discussions that can be said to have profoundly influenced how we conceive of sustainable development today. While the authors of the report engaged in ‘trying to know what could happen in the future’, they ultimately built a set of futures imaginaries driven by simulations and models which people could use to make decisions in the present.

Today, there are many growth-oriented future-imaginaries which try to address the notion of ecological limits while holding onto assumptions that economic growth is good and necessary. Examples include the circular economy, EU green deal, green growth and the bioeconomy which are all launched to compel coordinated action that could enable societal transformation to a sustainable future, or at least one that does not destroy our planet’s biosphere. Each of these future imaginaries offers certain virtues, policy regimes and solutions and yet also exposes biases and flaws, as well as deep assumptions about what can or should change and why.

The bioeconomy is fuzzy in its definition (Golembiewski et al. 2015), yet holds much promise to meet the challenge of producing a more ecologically symbiotic

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<sup>2</sup>Professor Matti Häyry gave a presentation on this topic for the Finnish Academy, presenting a bridge to the future that would avoid the pitfalls of an unjust future bioeconomy. <https://www.aka.fi/globalassets/32akatemiaohjelmat/biofuture2025/posterit-2019-lahti/hayry-bioecojust-poster-2.pdf>

economic system. Purely seen as a diverse knowledge base, contributing to the next paradigm built upon the information age, the knowledge-based bioeconomy can be seen to articulate new valuable know-how and information and practices directly pertinent to future global sustainable challenges. Renewable or bio-energy alternatives, as well as endless varieties of bio-based chemicals and materials to replace fossil dependence, offer the chance for industries and consumption to switch to cleaner alternatives. Likewise, for example, forests offer biomass and carbon capture capabilities to provide the planet the basis to tackle climate change and rebuild the economy around it. And yet this paradigm shift is still in its infancy, and formulations of the bioeconomy do not yet cover the full spectrum of a fully emerged bio-based society.

However, there are also many criticisms of the current formulations of the bioeconomy. For example, a critical view of bioeconomy (Ahlqvist and Sirviö 2019) depicts the results of their Finnish analysis as a closed future:

[...] there is little doubt that as a policy idea the bioeconomy is primarily designed to bring about a new round of capital accumulation [...] the bioeconomy clearly is an attempt (in the face of ecological exhaustion) to open up a new resource frontier of cheap nature to perpetuate the capital accumulation process.

They observe that the bioeconomy as a means to extract large biomass (in this case from forest) by the already established industries remains the main sentiment that overlooks the other new actors who might emerge and the opportunities of synthetic biology (ibid. 410). That is, the natural resources represent a means to accumulate wealth and replace the inputs of the fossil industry with them. This future socio-technological imaginary offers a colonization of certain interpretations of the future, in which nature is seen predominantly as an industrial resource and the subject of accumulation of capital.

They suggest rather a 'redefinition of the bioeconomy concept in such a way that enables environmental concerns to be articulated, concern about livelihoods and territorially balanced economic development to be voiced, as well as political pressure on economic praxis to be exerted' (ibid. 416). Clearly in their view the power relations asserted from top down have formed the singular narrative in which nation state or a region should define its economy and its connection to the global market. Ahlqvist and Sirvio tell how history has been inscribed in such a way to produce one specific economic relationship to nature, where the actors and markets are formulated toward that end. And that particular formulation of the bioeconomy defines its path toward the future. What is clear with this knowledge is that there are other paths open, some side-lined and some yet unidentified. Similarly, Birch examines from a neoliberal critique of how 'markets and natures are being imagined and constructed in the pursuit of the bio-economy', and where there is the need to 'identifying alternative bio-economies, reflecting different bio-economies that are not underpinned by market principles' (Birch 2016, 2017, 2019; Birch et al. 2010). This identifies a need to shift away from certain assumed perspectives where an industry perspective would be normative.



The diverse interpretations and evolution of the policy driven concept of bioeconomy suggest that it is absorbing new values and manifesting toward something novel. If you consider that it has at one time or another been referred to as the bio-based economy, the bioeconomy and the circular bioeconomy and now the circular sustainable bioeconomy (Hetemäki et al. 2017). You can imagine these as expanding rings on a tree, where time adds new sectors and interpretations upon the old, through necessity and changes in values. One notable interpretation by the Iceland Bioeconomy policy suggests a sphere with *freshwater, marine, human capital, wilderness, forests and farmland* with additional themes like *education, innovation, nature-based tourism, arts and crafts*, as well as *sustainable resources* amongst others occupying the inner rings (*backbone, service sector, secondary industries*, etc.) (see Mattis & Iceland Bioeconomy) (Smáradóttir et al. 2014). For this northern sector, multiple frames allow for a more holistic view of the complex relationships and the multiple emerging dimensions under one title. In addition, these are just policy developments that can be seen to be slow moving in comparison with what interpretations are happening in practice, where specific sectors are developing under its umbrella, defying current categorization. Many of them, like those working in synthetic biology ecosystems<sup>3</sup>, *lignin* start-ups<sup>4</sup>, novel carbon offsets<sup>5</sup>, ocean forestry<sup>6</sup>, nature tourism and those countless still to be discovered can be seen to be redefining the sector as a whole with further impacts and implications for society at large. Some of these niche areas could become adopted or converge with established industries or practices (like textiles industry, or biofuels); others could offer game-changing or creative destruction capabilities. The promise and vision of this new era is boundless in imagination.

However there have been clear warnings by researchers that the bioeconomy has been critically hijacked (Vivien et al. 2019) or not as sustainable as it is proposed, where sustainability has been used to greenwash dirty sectors that would lead to unsustainable or unjust futures (Ramcilovic-Suominen and Pülzl 2018). The risk is present in this ever-wider policy envelope where it acts like a Trojan Horse repackaging older or less desirable sectors and solutions under the greener paradigm transformation. This brings with it future problems that might perpetuate the old, or merely be a guise to reposition in a new market (Korhonen et al. 2020; Ramcilovic-Suominen and Pülzl 2018; Vivien et al. 2019). It must be assumed that there will always be problematic disingenuous factors that come along with the mix. For example, a circular economy does not automatically equate a good and just sustainable economy, just because it is more efficient, circular and a viable bio alternative to petroleum-based economy (Hetemäki et al. 2017). There is always the dangerous potential to enslave, colonize, restrict nature, dictate future land use, monopolize and affect equality all under a ‘good’ virtuous policy.

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<sup>3</sup> See <https://www.synbio.fi/> for example.

<sup>4</sup> See <https://ligninclub.fi/> for example.

<sup>5</sup> See <https://compensate.com/>

<sup>6</sup> See <https://www.nordicinnovation.org/news/growing-global-ocean-rainforest>

A ‘good’ bioeconomy may serve the perceived ‘greater good’, as dictated by the decisions made toward how a future image ‘should be’. In this vision, knowledge and even science may be guided toward results that match a minority belief and interest, or assumption about the future under the categories of relevance and strategic choices. A good example of this critical closing perspective is demonstrated by Andersson and Westholm (2019), who have indicated that the choices made toward certain dominant future images of the Nordic forest sector had the effect of closing futures, restricting certain research narratives and findings, to rather promote those that matched their desired official narrative.

Considering the above warnings, open biofutures would therefore entail the opposite of the above criticism. They would disrupt or end the perpetuation of colonialism, question the continuation of used futures which are no longer wanted and rebel against ‘guiding hands’ in science seeking to reinforce incumbent future imaginaries. Instead, open biofutures would prioritize the activation of sustainable and inclusive potentials that fully include justice for all living nature. Moreover, allowing space for considering new emerging pathways from diverse agents is suggestive of the unprecedented future and is conscious of the power of individuals’ own agency to affect it.

## 6 Toward Transformative Agency

Agency can be seen as a central ethical concern when engaging closed and open futures. Can people and other living beings participate in change? Are we able to influence our future, and if so how and to what extent? Furthermore, do we have ‘transformative agency’? Through this concept, agents are empowered in the transformation process, they affect their own destiny and also the futures of others, and they make meaningful and decisive contributions to the transformation of society. This locates future transformative discourse toward the individual level to engage larger systems.

Concerning change in a complex adaptive system, it can be difficult to identify who influences change in society. Does it happen top-down, through government, industry or an elite? Or does change happen bottom-up from the grassroots individual citizen level? In some perspectives the bioeconomy has located decision-making to be by high-level government and industry figures, resulting in the participation of citizens to be marginalized (Mustalahti 2018; Vainio et al. 2018). In this way industries are built on the basis of a future imaginary by the few upper echelons and not from within society. Another perspective could show that entrepreneurs as actors experiment and define new paths and make networks and communities at the grassroots level. These can be seen as individuals innovating new technologies, services or ecosystem services that open up new emerging pathways, although with uncertain outcomes. Yet another perspective would concern the agency and role of *others*, those non-human entities (e.g. other living species, as

well as natural systems such as lakes, rivers, etc.) that are impacted by the future imaginaries humans invent and enact. In this manner, who's agency is prioritized becomes a large factor in ethically approaching complex adaptive systems.

As nature, ecosystems and ultimately the whole biosphere are added into society-industrial perspectives, agency and transformative agency take on a completely new meaning. Thus, the actors are broad in range within and affected by the bioeconomy, as it is assumed to be approaching global scale and potentially to become the next transformational shift for life on Earth from post-industrial to a *bio age* or *bio-society*. These diverse abundant agents then can be seen to exist simultaneously, and the whole is built upon the diverse interconnection of these perspectives. Milojević and Izgarjan suggest that alternative storytelling as a strong means to engage in futures offer agency, where they empower individuals to overcome trauma, or a closed state, toward opening up alternative narratives (Milojević and Izgarjan 2014). Imagining and including those 'outsiders' into new narratives becomes crucial for our collective journey. As climate change continues to dislocate populations (Sassen 2016) and to drive whole species extinctions, 'the earth is full of refugees, human and not, without refuge' (Haraway 2015).

We propose that *open and closed futures* can enable ethicality in transformative agency, defined in such a way that change occurs in a complex and adaptive system, that can be identified as a catalyst toward holistic and continuous ecologically just change, where agency is collaborative and social in nature, linking social-ecological systems and understood as involving a systemic change at all levels (Steward 2008, 2012; Westley et al. 2013).

## 7 Reconsidering Futures, Informing Action Toward Long-Term Ethical Development of the Bioeconomy

Where admittedly futures studies as a field is highly multidisciplinary, naturally drawing from multiple fields' method and theory bases, off the shelf methodologies do not do justice for the potential research needs of the complexity and un-anticipatable long range of the BioEcoJust project. To say anything useful about what could be just or unjust between 2018 and 2125, we developed these lenses of open and closed futures as a basis for ethical argumentation, as even considering positions toward the future that are highly visionary in nature has a fatal flaw in that they can form a specific closed future. For example, 'Cathedral Thinking'<sup>7</sup> suggests that some individual or group can create grand projects which take multiple generations to complete to benefit future generations, like architectural cathedrals for future generations to enjoy. Our challenge to this proposition is that they form a rather rigid framework about what future people will need or want and perpetuate values, systems and assumptions from the moments they are made. Such projects do

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<sup>7</sup><https://cathedralthinking.com/>

not question the need for such cathedrals in the future, hog resources and human attention while they are produced, block other developments and assume significant efforts to maintain.

A counter-perspective would be *moonshot* investment in development projects that potentially have positive open spillovers to society at large, created by public-led investments to form pluralistic platforms for development through strategic missions (see Mazzucato 2019).<sup>8</sup> These kinds of projects culminate massive research and development knowledge, taking advantage of the state of the art. Consider the Internet, for example, that can be seen to have vastly opened future potential for our society. However, that said, in recent years it has been observed the negative environmental cost of the digital age, that is supposed to be free from worldly material consumption, the Internet and its associated technologies are responsible for ever-increasing huge global energy use and extraction of precious materials that have put the planet in crisis. It can be noted that socially too, technologies initially that were seen as liberating can be seen to close our human capabilities to socialize, to imprison within a system of dopamine gratification through social media and video games. Indeed, like all technologies, Internet Communication Technology has tightly coupled itself to our minds and now shapes our very consciousness. As we imagine futures of the bioeconomy, we would benefit from utilizing this knowledge and question any grand solutions, cathedral thinking, especially those considered to be green, renewable and sustainable for the future. We've found that evaluating potentialities by viewing them through the lenses of open and closed futures supports such a questioning.

In practice this approach has coloured our research to engage complexity in a critical and open manner. We undertook several such activities. One approach that continuously informed on our project was *open horizon scanning*. That as a practice it was open in nature intended to seek emerging and novel issues, to widen the scope of possibility. These would often challenge a normative perspective to open up new dimensions, often these were ethical in nature, pushing the boundaries of what could be included in the developing topic or future imaginary. Commonly horizon scanning involves exploring the landscape of environmental changes through a 'comprehensive systematic examination of risk, uncertainty and emerging trends', in order to push thinking toward challenging assumptions (Rowe et al. 2017). We added the element of open participation and an expanded framing to our practice. These were also actively shared openly with colleagues and wider networks to form discussion and debate. Issues such as geoengineering, synthetic biology, CRISPR gene editing technology, etc. test our assumptions and offer contrasting perspectives (see BioEcoJust Open Horizon Scanning)<sup>9</sup>. Literature searches were also conducted to identify common directions within the field of classic and progressive bioeconomy, and also those that critically assessed or offered new potentials.

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<sup>8</sup> [https://ec.europa.eu/info/sites/info/files/research\\_and\\_innovation/contact/documents/ec\\_rtd\\_mazzucato-report-issue2\\_072019.pdf](https://ec.europa.eu/info/sites/info/files/research_and_innovation/contact/documents/ec_rtd_mazzucato-report-issue2_072019.pdf)

<sup>9</sup> <https://ffrc.wordpress.com/2018/09/24/bioecojust-open-horizon-scanning/>

These processes formed a rather agnostic and objective approach to technology, policy and the economy. These resulted in generated observations on the complex relationship between the triangulation of humans, technology and nature. In a way we observed that each article or artefact expressed values about this relationship, and about its desired or undesirable future, for example, how technology should be used for humans toward nature. We observed about five general common worldviews that reoccurred in the literature and horizon material that we refer to as *bio-worlds* (Balcom-raleigh et al. 2018; Taylor et al. 2019). Some articulated or implied perspectives on what was ‘good’ way for a bioeconomy, i.e. resources as a solution, inspiration from nature’s design, edit nature through technology, rejuvenate and restore nature and the equality of all nature (ibid.). Agency and transformative agency can be seen to be expressed differently in all of these world archetypes, where *what is good and bad* or what innovations to prioritize going forward toward a bioeconomy imaginary. What becomes interesting is to see the combinations of these perspectives, the discord and discourse between these perspectives and all worldviews present in some manner or other. Convergence and divergence then lead to entanglement and engagement of opening and closing futures. Our interest has been allowing settings in which we can observe potential future decision-making that have especially ethical dilemmas. Those dilemmas represent turning points in complex systems.

Continuing in this process of participatory research allows an exploration of these *ethical stances* through structured interviews, Delphi (see Chap. 11, this book), and through the gamification of workshops (see Chap. 10, this book). Ethical stances can be seen to be positions more noticed in situational impasse’s, places where decisions are made based on ethical value-based assumptions, where there are also opposing views or challenges to be faced. In exploring long-range futures, understanding and looking out for these ethical stances, informed by the changing nature of the interaction of bioworlds, allows decision-making to be explored in such a way as to embrace uncertainty.

Encouraging exploration of these ethical stances we approach scenario making in such a way as to cultivate near impossible situations, which are crisis moments where there were no clear right or wrong answers of how to proceed and resolve the situation. These at first have been developed as *vignette* scenarios, which are short scenes that depict a certain critical situation. Furthermore, these future settings often explored seemingly extreme situations, although resembling current day issues or launching emerging technologies or practices to extreme ends. The scenarios in final form will be action oriented, to communicate to challenge holders who could continue to be aware of ethical stances, situations and the degree of openness of future imaginaries be it in policy or society, or technological form.

The basis for this approach is informed by the Futures Literacy Laboratory meta-design and approach (Miller 2018) that encourages reframing as an exercise in expanding the variety of ways people imagine futures. This encourages encounters with potential ‘change in the conditions of change’ (ibid.). This resonates with how agency and transformative agency can be achieved, to allow new narratives to be made. Examining this type of phenomena has informed our approach to disassociate

ourselves from forecasting the future of current bioeconomy, toward an open futures perspective that accepts as fact the persistent and natural diversity in the dynamics of change. Causation between actors and situations then can contribute to causal changes to the whole.

Consider biodiversity as an example of a complex adaptive system; the recent warning by the IPBES<sup>10</sup> has highlighted the loss of biodiversity as a serious threat to the planet. The rapid loss of biodiversity effects the ecosystems, and humans need nature, closing and limiting species and further contributing to climate change (Isbell et al. 2015). The rapid decrease in global insect, bird and fish population threatens to push ecosystems to a breaking point that in turn affect food availability and quality of life for humans. This is referred to as a ‘silent killer’<sup>11</sup> as it happens without most people noticing the massive loss until it is too late. This closing biofuture represents both a long-range future threat in which agency has already been stripped away long before it becomes a perceived threat, and it represents a depiction of the acute incompatibility of the current pathways in which human growth bound activity is at odds with global ecosystems. It also highlights the unseen value that it offers to humans to safeguard the planet and tackle climate change.

Therefore, an open biodiverse future would place diversity as a key issue, shifting away from scaled-up monocrops in agriculture, for example, or more generally identifying negative practices and processes that critically threaten species and create momentum to counter those. Ecosystems thus become collaborators with humankind. Considering also the emerging understanding about the vast underground networks of enzymes<sup>12</sup> that sprawl our planet under surface signals the scientifically yet unknown and unexplored aspects of our planet and the future roles that they could have. In this perspective humans are clearly understood to be but one of many species on this biodiverse planet.

## 8 Conclusion

Our chapter has proposed that maintaining agency can be seen to be a challenge when considering long-range biofutures. Both practically in terms of futures research considering its complexity and assumptions but also when considering all the critical observations that suggest the current future imaginaries relate to a closing bioeconomy. We have proposed open biofutures as a tool for reintroducing ethical and justice-related considerations to bioeconomy developments. This requires continually acting upon the present to provide future people and other beings with

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<sup>10</sup> <https://ipbes.net/news/media-release-biodiversity-nature%E2%80%99s-contributions-continue-%C2%A0dangerous-decline-scientists-warn>

<sup>11</sup> <https://www.theguardian.com/environment/2018/nov/03/stop-biodiversity-loss-or-we-could-face-our-own-extinction-warns-un>

<sup>12</sup> <https://www.theguardian.com/science/2018/dec/10/tread-softly-because-you-tread-on-23bn-tonnes-of-micro-organisms>

open options within which they can thrive. An open biofuture is one that can be used in the present to identify actions and new ways of being which can provide choices to people of tomorrow.

We propose this analytical concept as an antidote to the commonly used bioeconomy futures which are often utilized by governments and industries to attract resources and innovate to compete within existing extractive economic systems. These economic systems place limits on what degree any new bioeconomic product or service can do to regenerate soil, restore wild places, reduce human consumption and land use and restore ocean ecosystems. Taking on this mode of working can enable well-intentioned innovators to go further with their impacts and take into mind ethical considerations along the way. Our criticisms cited in this article might be misinterpreted at first as anti-industry and technology; our emphasis on critique of these is in reaction what is perceived as a normative perspective that requires viable alternatives.

As our ethical stance, this approach enforces the idea that there are no predefined pathways to the future, and to imagine alternatives to dominant futures can be an essential reflective process in which the openness or closedness of the future imaginary is considered. This allows for a space in which critical awareness can be articulated for emerging or highly complex phenomena. This is even truer of when considering biofutures than other subject areas, as the evolving bioeconomy discourse must contend with the complex system it is part of, not only those that directly involve humans or fragmented sectors.

The open framing demands thinking outside of the boundaries of current categorizations. We have suggested how it has been influential in tailoring our approaches. Biofutures as a topic for futures research requires engaging in multiple frames and sectors where a degree of abstraction ultimately leads to ethical judgements of the system through entry-points. The simple task of identifying what a 'good or bad bioeconomy' would be fraught with complex values and *ethical stances* in which actors position themselves and expose their anticipatory assumptions. It is in these settings where fruitful dialogues about biofutures can occur. Agency and especially transformative agency can be enabled for a greater number of people and a wider variety of species when we use the lenses of open and closed biofutures.

We offer the term open biofutures as one that can be used by the many and varied bioeconomy actors toward many perspectives. We do not claim ownership of this type of futures criticism of the bioeconomy; our use of open and closed terminology functions mainly to embrace the manifold of ethical positioning, to especially allow in daily practice space for participatory criticism of future imaginaries, how these imaginaries are used, and to encourage spaces for identifying emergent potentials for living nature to justly thrive.

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