




The urgency of the Lancet Planetary Health–Earth Commission’s report and IPBES transformations versus the ongoing Z transformation: the need to soften the human sustainability boundaries

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Abstract

The Lancet Planetary Health–Earth Commission’s report proposes the translation of safe and just Earth-system boundaries across scales, transitions and transformations as being necessary to create a durable pathway to sustainability. Here we address the willingness and engagement of individual people to understand, feel the value, and implement the totality of its recommended transformations. We adopt an approach based on inner dimensions of sustainability. This depends on seven human critical determinants that we believe can act as human sustainability boundaries (HSB), but can be suitably softened. We conclude that the required softening of HSBs is unlikely to be successful without phasing down the current counter-sustainability Z transformation. This is an heir of the Neolithic and Industrial Revolutions, but has acquired its own powerful identity, and is apparently unable to deliver sustainability.

Keywords Pathway to sustainability · The Lancet Planetary Health–Earth Commission report · Safe and just Earth-system boundaries · Human critical determinants · Human sustainability boundaries

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Abbreviations

CFR	Cooperation and free riding
DRS	Dopaminergic reward system
ESB	Earth-system boundaries
GDP	Gross domestic product
GHG	Greenhouse gas
HTI	Human–technology interconnectedness
HSBs	Human sustainability boundaries
HCD	Human critical determinants
HNI	Human–nature interconnectedness
IGGR	International geopolitical and geostrategic relations
LPHEC	Lancet Planetary Health-Earth Commission
SIU	Self-interest and utility
TD	Time discounting in intertemporal decisions

Introduction

Since the emergence of the concept of sustainable development in the late 1980s, the scientific community has called attention to and evaluated the associated risks should humankind fail to reach some reliable form of global

sustainability (Rockström et al. 2009, 2023; Lenton et al. 2019; Rammelt et al. 2023). Many actions, transitions, and economic, technological, institutional and governance transformations (Biermann et al. 2012; Moore et al. 2014; Linnér and Wibeck 2020), to alleviate and possibly eliminate those risks, have been proposed. However, progress in implementation has been extremely slow (UN 2024). There are two complementary dimensions in sustainability science (Ives et al. 2019). The first has a focus on the external world of the environment, social structures, economic systems, and governance. The second dimension addresses the role played by human inner world motivations as barriers to sustainability. In simple terms, the first tells what to do, while the second addresses the degree of collective willingness to do it.

Santos et al. (2024a) proposed an approach to deal with this second dimension, based on an analysis of human biological and cultural evolution. This led to the identification of seven human critical determinants (HCDs) that may act as human sustainability boundaries (HSBs). Softening the HSBs, taking into account the social contextual drivers where individuals decide and act, is an essential step to render sustainability more realizable. The role played by the HSBs on hindering global mitigation and adaptation to climate change, and the ways to soften their influence, have been analyzed (Santos et al. 2024b). Buzan et al. (2024) proposed the extension of the HSB approach to integrate frameworks from the psychological sciences. The importance of the second dimension of sustainability science has also been defended by Merz et al. (2023), when they advocate “prioritizing psycho-behavioral change over technological interventions may also have greater potential to relieve anthropogenic pressures on Earth”. Costanza et al. (2017) have also recognized the importance of behavioral change to induce transformative change by drawing an analogy between societal behaviors and individual addictions. They argue that societies can become “addicted” to unsustainable practices, such as overconsumption and relentless economic growth. Our HCDs offer the reasoning for creating and perpetuating these addictions.

The scientific literature on the first dimension of sustainability has benefitted from a succession of frameworks to evaluate the consequences of human driven pressures on the Earth system. In the Global North, the concept of sustainability has acquired powerful visibility (Lozano and von Haartman 2018). Sustainability is now a global framework that transcends the Global North–Global South divide (Singh 2020). However, across the world, but especially in the Global South, a deterioration of the natural systems that support life on Earth, coupled with climate change consequences, continues to aggravate health, food, water, energy, and profound economic insecurity. This is associated with an increasing risk of disease, socioeconomic inequality, displacement, and conflict. Must it be so? Why sustainability

proving such an elusive goal? Indeed, is sustainability actually attainable?

The Lancet Planetary Health–Earth Commission report

We discuss these questions using the current Lancet report framework for outlining the first dimension of sustainability, and the HSBs for interpreting the second dimension of sustainability. The Lancet Planetary Health–Earth Commission (LPHEC) report (Gupta et al. 2024) provides detailed spatial and temporal analysis, ranging from the present to 2050, and makes use of a broad scope and comprehensiveness of approach. The report proposes a holistic perspective to quantify safe and just Earth-system boundaries (ESBs). We concentrate on the human processes of transformational change needed to remain within those boundaries, rather than on the quantitative and qualitative description of ESBs. More recently the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES 2024) identified the transformative change and options that are needed for achieving the 2050 Vision for Biodiversity. These are in very broad agreement with those of the LPHEC report. The IPBES assessment emphasized what we cover in our HCDs. These are patterns of human domination, widening social and political inequalities, excessive consumption driven by self-interest, immediate gratification, and adherence to damaging social norms, and disconnection of policies, programs, knowledge, and technological innovation which fragment any move to sustainability. Furthermore, we acknowledge the recent European Academies Science Advisory Council report on the increasing urgency of transformative change (EASAC 2025). The Council notes the failure to recognize the immediacy of the critical dangers facing all life, the utter inability to connect and to tackle the multiple scales of governmental and private sector reactions, and the immense blockages caused by “our innate characteristics that drive us to compete, consume and resist rational action to avoid threats that are not immediate” (Page 2). As we note below, these are essential components of our HCDs.

The LPHEC report emphasizes that to stay within safe and just ESBs, the translation of ESBs across scales, transitions, and transformations are required. Transitions tend to focus on incremental changes in behavior, technologies, and policy. Transformations are more profound and comprehensive, and “involve systemic, synergistic, structural, political, practical, and individual changes across scales” (Gupta et al. 2024). After reviewing innumerable calls for just, systemic transitions and transformations “four fundamental and inter-related transformations supported by system-wide changes in governance” are proposed. These are: reducing and re-allocating consumption while ensuring minimum access;

transformations of economic systems for sustainability and justice; expanding sustainable and affordable technologies and transforming governance across scales. The four transformations, because they are fundamental and interrelated, constitute a comprehensive package that will be referred as the LPHEC transformation. Gupta et al., (2024) provide a detailed description of what needs to be done to implement the LPHEC transformation, which is arguably the most promising candidate to reach sustainability. This is a major challenge that requires individual changes focused on serious softening of the HSBs.

The Z transformation and the seven human sustainability boundaries (HSB)

Before addressing the seven HSBs, we note that the LPHEC transformation will not be the first human major transformation involving systemic, synergistic, structural, social, economic, political, and individual changes across scales. There are other examples in history such as the Neolithic and the Industrial Revolutions. Currently, humankind is under the spell of a transformation that is the heir to these two previous ones, but which has acquired its own identity. It is being forged by new economic and financial theories and practices, institutional, ideological and cultural changes, and an accelerated development of science, technology and innovation, in particular ICT and AI technologies. We refer to this current transformation as Z, the last letter of the alphabet. The authors prefer to use a neutral instead of a descriptive name because it is premature to fully capture the essence of a rapidly evolving and ongoing transformation by a single word or phrase. At this stage, a descriptive name could be easily misunderstood, which would divert from a more focused and substantive scientific debate. The Z transformation combines our assessments of the overwhelming of ESBs by the inner dimensions of human self-interest and immediate gratification, breaking our contract with nature, and crashing international cooperative commitments. We note that it expanded successfully throughout the world, reaching a climax during the Great Acceleration of the twentieth century (Steffen et al. 2015). The first significant challenge to the Z transformation with its seemingly inevitable damaging future started with the concerns that led to the UN Stockholm Conference in 1972 (UN 1973). Since then, as shown in the cited Lancet, IPBES, and EASAC reports, it has become increasingly apparent that the Z transformation is unable to deliver sustainability.

The seven human critical determinants that may act as human sustainability boundaries are: the dopaminergic reward system (DRS), time discounting in intertemporal decisions (TD), human–nature interconnectedness (HNI), human–technology interconnectedness (HTI), self-interest and utility (SIU), cooperation and free riding (CFR), and

international geopolitical and geostrategic relations (IGGR). Human–technology interconnectedness (HTI) was added to the six previously identified by Santos et al. (2024a, b). HTI is the antithesis of HNI since it reflects the opposing characteristics of nature and technology. While nature is broadly dominated for human benefit, technology has emerged as the instrument to achieve that goal. Technology developed at an accelerated pace along the history of human civilizations and, with the help of science, provided much better overall health, and remarkable increases in life expectancy, well-being, and economic prosperity. This gave it awesome propulsive power.

However, there are major technological risks that can transform HTI into an HSB. They include weaponization of technologies, autonomous weapon systems, cyber warfare, bioweapons and nuclear weapons, biotechnology risks, risks associated with the ICT and AI technologies, such as disinformation, deepfakes, algorithmic governance, and AI-powered weapons. Smart phones, although seemingly “indispensable”, have the capacity to produce strong losses of cognitive abilities, notably in complex critical thinking (Skowronek et al. 2023; Fabio and Suriano 2023).

Self-interest and utility (SIU) have played an important role in human ideological, social, economic, and cultural evolution leading to its preeminent role in the Z transformation. The Hobbesian claim of fundamental self-interest and competitiveness between individuals (Hobbes 1651) opened the way for the economic theory of Smith (1776), and the utilitarian morality of Bentham (1789) and Mill (1863). More recently, Ramsey (Ramsey 1928) and Solow (1956) contributed to the development of the neoclassical theory of economic growth by showing how to produce optimal saving and how to create optimal growth, through a formalized production function incorporating labor and capital. They explored the linking thread that connects the concepts of self-interest, competition, utility, capitalism and economic growth needed for the development of the Z transformation. This has assured continued global economic growth, but it severely aggravates inequalities and weakens the fundamental democratic capacity for consensus and collective decision-making on sustainability issues.

How to implement the four transformations proposed by the LPHEC report?

First transformation: reducing and reallocating consumption while ensuring minimum access

This transformation is closely related with six HCDs: DRS, HNI, HTI, SIU, CFR, and IGGR. Implementation requires that these HCDs do not act as HSBs. The first softening step demands that a much larger part of the human population,

especially in the Global North, becomes more well-informed and aware of the need to reduce and redistribute consumption to avoid current and future risks. Essentially, it requires an arresting dose of stark reality of possible non-survival for many. The second step requires practices of active cooperation for the common good. These include practices of generosity and justice to reduce socioeconomic inequalities, coupled with temperance to reach sufficiency in the use of natural resources, instead of focusing on self-interest and utility maximization. Unabated socioeconomic inequalities drive excess consumption, which aggravates the problem of climate change (Nielsen et al. 2021; Chancel 2022; Santos et al. 2024b). The third step is to enhance cooperation for reallocating consumption between the advanced-economy countries and the rest of the world, to reduce protectionism, trade wars and geopolitical tensions and conflicts. Softening is mostly the practice of well-known plain virtues that has become less attractive as the Z transformation triumphed. Many practice these virtues and contribute effectively to reducing and reallocating consumption. However, this transformative movement must increase in scale and become more self-propelling to be effective.

Transformations that embrace the whole world and change the established consumption practices and expectations are inevitably going to take a long time to be accepted and to take effect. In the reality of day-to-day government, the first transformation is likely to be viewed as slowing down global GDP growth, possibly leading to degrowth in some countries. This outcome is currently unacceptable to most voters in democratic countries, and to most people living in autocratic regimes.

Nevertheless, there is sympathy with the concerns that underline the first transformation. The way the Z transformation addresses them is to reduce the distribution of poverty and to enhance global income convergence between the advanced economies and the rest of the world. GDP growth must continue unabated in the advanced-economy countries, but in the less-developed economies, it must grow faster. This program requires an increasing demand for natural resources and reduces biodiversity which contradicts the objective of the first transformation. Furthermore, recent trends in global economic convergence are disappointing. In this form of convergence, named unconditional beta convergence, the growth rate of real per capita GDP is negatively related to its starting levels. However, the empirical evidence is that many lower income countries, including those among the “Bottom Billion” (Collier 2007, 2009) continue to move further behind the rest of the world in most socioeconomic and environmental indicators (Johnson and Papageorgiou 2020; Cust et al. 2023). Meanwhile, the number of those living in extreme poverty has begun to rise again currently reaching 700 million, after decades of decline (World Bank 2024). The first transformation is on a path to sustainability,

but its implementation requires a widespread and engaged personal and collective willingness to soften the HSBs.

Second transformation: transformations of economic systems for sustainability and justice

The LPHEC report emphasizes that in the current mainstream economic system, the “standard measure of economic success is growth measured as increase in GDP or business profits, neither of which account for environmental impacts or broader human needs”. GDP is an indicator at the core of the mainstream economic system that supports the Z transformation. What we assess here is how to replace the Z transformation by the new proposed LPHEC transformation that has four components to keep humankind within safe and just ESBs.

To achieve this outcome, goal transformations have first to develop at the level of the second dimension of sustainability. Softening SIU and CFR requires a degree of personal and collective commitment where most people are no longer attracted to continue on the route of the Z transformation. Is this possible? If not, the consequences of unsustainability are likely to become sufficiently harmful and destructive that humankind is forced to follow unwillingly a new degenerative transformation paradigm, without the capacity to choose it.

Third transformation: expanding sustainable and affordable technologies

Sustainable and affordable technologies are increasingly necessary to mitigate current negative environmental externalities. Here we will address only one of the most difficult challenges, which is the energy transition, namely to reduce the greenhouse gas emissions (GHG) from the energy, industry, buildings, mobility, and agriculture sectors at the global scale for overall atmospheric GHG concentrations to start decreasing. The most promising technologies include the wider use of solar and wind energy, battery storage, electric vehicles, and energy efficiency improvements, especially in cities, through urban planning, energy efficient buildings, and smart grids. Technological innovation is also required for carbon dioxide removal, to reduce emissions from high-carbon industries, development of carbon neutral synthetic fuels, improved livestock management, and optimizing fertilizer use.

One of the main reasons why these mitigation technologies have been unable to reduce global GHG emissions is that the investment needed for their development and deployment competes with other counterpoised investments that provide profits in the short-term instead of avoiding harmful impacts in the long term. In this case, the time discounting HCD (TD) acts as an HSB. The way to soften TD

is to give greater value to the future by building a conviction at the individual and collective level that the development of intergenerational justice must have a higher moral priority. The North–South divide implies that most Global South countries are unable to decarbonize their economies without massive technological support combined with public and private funding from advanced-economy Global North countries and from multilateral development banks. This critical support requires the softening of SIU, CFR, and IGGR for any chance of success.

Technological fixes that may mitigate a given sustainability challenge with potentially dangerous side effects should be avoided. This goal requires the softening of HTI boundary. A well-known example is solar radiation management (IPCC 2012; Reynolds 2019; NASEM 2021), which increases the Earth's albedo aimed at reducing global mean surface temperatures. This is a highly controversial intervention that will disrupt the global water cycle and reduce global precipitation (Trenberth and Dai 2007; Haywood et al. 2013). Softening HTI implies that technology should be used to address the root cause of a given sustainability problem, and not to countervail some of its harmful impacts. Technologies have a strong transformative power in human societies and are a major driver of economic growth. One of the primary motivations of technological development is that when technologies are successful at creating utility, they can scale quickly at low marginal costs, which offers exponential growth and profits. This success does not mean that they are currently safe and just. HTI softening is critical to keep them safe and just.

Fourth transformation: transforming governance across scales

Transformations in consumption, economics, and technology require transformation of governance and the consent of the governed. The levers of governance for transformation must be endorsed globally by people at a much larger scale than is currently the case (Chan et al. 2020). A large part of the ESBs risks have global qualities that require some form of global dialog, and eventually a high degree of consented governance. There are renewed calls to reform the UN to be able to deliver on the required transformations. These include, e.g., reforming the UN Security Council and setting up an Earth governance regulatory body to address peace and human security, including health, food, climate, economic and environmental security (Ângelo 2024; Gupta et al. 2024). However, such developments are clearly challenging in the current geopolitical environment.

The way to change the present situation is likely to be very slow moving because it requires deep personal and collective commitment to soften the IGGR. Softening requires that a large part of the world population feels more protected by

cultivating some form of global identity that governs global natural resources and commons and the climate, rather than cultivating exclusively their national identity, nationalism including its extreme forms. A common global identity is increasingly needed. But is also increasingly impaired by the North–South divide and by brutal contemporary geopolitics. This divide might fuel an emerging new global order with three main powers, the US, China, and Russian Federation, and with India aspiring to join. These new tendencies are transforming globalization into the so-called re-globalization, where economic trade flows and political interactions become less integrated with a concomitant decrease of openness and interaction (Brites Pereira et al. 2021; Sousa et al. 2024). This is widely considered unsustainable.

Conclusion

The roadmap for sustainability proposed by the LPHEC report is well argued, sound and theoretically achievable. However, its practical implementation requires the willingness and engagement of hundreds of millions of people to understand, feel the purpose and value, and be driven by the need to implement the portfolio of recommended transformations. It was shown that to achieve that goal, it is necessary to evolve at the human inner world level, to develop critical thinking and motivations to overcome the constraints imposed by the human sustainability boundaries (HSBs). For each of the four LPHEC transformations, we identified the HSBs that must be opened up by softening.

Humankind is under the spell of the multi-century Z transformation, centered on self-interest, utility and competition that hinders the softening of HSBs required to implement the transformations needed to stay within safe and just ESBs. Without overcoming these barriers, future social generations are very likely to face a difficult and dangerous future. The present world situation reveals an increasing number of electorates and countries that exhibit a tendency to value self-interest, utility maximization, extreme competition, and nationalism and to devalue science and ethics. These features are likely a sign of dysfunctionality and decline in the Z transformation, which may elicit a reaction towards greater acceptance of the LPHEC transformation. More research is needed to assess this thesis. The major challenge is how to enhance the individual and collective capacities for achieving sustainability taking into account the resistances implied by the seven human critical determinants. There is an increasing need for the synergistic reinforcement of the two dimensions of sustainability science, between psycho-behavioral change and the development and application of science, technology and innovation for sustainability. Furthermore, the paper opens research areas on the future development

of the Z transformation, which must be replaced by the LPHEC transformation to enter the pathway to sustainability, but constitutes a powerful adverse setting for its successful implementation.

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Data availability Data analyses, literature review, and figures generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability No codes were used for the study and analyses.

Declarations

Conflict of interest The authors declare no conflicts of interest in this article.

Ethical statement The Faculty of Science, University of Lisbon (FCUL) approved the study protocol. More detail about the different stages of the research is available from the corresponding author on reasonable request.

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