

Chapter 35

Technological Imagination to Stay Within Planetary Boundaries



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Abstract Technological imagination has been, until now, a stronger driver of development and has permitted to scale economy and even to obtain increasing returns of investments. However, times are a changing. Humanity faces now societal and environmental changes that are pushing the planet Earth toward a danger zone, overpassing recommended limits for several critical processes, such as bio-geochemical fluxes of nitrogen and phosphorus, greenhouse gases concentration in the atmosphere, biodiversity loss and land use change. The role of technology applied to built environment design should be redefined to stay within the so-called safe operation space for humanity, considering the limited resources we have and the need of low-energy solutions for buildings and cities. This chapter introduces the key concepts for the understanding the new role that we must assign to technological imagination to face the challenge of the Anthropocene epoch and discusses how to achieve the seven transitions objectives for transforming our world in a sustainable way.

Keywords Anthropocene · Safe operation space · Planetary boundaries · Strong sustainability · Kondratiev waves · New economy · Smart city · Environment

35.1 Introduction: The Planetary Boundaries

We live in a transition world. Since the decade of the '70 in the past century, science and society have been focused on global problems, such as global warming, resources depletion, environmental pollution and sustainability of development. Key moments to be remembered are at least: the publication of the book "Limits to growth" in 1972 (Meadows et al. 1962); the publication of the report "Our common future" in 1987 (Brundtland et al. 1987); the creation of the Intergovernmental Panel for Climate Change in 1988 (World Meteorological Organization 1988); the United Nation Convention on climate change in 1992 (United Nations 1992); the adoption of the Kyoto protocol in 1997 (United Nations 1998); the official proposal of the

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term “Anthropocene” to refer to our geological epoch (Crutzen and Stoermer 2000; Crutzen 2002) in early XXI century; the proposal of the 17 Sustainable Development Goals (United Nations 2016); and the adoption of the Paris Agreement in 2015 (United Nations 2015). The transition to a sustainable world, a world in which future generations can satisfy their own needs, required of urgent actions to be taken, both under environmental and societal point of view, to face the challenges of the present. Respect to environmental challenges, climate change and other critical processes (Steffen et al. 2015) must be limited to stay in the so-called safe operating space (Rockström et al. 2009a) or within the planetary boundaries (Rockström et al. 2009b) (Fig. 35.1). Respect to societal challenges, the end of poverty and hunger, the provision of wealth to everyone, the right to a safe urban environment and the reduction of inequalities are the most important goals to be reached soon (United Nations 2022).

35.2 A social Dilemma: Growth, Wealth and the Role of Technology

Unfortunately, our world is at the same time a globalized world and a very uneven world. Economic growth is still highly depending on fossil fuel consumption, and the vision of a dominant model in finance and industry has led to an accelerated increase in inequalities, both between countries and inside each country, especially in growing economies. In 1954, the economist Simon Kuznet formulated its hypothesis that development implies an inequality increase during the early stages and a reduction of inequalities during the mature stages (Wang-Erlandsson 2022). However, the Kuznet hypothesis and the proposed curve of development are now under revision (Kuznets 1953), incorporating environmental issues and considering the interrelationships between countries in a very connected world (Jha 1996). Moreover, new economic theories, such as the proposition of Thomas Piketty (Stern 2018), pointed out that inequalities are increasing even in developed countries, due to the new disbalance among capital and labor rentabilities.

Technological imagination can be one of the driving forces to a more sustainable world. Early in the XX century, Russian economist Nicolai Kondratiev (Piketty 2013) formulated a theory of technological “waves” that push forward the economic cycles. He identified and predicted five waves, which already occurred and now can be analyzed.

As pointed out by several academics from different disciplines (as for example the economist Leo Nefiodov and the urban planner Micheal Batty), the next wave is approaching and could relate to aspect such as: environment protection, health, digital transition, smart cities or a mix of them. Nefiodov (Kondratiev 1935) suggest that health care should be the most important economic driver in the sixth wave. Batty (Nefiodov and Nefiodov 2017) think that the smart city and the digital transformation are the main vectors. However, things are much more connected. The pandemic episode of 2020–2021 underlined the existence of a deep link among nature, cities

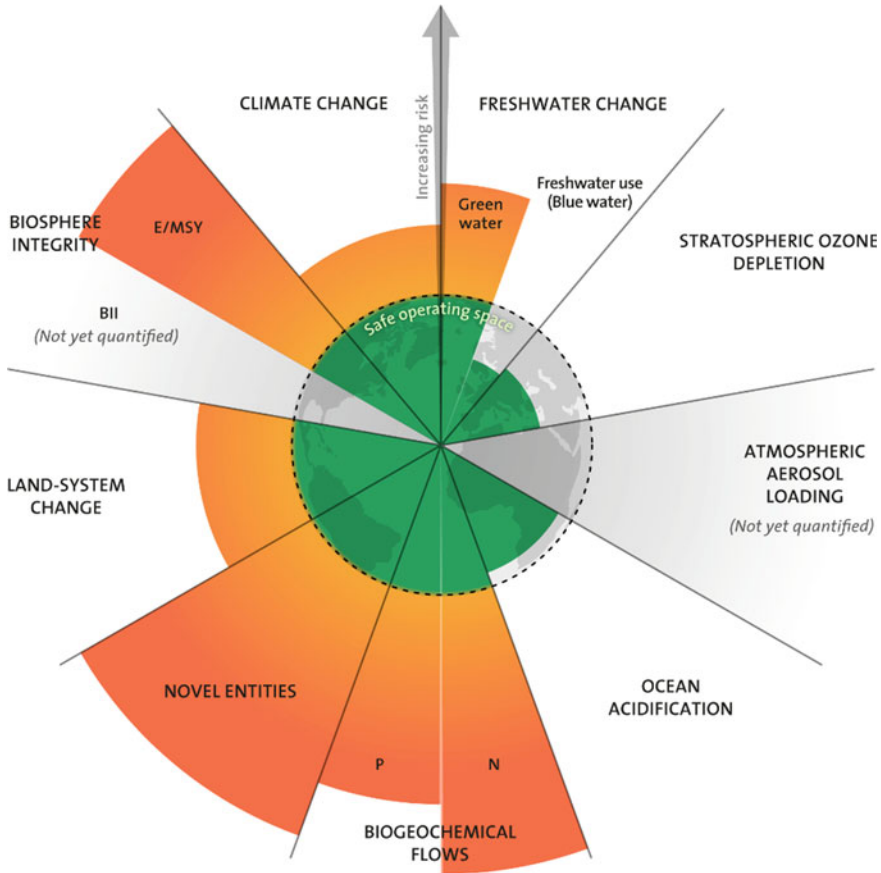


Fig. 35.1 Safe operation space for humanity and critical processes of the Earth system. Image from: Azote for Stockholm Resilience Centre, based on analysis in Wang-Erlandsson et al. 2022 (Wang-Erlandsson 2022), Persson et al. 2022 (Kuznets 1953) and Steffen et al. 2015 (Steffen et al. 2015). Reproduced with permission

and health (including mental health). Environmental issues are entangled with any possible technological innovation, being the biotechnology only one aspect of that complex relation.

However, looking at Batty’s proposition and reinterpretation of Kondratiev theory, it can be observed that the new waves have the characteristic to be more and more intense and frequent, pointing out the risk of collapse of the structural stability (Batty 2018) in which we live in. A new economy is also necessary. Sustainability concept can be regarded as weak or strong (Naumer et al. 2010) depending on the interpretation of its components. If an economical benefit can justify a reduction in environmental or social “shares” of sustainability, we are using the weak concept. If, on the contrary, an economical benefit can be achievable only inside a social bearable world,

and a social benefit can be achievable only in a healthy environment, we are using the strong concept to define what “sustainable” should mean. Under this perspective, to squeeze productive efficiency to increase rentability of financial investments, it is clearly not a solution.

Jevons paradox (Kauffman 1993) remember us that if technology is used to maximize output power, the result is a drastic increase in entropy and a faster resources depletion. Moreover, no change of scale is achievable while approaching planetary boundaries. For all these reasons, some authors have been working on the ecological meaning of “sustainability” concept. In landscape ecology, for example, Wu (Beckerman 1994) defined the sustainable landscape as a landscape which has the capacity to carry with the needs of all the species that take part in its processes. Such a landscape, complex and adaptive, is the substrate we need to be who we are.

35.3 Seven Transitions to Sustainability

So, technological imagination in the green and digital transition should be regarded as the opportunity to drive us to a world in which the environment is protected by specific policies; economy is a strong, essential tree where societies and cultures can flourish; and diversity is the global result, guaranteeing resilience of the global ecosystem and helping us to stay inside the boundaries of the Earth’s critical processes (Fig. 35.2). In architecture and design, imagination has always been the base of development. Today, however, technological imagination must be guided. The vision should be retrospective: first imagining the world we want for the future, and then go back to the present to figure out, step by step, the way to build that desired world. We need for a low-tech, low-energy-dependent, smart built environment to face the challenges of the future. Our buildings and cities are more than the deposition of technomass (Sorrell 2009) on a biological substrate. They are the drivers of our behaviors, showing us the way to follow. Architects and planners have the immense responsibility to make the way to a sustainable scenario, not a business as usual one.

In the ‘80s, Nobel laureate Murray Gell-Mann (Wu 2013) stated that sustainability will only be achieved by humanity under passing through seven transitions: demographic transition, technological transition, economic transition, social transition, institutional transition, informational transition and ideological transition. All described transitions are necessary to build a world that could be called “sustainable.” Population should converge to a fixed limit (someone estimates around 11,000 millions of individuals) and then move around this attractor; technology should help improving quality of life and focus on human health; economy should transform itself (or return to be) into the science of “taking care” of our home; human society must accept its very peculiar character of being at the same time diverse and globalized; institutions have to be changed to adapt us to our new complex world, possibly eliminating older structures as national states and substituting them with both global and regional new institutions; informational transformation has already pushed human possibility to communicate over limits that even Murray Gell-Mann cannot imagine

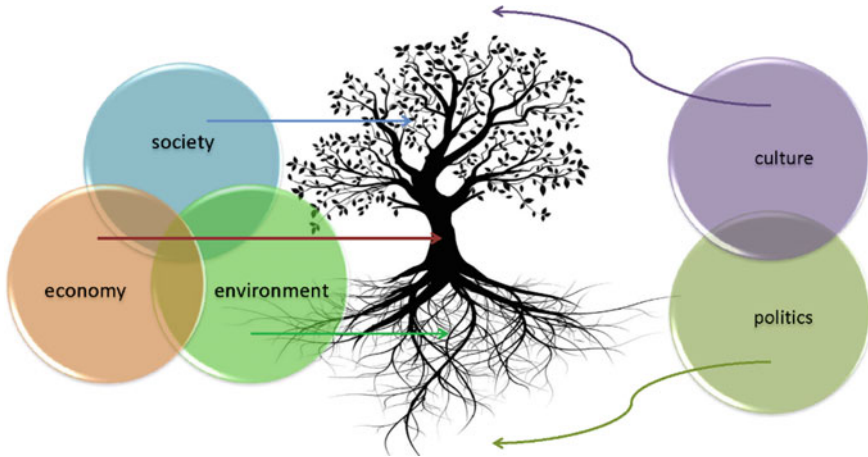


Fig. 35.2 Vision of sustainability as something bigger than a range of opportunities. Drawing by Manfred Max Bergman 2017 (Gell-Mann 1994). Reproduced with permission

in the '80s; ideological transformation is probably the most important transition and the most difficult to be achieved. We still live in a very conservative world, as demonstrated for example by the existence of academic static disciplines; mentors and masters to be served; dictators dominating and sometimes owning entire nations; labor division often following strange class and race criteria; political and economic power concentration in very few hands.

35.4 Conclusion

In this chapter, I have briefly introduced the idea of technological imagination as a fundamental tool for humanity to stay within planetary boundaries. In the past, creativity and innovation have been regarded as important driving factors of economic growth, permitting to shift scales and to even obtain increasing returns (Inostroza 2014). However, that times were privileged times, and now, we face a very different situation. Saturation of markets and resources depletion are envisioning times of transitions and great challenges. As described by David Harvey (Bergman 2017), the global capitalistic economy, based on finance more than on industrial production, is quite close to its end. A new economic thinking and a new ideology are the final points to be reached in the transition to a completely new world.

The role that technology and especially built environment-related technology will have during the transition, an after its completion, is still to be determined in detail. Nevertheless, I can figure out for such technology a very important role in balancing the reduction in excessive consumption of goods, energy, water, food and the increase

in social health, happiness and cultural development of humanity. It is not a nonsense: the need to reduce the human excesses justified only by extreme capitalistic vision can be combined with a better way of life for everyone. Indigenous thinkers of South America call it “sumak kawsay” (Gell-Mann 1994), that means “living good.” This concept must substitute the idea of “living better and better” that has failed in driving us toward a desirable world. For architects and planners, the challenge is enormous. But we must stay with the trouble and accept the idea to imagine, once again, that a new world is possible. Imagine yourselves, for example, completing the project of “New Babylon,” the city of freedom envisioned by situationist architect Constant (Romer 1986) in the ‘60s, a place where a new humanity can stay for a while, eventually unchained, so far away from the mindless circle of production and consumption in which we are still trapped.

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