

First Background Paper for Transformations within Reach (Phase-2)

Framework for Catalyzing Societal Transformations

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We gratefully acknowledge the following IIASA colleagues who helped refine the framework with their expertise and suggestions during personal interviews:

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27 October 2022

ZVR 524808900

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The authors gratefully acknowledge funding from IIASA and the National Member Organizations that support the institute (The Austrian Academy of Sciences; The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES); The National Natural Science Foundation of China (NSFC); The Academy of Scientific Research and Technology (ASRT), Egypt; The Finnish Committee for IIASA; The Association for the Advancement of IIASA, Germany; The Technology Information, Forecasting and Assessment Council (TIFAC), India; The Indonesian National Committee for IIASA; The Iran National Science Foundation (INSF); The Israel Committee for IIASA; The Japan Committee for IIASA; The National Research Foundation of Korea (NRF); The Mexican National Committee for IIASA; The Research Council of Norway (RCN); The Russian Academy of Sciences (RAS); Ministry of Education, Science, Research and Sport, Slovakia; The National Research Foundation (NRF), South Africa; The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS); The Ukrainian Academy of Sciences; The Research Councils of the UK; The National Academy of Sciences (NAS), USA; The Vietnam Academy of Science and Technology (VAST).



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Executive Summary

Humankind seems to be descending into a vicious spiral of social-ecological adversities. Despite multiple scientific warnings about human impacts on the resilience of ecosystems, decades of insufficient action have heightened the risk of irreversible tipping points in the Earth systems. Moreover, insufficient progress on fulfilling the SDGs has been further undermined by the COVID-19 pandemic, while geopolitical tensions and conflicts are derailing prospects for global cooperation on global challenges. Although technological progress continues to enhance our (creative and destructive) capabilities, our institutions and political economies are becoming increasingly malfunctioning.

These biophysical and social realities compel us to analyze underlying causes and discern possible alternatives. With support from the Advisory Board, co-creation with a diverse Community of Experts and Practitioners (CoSP), and consultation with IIASA-based researchers, Transformations within Reach (TwR) phase-2 aspires to galvanize action toward societal transformations. This background paper is our starting point. It is the outcome of an extensive literature review and forms the basis for the first workshop with the TwR CoSP. We concur with a growing body of social science research that unbridled consumption by high-income social actors and the pursuit of GDP growth as an end in itself is detrimental to sustainable well-being. Economic growth-dependence of political economy constrains a collective anthropic agency to tackle sustainability crises. In its current form, it is a major driver of negative ecological tipping points and increasing social fragility, likely to result in a societal collapse. We, therefore, attempt to define the alternative political-economic teleology needed to prioritize sustainable well-being for all within biophysical limits.

We further outline a structure–agency symbiosis that sustains the status quo and possible alternatives to catalyze transformations. We surmise that to enhance our collective agency, we need to foster:

- Eudaemonic rather than monetary value systems;
- Convivial value–driven rather than profit-driven technologies;
- Cooperation rather than competition (especially at the international level); and
- Holistic rather than narrow and partial information processing.

This leads us to the possible alternatives to the structural enablers of the status quo:

- **Needs-driven sustainable business models** rather than supply-driven industrial capitalism;
- **A social-ecological security framework** rather than military security;
- **Dispersion of power** rather than the current concentration with vested interests; and
- **Transdisciplinary knowledge systems** rather than reductionist science.

We aspire to build on the resultant framework (Figure 11: Framework for societal transformations) to synergistically catalyze societal transformations. We use recommendations from the IIASA-ISC joint initiative, "Bouncing Forward Sustainably: Pathways to a Post-COVID World" (TwR Phase-1) as examples of possible actions in relation to this framework. Using structural enablers as entry points, we seek to catalyze the alignment of anthropic agency and societal decision-making with sustainable well-being.

1. Introduction

I can see no other escape from this dilemma (lest our true aim be lost for ever) than that some of us should venture to embark on a synthesis of facts and theories, albeit with second-hand and incomplete knowledge of some of them—and at the risk of making fools of ourselves - Erwin Schrödinger (1992, p. 1).

Since its inception in 1972 to promote scientific cooperation and address global challenges, IIASA has been at the forefront of providing a scientific assessment of the human impact on the Earth System. IIASA's foundational principles commit us to seek "a better future for all" (Gluckman et al., 2022). As elaborated in the subsequent sections of this paper, urgent and critical actions are needed to avert social collapse and ecological tipping points. Transformations within Reach (TwR) (Phase-2) is intended to provide an action-oriented synthesis for catalyzing societal transformations toward sustainability. It aspires to build on the outcomes from the IIASA – ISC (International Science Council) joint initiative, "Bouncing Forward Sustainably: Pathways to a Post-COVID World" (Srivastava et al., 2021) and a wealth of similar initiatives, academic papers, reports, that have outlined possible pathways for the necessary societal transformations. This background paper should be seen as a synthesis of our literature review-based findings to date. It presents a framework for catalyzing societal transformations that has been refined through consultations with IIASA researchers in the form of semi-structured interviews.

An integral part of our initiative is to conduct a series of workshops with a diverse Community of Experts and Practitioners (CoSP) in partnership with whom we seek to achieve our objectives. With inputs from this paper, the first CoSP workshop will deliberate on the broad systemic perspective and also leverage different theories of change to discern the following: What are the key areas for intervention in the societal dynamic that need to be simultaneously transformed? How do they relate to each other? How can different actors be enabled to take critical actions to ensure sustainable well-being for all, amid existing and emerging social-ecological challenges? Our first workshop will proceed as follows:

1. We will briefly present the TwR initiative and the general framework based on this paper and solicit feedback from the participants.
2. In relation to the framework, we will deliberate on specific high-impact and mutually synergistic actions as catalysts for societal transformations.
3. We will invite reflections and suggestions on how to build on our work in the next stages of this initiative.

This paper is structured as follows. After this short introduction, Chapter 2 establishes "The Rationale for Societal Transformations." In the first part of Chapter 2, a "Situational Assessment," is outlined, including biophysical tipping points, social unravelling, the vicious social-ecological spiral, and further adverse prospects, if we continue with business-as-usual. Chapter 2 then highlights that efforts to date have focused on weak leverages and recognizes the need for much deeper "Societal Transformations." In Chapter 3 we create "A Framework for Societal Transformations," which starts with problematizing uneconomic growth as an end in itself (implicit teleology), and instead proposes sustainable well-being for all within biophysical limits as a "Political Economic Teleology." Following this, we highlight "The role of anthropic agency," followed by "Structure–agency symbiosis." We conclude the framework chapter with "Structural Enablers" to catalyze sustainability transformations. Chapter 4 provides an "Outlook for further action-oriented synthesis" with selected recommendations from Phase-1 of the TwR initiative, and relates these to the Phase-2 framework.

2. The Rationale for Societal Transformations

2.1 Situational Assessment

Our world is in big trouble. Divides are growing deeper. Inequalities are growing wider. Challenges are spreading farther. (Guterres, 2022a)

Biophysical tipping points

As a result of the human impact on the Earth system, described as “the Great Acceleration” (Steffen et al., 2015, p. 81), “Nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are deteriorating worldwide” (IPBES, 2019, p. 10). Earth System scientists have warned that we are on the cusp of triggering compounding phase shifts in the “tipping elements,” a set of interdependent biophysical processes that are crucial for regulating the relative stability of the Holocene Earth system (Lenton et al., 2008; Martin et al., 2021). Potential tipping cascades in these processes have been considered “an existential threat to civilization” (Lenton et al., 2019, p. 595). Time is running out to contain global climate change below a 1.5°C increase compared to the pre-industrial baseline aspired to in the Paris Agreement. “GHG emissions are projected to rise beyond 2025, leading to a median global warming of 3.2 [2.2 to 3.5] °C by 2100” (IPCC AR6 WGIII, 2022, p.21). This implies irreversible processes that will exceed many of the tipping elements foreseen by scientists (Armstrong McKay et al., 2022).

Social unraveling

International efforts and progress toward achieving the Sustainable Development Goals (SDGs) is lagging far behind the targets and, in some cases, is being reversed. “In 2020, the global extreme poverty rate rose for the first time in over 20 years. Hundreds of millions of people were pushed back into extreme poverty and chronic hunger. The COVID-19 pandemic has interrupted one or more essential health services and has posed major health threats beyond the disease itself. It has wreaked havoc worldwide on children’s learning and well-being, and women have suffered a disproportionate share of job losses and increased care work at home. The pandemic has exposed and intensified inequalities within and among countries” (UN, 2021, p. 3). As a result, social unrest and political extremism are on the rise.

The vicious social–ecological spiral

An increasing number of extreme weather events, their consequences, and other ecological disasters are already exacerbating living conditions across the globe and especially in low-income countries (Coleman, 2022). Higher-income and wealthy social actors continue to impose a burden of unsustainable consumerism on lower-income communities and individuals who are already the most vulnerable to socially triggered ecological tipping points (O. Táíwò, 2022) (See, for example, Global Commons Stewardship Index in Ishi et al. (2022)). UN Secretary-General Antonio Guterres has warned that ongoing violent conflicts combined with the effects of climate change and the COVID-19 pandemic “threatens to tip tens of millions of people over the edge into food insecurity followed by malnutrition, mass hunger and famine” (BBC, 2022). Ensuing economic hardships will entail choices that favor short-term relief over longer-term resilience and reduce public support for climate action (Kenny, 2018). This is likely to exacerbate existing social conflicts and geopolitical tensions, as countries and various other actors compete over scarce resources; see, for example, the emerging “Food-Energy-Water–conflict nexus,” in Abbott et al. (2017). These dynamics are leading to a “Global System Death Spiral”: a “reinforcing

feedback between ecological and social collapses” (Beard et al., 2021, p. 2), as depicted in Figure 1: A vicious spiral. The United Nations Development Program (UNDP) surmises, “Though humanity has achieved incredible progress, we have taken the Earth for granted, destabilizing the very systems upon which we rely for survival” (UNDP HDR, 2020, p. 8).

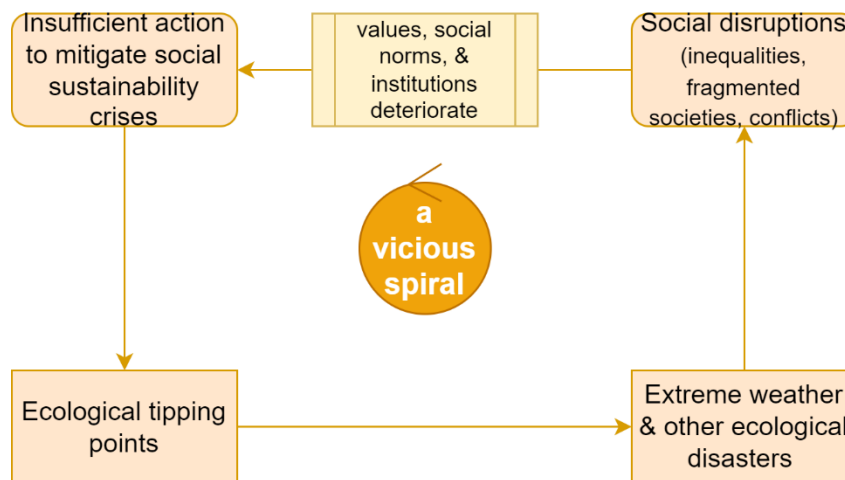


Figure 1: A vicious spiral

Further prospects

We have Paleolithic emotions, medieval institutions and godlike technology. And it is terrifically dangerous, and it is now approaching a point of crisis overall - Edward O. Wilson (Wilson, 2017).

Climate change mitigation continues to be seen as a trade-off in relation to short-term profit maximization and economic growth dependency (Jackson, 2021), both of which are still a key priority societal decision-making. For example, The world’s governments plan to produce more than twice the amount of fossil fuels in 2030 than would be consistent with limiting warming to 1.5°C. [...] G20 countries have directed over USD 300 billion in new funds towards fossil fuel activities since the beginning of the COVID-19 pandemic — more than they have towards clean energy (SEI, IISD, ODI, E3G, and UNEP, 2021). Without critical actions to mitigate climate change, we risk “incinerating our only home” (Guterres, 2022a). Van der Leeuw (2020, p. 10) notes, “Emissions are only one aspect of a much more fundamental threat to the continuity of our current ways of living on Earth.” Geopolitical tensions and military conflicts undermine the prospects for global cooperation on climate change and other global challenges and further exacerbate economic hardships, as countries bolster their military expenditures. Furthermore, conflicts are likely to become more pernicious (and possibly existential), as humanity continues to unleash more technological powers in multiple domains (e.g. Artificial Intelligence [AI], nanotechnology, artificial enhancement of biology, etc.) (Avin et al., 2018; Bostrom, 2019; Rees, 2018). Folke et al. in their review entitled “The Anthropocene Biosphere” conclude: “Whether humanity has the collective wisdom to navigate the Anthropocene to sustain a liveable biosphere for people and civilizations, as well as for the rest of life with which we share the planet, is the most formidable challenge facing humanity” (2021, p. 834).

2.2 Societal Transformations

Business-as-usual is not working

Major international efforts toward fulfilling the SDGs and mitigating social-ecological sustainability crises have focused on highly tangible but essentially weak, leverage points (Abson et al., 2017). These have mainly been limited to technological fixes with limited incentives and moderate market-based mechanisms, such as cap and trade, carbon offsets, etc. Moreover, these efforts are plagued by difficulties in scale-up and implementation. Benefits of sustainable choices are not well integrated into economic incentives and are dwarfed by continuing subsidies for fossil-fuel based infrastructure. According to a review paper by Stoddard et al., “Three decades of choosing to fail on mitigation have shifted the climate challenge from a technocratic adjustment to business-as-usual to requiring a rapid, system-level change within both industrialized and industrializing societies” (2021, p. 680). Another eminent group of researchers conclude: “in light of the profound challenges of navigating the future of human societies towards a stabilized Earth state, it becomes clear that modest adjustments on current pathways of societal development are not very likely to guide humanity into sustainable futures” (Folke et al., 2021, p. 845). IPBES report concurs, “[Sustainable development] for 2030 and beyond may only be achieved through transformative changes across economic, social, political and technological factors” (2019, p. 14).

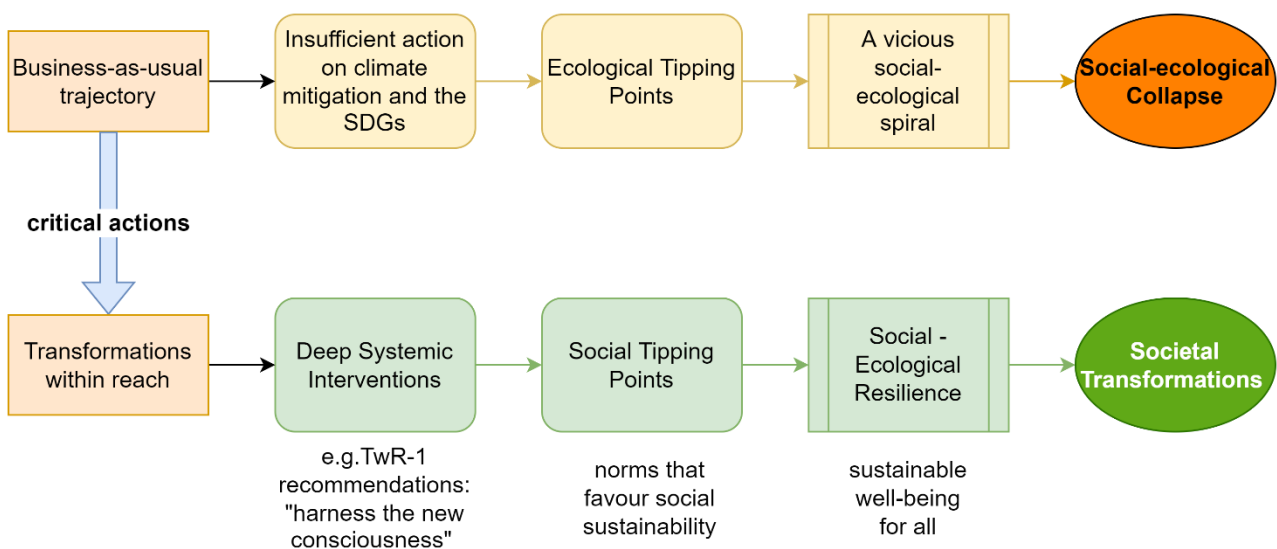


Figure 2: Transformations or collapse

A deeper societal transformation is needed

Given the exigency of simultaneous transformations across multiple interdependent societal domains (Lenton et al., 2022) and geographical regions (Rockström, 2022), we prefer the term “societal transformation” rather than social, systemic, or structural transformation, as the latter tend to be associated with specific characteristics of transformation. For example, systemic transformation is typically associated with specific sectoral changes (e.g., a shift to renewable energy), while social and structural transformation tends to focus on a political-economic change (Scoones et al., 2020).

While ongoing crises are limiting conventional agency (e.g., by furthering fiscal constraints), they are also opening up prospects for more transformational paradigm shifts (van der Leeuw & Folke, 2021). The seeds for such transformations are emerging. Van der Leeuw & Folke (2021, p. 13) observe that, “the new “collective mind” of society is coevolving with the dynamics of the realities of the Anthropocene. It will hopefully foster capacities for redirecting societal development into basins of attraction ensuring sustainable futures”.

Research suggests that societal transformations typically follow an S-curve of evolution across coupled social-technological–ecological systems that are mutually reinforcing (Lenton et al., 2022). Until now, we are seeing only the activities of pioneers and early adopters. Examples include mission-oriented science initiatives,¹ the center for humane technology,² global youth-led climate justice movements, the C40 alliance of cities,³ and the adoption of well-being indicators by a growing number of governments (Fioramonti et al., 2022). But prospects for these sustainable transformations to become “a new normal” are far from guaranteed and given how urgent it is to break free from the vicious spiral (see Situational Assessment [above](#)), these efforts need to be catalyzed to avert catastrophic social collapse. This implies critical actions to address deep systemic factors that relate to the design (i.e., structures and institutions that manage feedbacks and parameters) and intent (i.e., norms, values and goals and the underpinning paradigms from which they arise) (Abson et al., 2017; Meadows, 2008). As will be shown in the next chapter, our framework for societal transformation toward sustainability implies rapid transformations comparable to those of the industrial revolution of modernity, which entailed paradigmatic shifts in narrative ontologies, epistemology, political–economic teleology, associated decision-making structures, production models, and other social practices.

¹ <https://council.science/actionplan/funding-science-global-commission/> accessed on 14.05.2022

² <https://www.humanetech.com/> accessed on 14.05.2022

³ <https://www.c40.org/> accessed on 14.05.2022

3. A Framework for Societal Transformations

3.1 Political–Economic Teleology

What perpetuates a growing gap between our long-term sustenance and current actions reflected in our *Situational Assessment*? Our observation is that anthropic agency (as reflected in societal decision-making) is currently dictated and constrained by the straitjacket of the quantitative growth imperative. As Folke et al. (2021, p. 836) note, economic development and technological change have fostered “belief systems” that “view humans and nature as separate entities.” A growing body of research concludes that economic growth as an end in itself is counter-productive (Schmelzer et al., 2022). Its perpetuation - among wealthy, high-income, and influential social actors in particular (Nielsen et al., 2021) - is leading humankind into a downward spiral of mutually reinforcing social and ecological deterioration (as briefed in section 2.1 *Situational Assessment*). The report of the World Business Council for Sustainable Development (2020) concurs: “The degree to which social stability and welfare depend on constant economic growth is a source of vulnerability,” especially in the context of emergent social-ecological crises that make it difficult to sustain economic growth. Following Herman Daly (1999), we label it as an uneconomic growth in the illustration below (Figure 3). Uneconomic growth is characterized by:

- an overshoot of the planetary biophysical limits by high-income segments of the human population (Nielsen et al., 2021); and
- increasing social fragility marked by rising inequality (Piketty, 2018) and consequent political dysfunction.

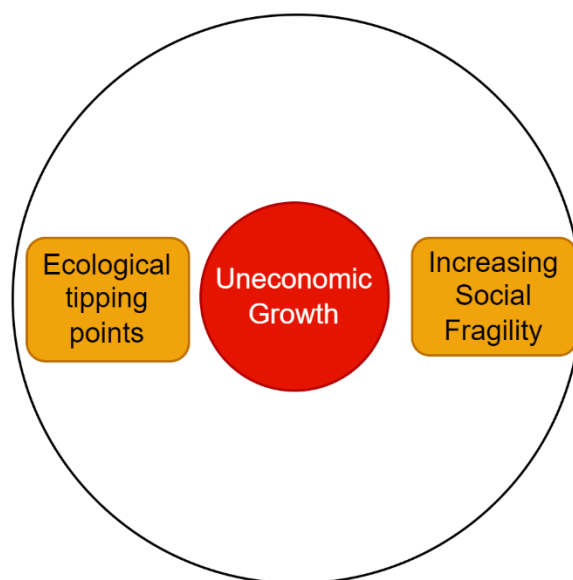


Figure 3: Current (BAU) political economic teleology

Building on doughnut economics and the planetary boundaries framework, we favour a post-growth-oriented stance of prioritizing sustainable well-being for all (Fioramonti et al., 2022). This entails maintaining ecological resilience and ensuring the fulfilment of universal basic needs. We depict the defining boundary conditions of this teleology in Figure 4 below:

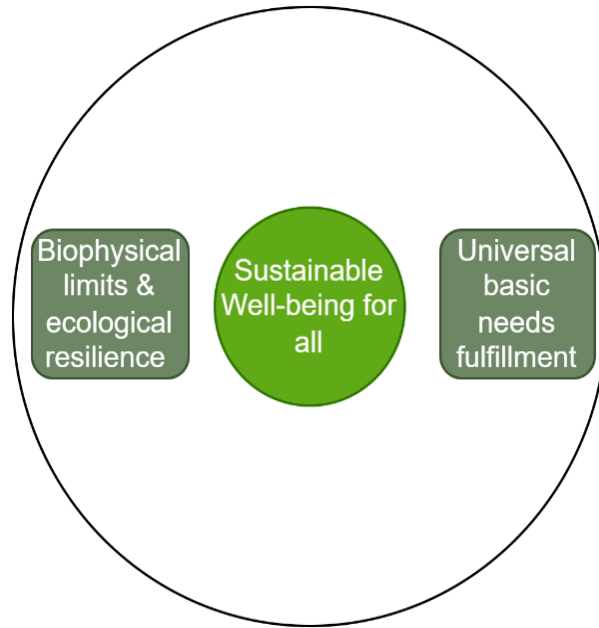


Figure 4: Transformational political economic teleology

Enabling the sustainability of material sufficiency for all on a planet with limited resources would entail a significant reduction in high-consumption lifestyles, complemented by transformations in the embedded value systems (Nielsen et al., 2021). This would be exigent for securing the SDGs while fostering ecological resilience (Creutzig et al., 2022). The summary for policymakers of the Intergovernmental Panel on Climate Change (IPCC, AR6, WG3) notes with high confidence that demand-side mitigation response options are consistent with improving basic well-being for all. Human well-being is decoupled from GDP growth beyond a certain threshold (Collste et al., 2021). Well-being may also be fostered by enriched value systems, some of which have been lost in the pursuit of material growth (van der Leeuw, 2020, p. 414). A recent Club of Rome report concurs, 'no Limits to Learning' responds well to the challenge posed by 'The Limits to Growth'. In other words, a world of material sufficiency can very well be a healthy one with creativity driven by the infinite possibilities of relationships within nature. This is the cultural shift we need (Dixson-Declève et al., 2022).

3.2 The Role of Anthropic Agency

Dependency on economic growth leads to malfunctioning in the anthropic agency as reflected in our collective failure to mitigate social sustainability crises (Stoddard et al., 2021) and other emergent anthropogenic technological risks (Bostrom, 2019). We identify four key dimensions of malfunctioning in the collective agency that are mutually reinforcing:

- The dominance of **materialistic value orientations** is based on fleeting hedonistic conceptions of well-being (Lamb & Steinberger, 2017). These are reinforced by the current economic incentives and by influential social actors in particular (Nielsen et al., 2021) to satisfy limitless wants at the expense of the

biophysical substrate and collective well-being. See, for example, “imperial mode of living” in Schmelzer et al. (2022);

- **Global competition** to appropriate, extract, and deplete limited resources, often characterized by repression of the local (indigenous) communities and sometimes spilling over into large-scale military invasions;
- **Inadequate processing of information:** this particularly concerns human impact on Earth systems and social–ecological sustainability (Grumbach & Leeuw, 2021); for example, plans for mining in the deep ocean with an extremely inadequate and opaque regulatory framework (McVeigh, 2022); and
- **Profit-driven technologies**, which enable the acceleration and expansion of these processes and induce novel existential risks (Avin et al., 2018; Bostrom, 2019; Rees, 2018).

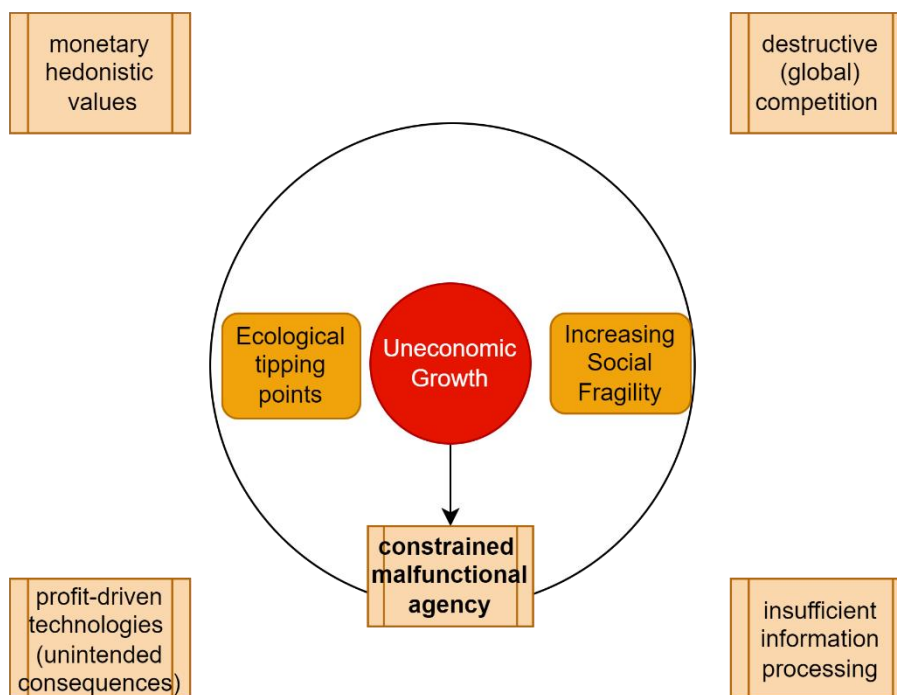


Figure 5: Constrained malfunctional agency

In contrast, sustainability-enhancing agency aligned with well-being would be characterized by:

- **Eudaemonic value orientations**, rooted in more comprehensive conceptions of well-being: “as multidimensional (with no substitution between dimensions), satiable (there is such a thing as ‘enough’ to live a good life), and socially based (rather than depending solely on individual attitudes)” (Lamb & Steinberger, 2017, p. 10);
- **Enhanced cooperation** for collective action (especially at the international level) (Stewart, 2014);
- **Holistic information processing** (Chabay et al., 2021; Grumbach & Leeuw, 2021; van der Leeuw, 2020) of the human impact on social-ecological systems;

- **Convivial value-driven technologies**, that enable societal development and enhance our humanness (Arthur, 2009; Illich, 1973) rather than reducing everything (including humans) to a resource for exploitation (Heidegger, 1954).

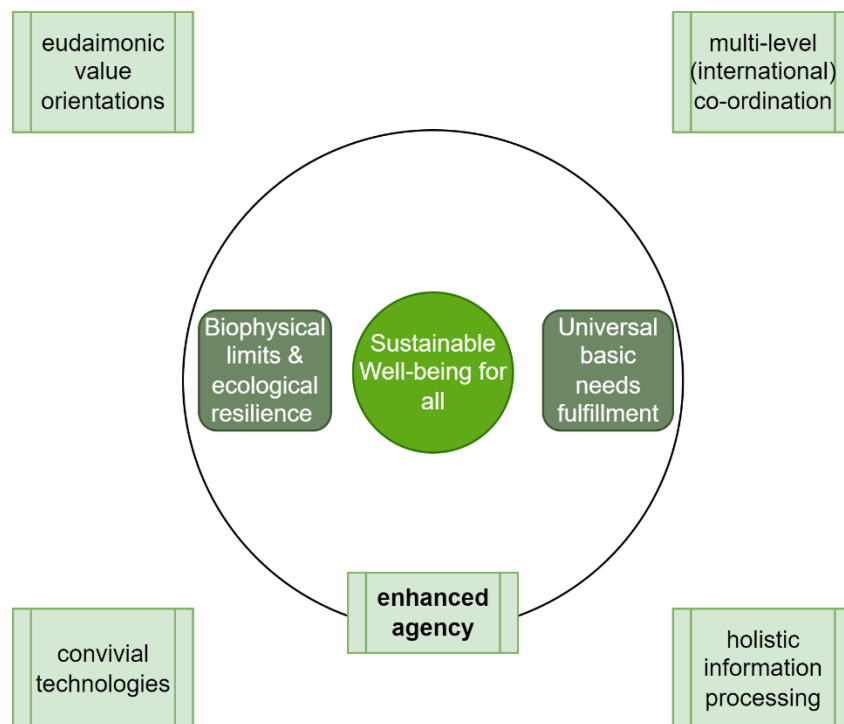


Figure 6: enhanced agency aligned with sustainable well-being

3.3 Structure–Agency Symbiosis

Our next step is to identify structural enablers of the business-as-usual orientation (characterized by uneconomic growth and malfunctioning agency) and the alternative orientation (characterized by sustainable well-being for all and enhanced agency). We further note that like all models, this is by definition an over-simplification of social complexities. As the saying goes, “all models are wrong, but some are useful.” While maintaining a broad perspective, we strive to remain succinct in identifying cross-cutting structural features across different systems (e.g., food, energy, education) and in relating them to the dimensions of agency identified in the previous section:

- Current industrial capitalist production models fuel hyper-consumerism. It generates insatiable “wants” and drives a constant demand for resource exploitation which, in turn, fosters militarism as a key security framework; for more on this, please refer to Stoddard et al. (2021, Section 3.3. Geopolitics and Militarism). Sustainable production models may instead serve to fulfil material “needs” aligned with sufficiency principles under eudaemonic value orientations (Lamb & Steinberger, 2017). As elaborated in the next section, a “social-ecological security framework” is proposed to foster eudaemonic and post-materialistic value orientations.

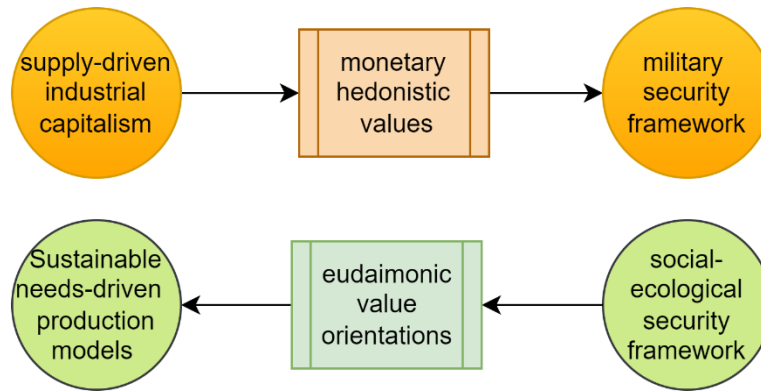


Figure 7: Values (~ontologies)

- The concentration of power in vested interests seeks to reinforce itself via a competitive dynamic that, in turn, perpetuates the military security framework. We note that current (un)economic incentives, for example, vested interests in maintaining and expanding the military-industrial complex, also contribute significantly to this destructive competition. Dispersion of power (including stronger international institutions) and a social-ecological security framework, rooted in biophysical realism (as elaborated in the next section), would instead facilitate global cooperation on global challenges.

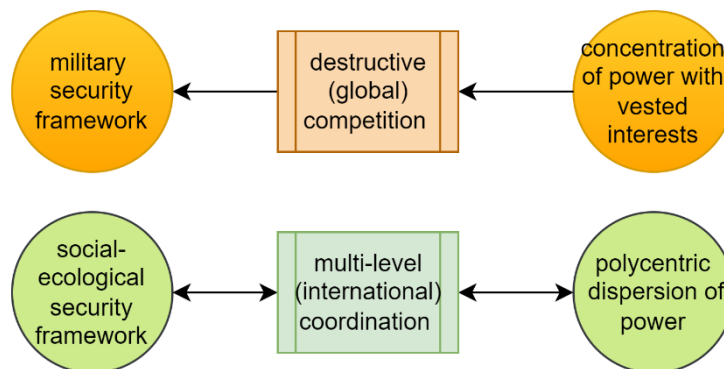


Figure 8: Competition vs Coordination (~methodologies)

- Reductionism in knowledge systems, appropriated by power structures has led to insufficient and biased information processing, especially with an increase in social complexity (Renn, 2020). While digitalization has been heralded as a key solution, our literature review suggests that it needs to be regulated by transdisciplinary knowledge systems able to integrate multiple worldviews, perspectives, and disciplines (Chabay et al., 2021) and dispersion of power characterized by the subsidiary principle. This is essential to enable a more holistic information processing for navigating the Anthropocene (Dryzek et al., 2019; Grumbach & Leeuw, 2021; Renn, 2020) which in turn, may foster further transdisciplinary knowledge creation and dispersion of power.

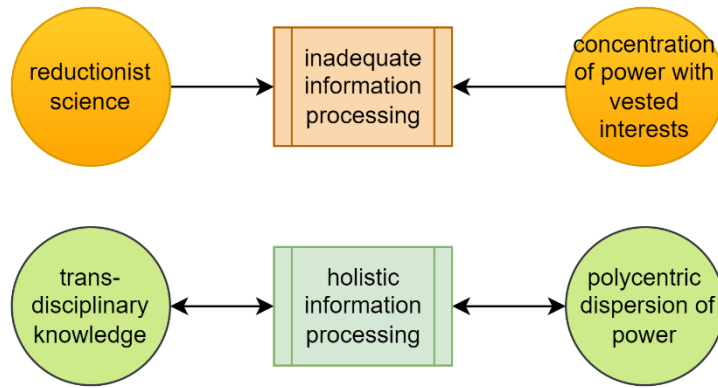


Figure 9: information processing (*~epistemology*)

- Technologies are the key driving force of human evolution in modernity. They are not value-neutral (Arthur, 2009; Heidegger, 1954). Profit-driven technologies are multiplying global anthropogenic catastrophic risks (Bostrom, 2019). While current business models are heralded for fostering innovation, pioneering scientific research is often funded via public investments (Arthur, 2009). Once technologies mature, business interests frequently collide with the democratizing benefits of technological breakthroughs (e.g. the refusal of the European Union to waive patents on Covid-19 vaccines). Therefore, we see a need for value-driven convivial technologies enabled by more holistic transdisciplinary knowledge systems (that can better anticipate the systemic consequences of new technologies) to support sustainable production in service of societal needs.

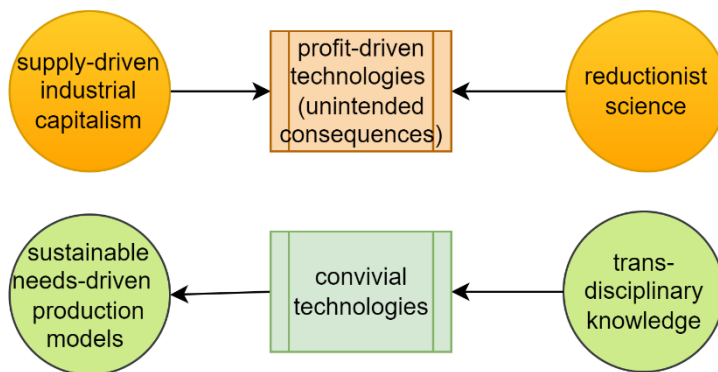


Figure 10: Technologies (*~methods*)

As a synthesis of the analysis so far, we present the following Framework for societal transformations (Figure 11):

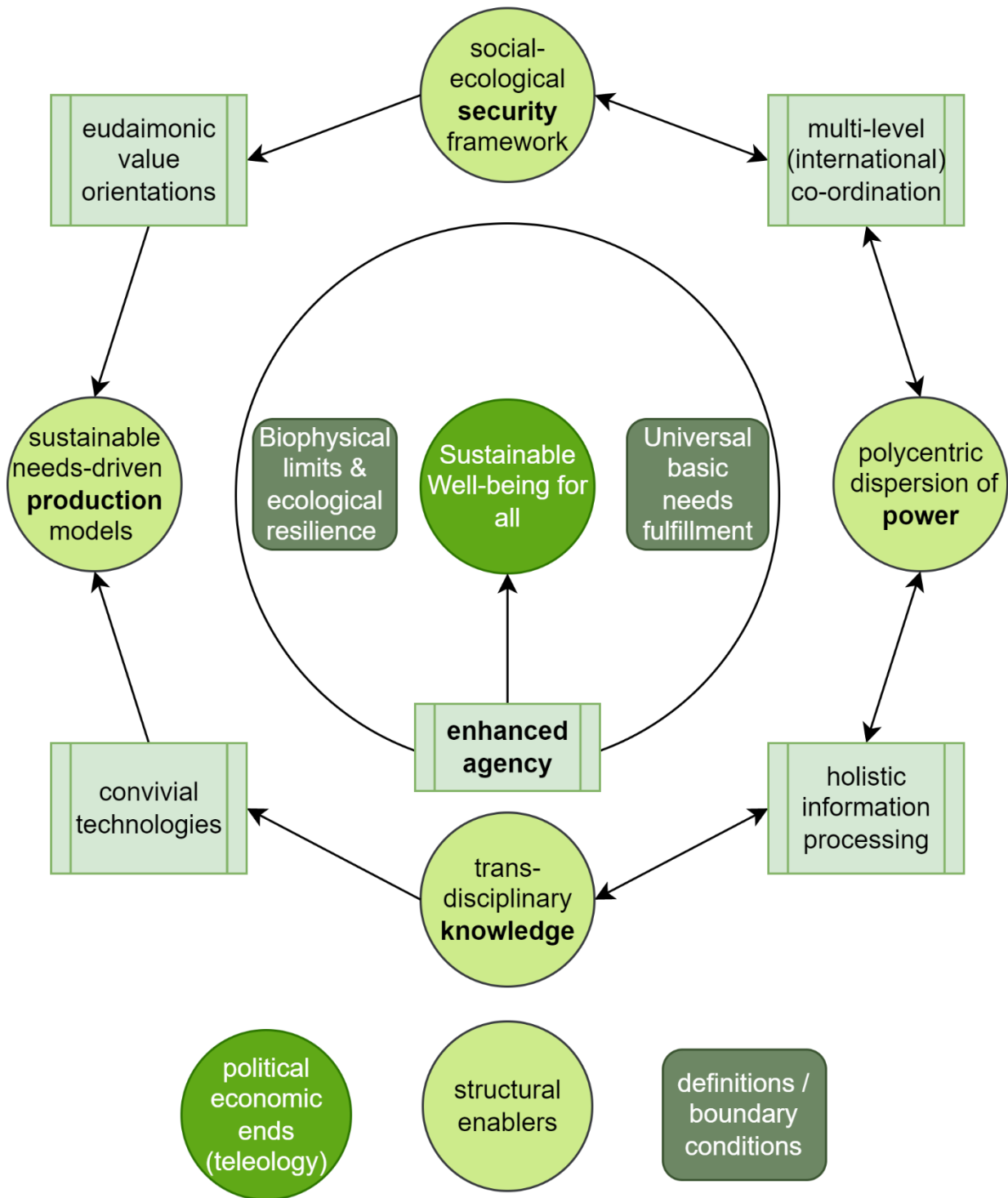


Figure 11: Framework for societal transformations

We consider the structural enablers as concrete entry points for enhancing agency and aligning societal decision-making with societal transformations (as elaborated in the subsequent text). In contrast to the framework above, we depict the current societal dynamic in figure 12 below.

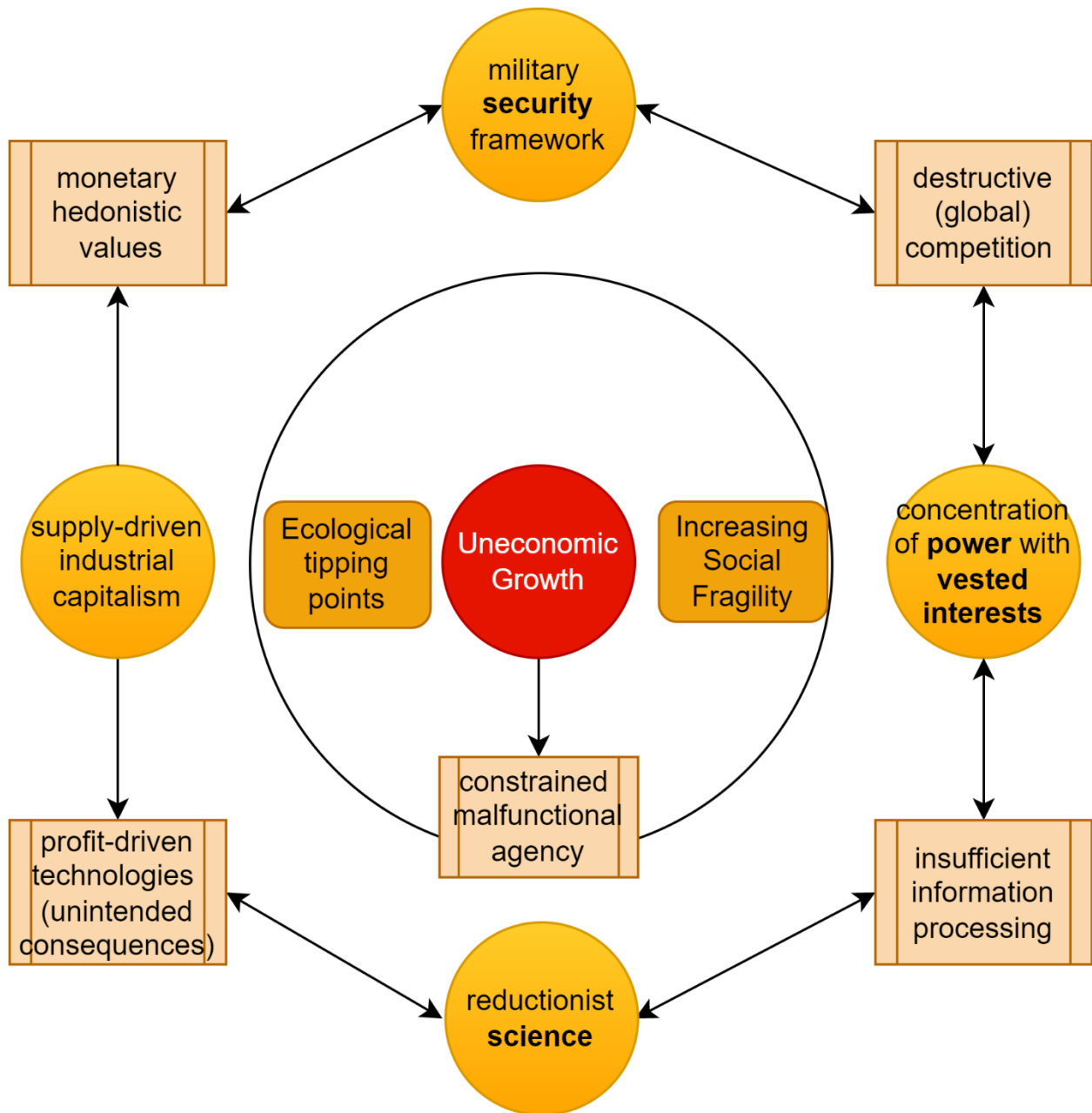


Figure 12: Current Societal Dynamic

3.4 Structural Enablers

1. Production Models

Current production models overwhelmingly favour short-term private profits for the shareholders over long-term sustenance for all. Short-term profit maximization for shareholders dictates every business

decision, irrespective of wider social-ecological “externalities.” Everything else, including environmental sustainability, becomes a cost that undermines the business proposition. Even governments around the world compete for capital investments (e.g., via generous corporate tax concessions) rather than fostering social-ecological resilience. We concur with the following findings from the 2020 report of the World Business Council on Sustainable Development: “The core problem is that capitalism, as we know it today, does not distinguish between value creation and value extraction. By privileging returns on financial capital over the preservation (let alone accumulation) of other forms of capital, our current version of capitalism has dangerously depleted the natural, social and human capital that underpins economic value creation. In addition, risks are socialized while rewards are privatized [...] We see failures at three levels— the way we think about and measure economic and business performance; market structures and dynamics that favour financial value extraction; and weak institutions that are not able to regulate markets” (WBCSD, 2020, p. 82).

The WBCSD report (2020, p. 83) envisions **five key principles for reformed business models:**

- 1 Stakeholder-oriented rather than shareholder value-maximizing.
- 2 Impact-internalizing rather than impact-externalizing.
- 3 Long-term rather than short-term.
- 4 Regenerative rather than degenerative.
- 5 Accountable rather than unaccountable.

2. Security Frameworks

Security is an essential human need. It is a prerequisite for healthy social relations and for enabling human development. It has been one of the driving forces of history. Traditionally, military power has been the foundation of ensuring security for sovereign polities and other entities. Military power continues to be the dominant means of seeking security in the world today. It is reinforced by the military-industrial complex and political-economic teleology that necessitates the ever-growing extraction of resources, which in turn exacerbates historical geopolitical disputes. This is reflected, for example, in military spending as a percentage of GDP in various countries, military alliances, and armed conflicts.

Further militarization in response to geopolitical tensions may appear to be a necessary short-term solution for individual nation-state actors, but it endangers our common future and emboldens authoritarian tendencies. It is not realistic to expect sustainability transformations while the world becomes more militaristic with increasingly more powerful and destructive technological capabilities. This will only accelerate a vicious spiral, as depicted in [Figure 1](#). As signified by the launch of UNDP’s special report on security in the Anthropocene, it is time to consider security as a central concern for human development and sustainability. The UNDP report highlights that we need, “a systematic, permanent and universal attention to solidarity—not as optional charity or something that subsumes the individual to the interests of a collective, but as a call to pursue human security” (*UNDP HDR, 2020*). Building on this and other literature on human security (Elliott, 2015; Morrissey, 2019), we propose **a new “social-ecological security framework” underpinned by the internalization of biophysical and social realities:**

- Human survival and flourishing are contingent upon resilient ecosystems that are under increasing strains of anthropic exploitation (Folke et al., 2021). International cooperation rather than competition is a key to our collective indivisible security. This needs to be reflected in how nations pursue their security interests.

- Societies, where everyone's basic needs are met, are less prone to conflicts (both internal and external) (Lamb & Steinberger, 2017; Morrell & Dahlmann, 2022; Paulson & Büchs, 2022).

This would entail:

- A gradual replacement of the military-industrial complex by a universal basic provisioning infrastructure (Coote & Percy, 2020) as a key enabler of security and resilience in the Anthropocene.
- Further steps to foster a social-ecological security mindset and to see how this positive security framing relates to broader societal transformations toward sustainability
- A possible quantifiable metric/index (similar to the HDI).

3. Power Structures

The concentration of power with vested interests (reflected in regulatory failures, lack of accountability, the influence of money in politics, fossil fuel and other lobbies) has been instrumental in the perpetuation of social-ecological unsustainability (Stoddard et al., 2021) and increasing inequalities (Piketty, 2018). This has led to an increasing disillusionment with the legitimacy of institutional governance structures, a rise in extremism, and further authoritarian power grabs. Modern governance systems appear unable to deal with the grand challenges of the Anthropocene (Creutzig, 2020). There is an increasing gap between the simplistic solutions offered by leaders (including in politics and business) and the complexity of societal challenges (Dryzek et al., 2019; Torres, 2019). The rise of citizen assemblies in recent years provides hope for democratic renewal underpinned by the polycentric dispersion of power according to a subsidiary principle. "Social science on "deliberative democracy" offers reasons for optimism about citizens' capacity to avoid polarization and manipulation and to make sound decisions. The real world of democratic politics is currently far from the deliberative ideal, but empirical evidence shows that the gap can be closed [...] Ordinary people are capable of high-quality deliberation, especially when deliberative processes are well-arranged: when they include the provision of balanced information, expert testimony, and oversight by a facilitator" (Dryzek et al., 2019, p. 1145). This would imply **a revival of community-based self-organization of decision-making pertaining to local scales** (examples include, democratic workers syndicates at work, cooperative housing, village councils e.g. "gram sabhas" in India (Kumar, 2018)), **experimentation with novel governance mechanisms** (such as "lottocracy", empowering randomly selected ordinary citizens in the role of representatives. see, (Landemore, 2020)) **and strengthened global co-ordination (across different political systems) to ensure a coherent response to global challenges.**

4. Knowledge Systems

While science systems are cherished for their valued neutrality, they have unwittingly served to perpetuate the destructive status quo with their reluctance to question the social norms and their willingness to offer policy advice without questioning the broader frameworks (see, "The Enabler Cluster" in Stoddard et al. (2021)). "Science has progressively lost independence [...]. On the one hand, it has become encapsulated by business as a way to innovate and make money while on the other it has been used by governments everywhere – and at all levels – to justify decisions that society was not always ready to take" (van der Leeuw, 2020, p. 12).

Knowledge systems may instead serve as "transformative catalysts" (Chabay et al., 2021) with a more normative, value-driven approach. This requires a significant "rethink" (Abson et al., 2017) of the role and limits of science systems in society (Fazey et al., 2018). While science must adhere to its empirical neutrality, the

normativity of research design and science advice is unavoidable. While adopting a forward-looking complex systems approach to navigate future challenges rather than a reductionist empirical tradition that relies on observations from the past, scientific advice also has to acknowledge its predictive limits. Chabay et al. (2021, pp. 2–4) conclude, “Without any doubt, modern societies need scholarship that illuminates systemic risks and opportunities and from those insights catalyzes changes in practice and policy that lead to sustainable futures for all. This requires a substantially greater capacity to imagine, anticipate, avoid, mitigate, and adaptively cope with systemic risks. We argue for a transformative perspective that addresses the complexity of the dynamics involved and leads to a restructuring of scholarship and educational trajectories to embrace new visions of socioeconomic developments that promote the co-evolution of natural and cultural systems within the biophysical limitations of available resources. [...] They [science systems] must not limit themselves to signalling that a train wreck is coming but engage in avoiding it as part of a societal process”. Jürgen Renn notes, **“We recognize the predicament of humanity in the Anthropocene as a challenge of knowledge. This is not a technocratic perspective; just producing new scientific and engineering knowledge within the current knowledge economies will not suffice to cope with the Anthropocene. Much of the necessary knowledge does not fall within these categories. It may rather be described as a combination of:-**

- **System knowledge:** required to understand the Earth system with its human components. It presupposes an integration of knowledge currently fragmented along disciplinary boundaries
- **Transformation knowledge:** primarily concerns the role of human societies as part of the Earth system and raises the question of how human collective action can affect its dynamics in such a way as to ensure sustainable development and ultimately the survival of the species.
- **Orientation knowledge:** the reflective dimension of the other forms of knowledge, connecting them to ethics, politics, and belief systems for individuals and collectives, and thus to questions of individual and collective identities and values” (Renn, 2020, pp. 379–382).

4. Outlook for Further Action-Oriented Synthesis

"The crisis consists precisely in the fact that the old is dying and the new cannot be born; in this interregnum a great variety of morbid symptoms appear." - Antonio Gramsci, Prison Notebooks⁴

"Changes in narrative occur when there is an increasing mismatch of the interaction between the cognitive apparatus of a society and the dynamics of its environment" (van der Leeuw & Folke, 2021, p. 33). We surmise now is such a juncture, as societies are looking for new narratives while our world seems to descend into social and ecological turmoil. Complex adaptive networks of social and ecological processes are not subject to deterministic planning but their evolution may be oriented toward desirable outcomes (Folke et al., 2021; Lenton et al., 2022). In this paper, we have proposed a framework around which critical actions needed for societal transformations can be synergistically organized. As a tentative example, Table 1 (in the Appendix) summarizes a selection of action recommendations from IIASA–ISC Transformations within Reach (Phase-1) initiative, how they relate to the structural enablers, and the dimensions of the agency from the framework. In our further work with the IIASA colleagues, CoSP, partner network, and additional experts, we intend to elaborate on the structural enablers as entry points to enhance agency and societal decision-making toward sustainable well-being for all.

*We need action across the board. Let's have no illusions.
Our planet is burning. We have a duty to act.* (Guterres, 2022b)

⁴ <https://www.goodreads.com/quotes/3204739-the-crisis-consists-precisely-in-the-fact-that-the-old>

5. Glossary

Societal decision-making

Formal governance systems at global, national, and multiple local levels, as well as broader contexts in which societal actors including businesses and citizens make decisions that affect societal choices

Structural enablers

Entry points for enhancing agency to align it with the sustainable well-being for all

Catalysts for transformation

Actionable recommendations that can act as catalysts for societal transformations toward sustainability

Knowledge systems

Methodologies and means (e.g., institutions) of gaining and validating knowledge claims

Societal transformations

Transformations on a scale of the industrial revolution of modernity that entailed paradigmatic shifts in narrative ontologies, epistemology, political-economic teleology, associated decision-making structures, production models, and other social practices

Power structures

The explicit and implicit organization and diffusion of power among different social actors

Convivial technologies

Value-driven technologies meant to serve sustainable well-being (first conceptualized by Ivan Illich)

Eudaemonic well-being

A comprehensive conception of well-being: "as multidimensional (with no substitution between different dimensions), satiable (there is such a thing as 'enough' to live a good life), and socially based (rather than depending solely on individual attitudes)" (Lamb & Steinberger, 2017).

6. References

- Abbott, M., Bazilian, M., Egel, D., & Willis, H. H. (2017). Examining the food–energy–water and conflict nexus. *Current Opinion in Chemical Engineering*, 18, 55–60. <https://doi.org/10.1016/j.coche.2017.10.002>
- Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., Ives, C. D., Jager, N. W., & Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio*, 46(1), 30–39. <https://doi.org/10.1007/s13280-016-0800-y>
- Armstrong McKay, D. I., Staal, A., Abrams, J. F., Winkelmann, R., Sakschewski, B., Loriani, S., Fetzer, I., Cornell, S. E., Rockström, J., & Lenton, T. M. (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science*, 377(6611), eabn7950. <https://doi.org/10.1126/science.abn7950>
- Arthur, W. B. (2009). *The nature of technology: What it is and how it evolves* (1st ed.). Allen Lane.
- Avin, S., Wintle, B. C., Weitzdörfer, J., Ó hÉigeartaigh, S. S., Sutherland, W. J., & Rees, M. J. (2018). Classifying global catastrophic risks. *Futures of Research in Catastrophic and Existential Risk*, 102, 20–26. <https://doi.org/10.1016/j.futures.2018.02.001>
- BBC. (2022, May 18). Ukraine invasion could cause global food crisis, UN warns. *BBC News*. <https://www.bbc.com/news/world-europe-61503049>
- Beard, S. J., Holt, L., Tzchor, A., Kemp, L., Avin, S., Torres, P., & Belfield, H. (2021). Assessing climate change’s contribution to global catastrophic risk. *Futures*, 127, 102673. <https://doi.org/10.1016/j.futures.2020.102673>
- Bostrom, N. (2019). The Vulnerable World Hypothesis. *Global Policy*, 10(4), 455–476. <https://doi.org/10.1111/1758-5899.12718>
- Chabay, I., Renn, O., Leeuw, S. van der, & Droy, S. (2021). Transforming scholarship to co-create sustainable futures. *Global Sustainability*, 4. <https://doi.org/10.1017/sus.2021.18>
- Coleman, J. (2022). Climate change made South Asian heatwave 30 times more likely. *Nature*. <https://doi.org/10.1038/d41586-022-01444-1>
- Collste, D., Cornell, S. E., Randers, J., Rockström, J., & Stoknes, P. E. (2021). Human well-being in the Anthropocene: Limits to growth. *Global Sustainability*, 1–17. <https://doi.org/10.1017/sus.2021.26>
- Coote, A., & Percy, A. (2020). *The case for universal basic services* (pp. vi, 162 Seiten). Polity.

- Creutzig, F. (2020). Limits to Liberalism: Considerations for the Anthropocene. *Ecological Economics*, 177, 106763. <https://doi.org/10.1016/j.ecolecon.2020.106763>
- Creutzig, F., Niamir, L., Bai, X., Callaghan, M., Cullen, J., Díaz-José, J., Figueroa, M., Grubler, A., Lamb, W. F., Leip, A., Masanet, E., Mata, É., Mattauch, L., Minx, J. C., Mirasgedis, S., Mulugetta, Y., Nugroho, S. B., Pathak, M., Perkins, P., ... Ürge-Vorsatz, D. (2022). Demand-side solutions to climate change mitigation consistent with high levels of well-being. *Nature Climate Change*, 12(1), Article 1. <https://doi.org/10.1038/s41558-021-01219-y>
- Daly, H. E. (1999). *Uneconomic growth: In theory, in fact, in history, and in relation to globalization* (Clemens Lecture Series. 10). https://digitalcommons.csbsju.edu/clemens_lectures/10
- Dixson-Declève, S., Gaffney, O., Ghosh, J., Randers, J., Rockström, J., & Stoknes, P. E. (2022). *Earth for all: A survival guide for humanity: a report to the Club of Rome (2022), fifty years after The limits of growth (1972)*. New Society Publishers. <https://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=3304842>
- Dryzek, J. S., Bächtiger, A., Chambers, S., Cohen, J., Druckman, J. N., Felicetti, A., Fishkin, J. S., Farrell, D. M., Fung, A., Gutmann, A., Landemore, H., Mansbridge, J., Marien, S., Neblo, M. A., Niemeyer, S., Setälä, M., Slothuus, R., Suiter, J., Thompson, D., & Warren, M. E. (2019). The crisis of democracy and the science of deliberation. *Science*, 363(6432), 1144–1146. <https://doi.org/10.1126/science.aaw2694>
- Elliott, L. (2015). Human security/environmental security. *Contemporary Politics*, 21(1), 11–24. <https://doi.org/10.1080/13569775.2014.993905>
- Fazey, I., Schöpke, N., Caniglia, G., Patterson, J., Hultman, J., van Mierlo, B., Säwe, F., Wiek, A., Wittmayer, J., Aldunce, P., Al Waer, H., Battacharya, N., Bradbury, H., Carmen, E., Colvin, J., Cvitanovic, C., D'Souza, M., Gopel, M., Goldstein, B., ... Wyborn, C. (2018). Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. *Energy Research & Social Science*, 40, 54–70. <https://doi.org/10.1016/j.erss.2017.11.026>
- Fioramonti, L., Coscieme, L., Costanza, R., Kubiszewski, I., Trebeck, K., Wallis, S., Roberts, D., Mortensen, L. F., Pickett, K. E., Wilkinson, R., Ragnarsdóttir, K. V., McGlade, J., Lovins, H., & De Vogli, R. (2022). Wellbeing economy: An effective paradigm to mainstream post-growth policies? *Ecological Economics*, 192, 107261. <https://doi.org/10.1016/j.ecolecon.2021.107261>

- Folke, C., Polasky, S., Rockström, J., Galaz, V., Westley, F., Lamont, M., Scheffer, M., Österblom, H., Carpenter, S. R., Chapin, F. S., 3rd, Seto, K. C., Weber, E. U., Crona, B. I., Daily, G. C., Dasgupta, P., Gaffney, O., Gordon, L. J., Hoff, H., Levin, S. A., ... Walker, B. H. (2021). Our future in the Anthropocene biosphere. *Ambio*, *50*(4), 834–869. PubMed. <https://doi.org/10.1007/s13280-021-01544-8>
- Gluckman, P., Quirion, R., Sachs, J., & van Jaarsveld, A. S. (2022). Scientific diplomacy keeps reason alight in dark times. *Nature*, *604*(7906), 425–425. <https://doi.org/10.1038/d41586-022-01060-z>
- Grumbach, S., & Leeuw, S. van der. (2021). The evolution of knowledge processing and the sustainability conundrum. *Global Sustainability*, *4*. <https://doi.org/10.1017/sus.2021.29>
- Guterres, A. (2022a, May 18). *António Guterres: Time to Jump-Start the Renewable Energy Transition | UNFCCC*. <https://unfccc.int/news/antonio-guterres-time-to-jump-start-the-renewable-energy-transition>
- Guterres, A. (2022b, September 20). *Secretary-General's Address to the General Assembly [Trilingual, as delivered, follows; scroll further down for all-English and all-French | United Nations Secretary-General*. <https://www.un.org/sg/en/content/sg/statement/2022-09-20/secretary-generals-address-the-general-assembly-trilingual-delivered-follows-scroll-further-down-for-all-english-and-all-french>
- Heidegger, M. (1954). *The Question Concerning Technology and Other Essays* (W. Lovitt, Trans.). Garland Publishing (1977).
- Human Development Report | UNDP HDR*. (2020). Human Development Report 2020 | UNDP HDR. <http://report.hdr.undp.org>
- Illich, I. (1973). *Tools for Conviviality*. Marion Boyars.
- IPBES. (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services* (summary for policy makers). Zenodo. <https://doi.org/10.5281/zenodo.3553579>
- IPCC. (2022). *Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.
- Ishi, N., Dasgupta, A., Lafortune, G., Oppenheim, J., Rockström, J., Schmidt-Traub, G., Cornehl, F., & von Preussen, A. (2022). *Safeguarding the Global Commons for human prosperity and environmental*

sustainability. The Global Commons Stewardship Framework. Center for Global Commons, University of Tokyo.

Jackson, T. (2021). *Post growth: Life after capitalism*. Polity Press.

Kenny, J. (2018). The role of economic perceptions in influencing views on climate change: An experimental analysis with British respondents. *Climate Policy*, 18(5), 581–592.
<https://doi.org/10.1080/14693062.2017.1414026>

Kumar, D. J. (2018). Gram Sabha and Deliberative Democracy. In *Deliberative Democracy*. Routledge.

Lamb, W. F., & Steinberger, J. K. (2017). Human well-being and climate change mitigation. *WIREs Climate Change*, 8(6), e485. <https://doi.org/10.1002/wcc.485>

Landemore, H. (2020). *Open democracy: Reinventing popular rule for the twenty-first century*. Princeton University Press.

Lenton, T. M., Benson, S., Smith, T., Ewer, T., Lanel, V., Petykowski, E., Powell, T. W. R., Abrams, J. F., Blomsma, F., & Sharpe, S. (2022). Operationalising positive tipping points towards global sustainability. *Global Sustainability*, 5. <https://doi.org/10.1017/sus.2021.30>

Lenton, T. M., Held, H., Kriegler, E., Hall, J. W., Lucht, W., Rahmstorf, S., & Schellnhuber, H. J. (2008). Tipping elements in the Earth's climate system. *Proceedings of the National Academy of Sciences*, 105(6), 1786–1793. <https://doi.org/10.1073/pnas.0705414105>

Lenton, T. M., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W., & Schellnhuber, H. J. (2019). Climate tipping points—Too risky to bet against. *Nature*, 575(7784), Article 7784.
<https://doi.org/10.1038/d41586-019-03595-0>

Martin, M. A., Sendra, O. A., Bastos, A., Bauer, N., Bertram, C., Blenckner, T., Bowen, K., Brando, P. M., Rudolph, T. B., Büchs, M., Bustamante, M., Chen, D., Cleugh, H., Dasgupta, P., Denton, F., Donges, J. F., Donkor, F. K., Duan, H., Duarte, C. M., ... Woodcock, J. (2021). Ten new insights in climate science 2021: A horizon scan. *Global Sustainability*, 4. <https://doi.org/10.1017/sus.2021.25>

McVeigh, K. (2022, April 1). Seabed regulator accused of deciding deep sea's future 'behind closed doors'. *The Guardian*. <https://www.theguardian.com/environment/2022/apr/01/worlds-seabed-regulator-accused-of-reckless-failings-over-deep-sea-mining>

Meadows, D. H. (2008). *Thinking in systems: A primer* (D. Wright, Ed.; AC08054080; 1. print.). Chelsea Green Publ.

- Mechler, R., Stevance, A.-S., Deubelli, T., Scolobig, A., Linnerooth-Bayer, J., Handmer, J., Irshaid, J., McBean, G., Zapata-Marti, R., Gordon, M., Ivanova, M., Srivastava, L., Gomez Echeverri, L., Hochrainer-Stigler, S., Schinko, T., & Olukoshi, A. (2021). *Transformations within reach: Pathways to a sustainable and resilient world - Enhancing Governance for Sustainability*.
<https://pure.iiasa.ac.at/16819/1/Governance.pdf>
- Morrell, K., & Dahlmann, F. (2022). Aristotle in the Anthropocene: The comparative benefits of Aristotelian virtue ethics over Utilitarianism and deontology. *The Anthropocene Review*, 20530196221105092.
<https://doi.org/10.1177/20530196221105093>
- Morrissey, J. (2019). Towards a human security vision of global climate action. *Geoforum*, 107, 220–222.
<https://doi.org/10.1016/j.geoforum.2019.08.010>
- Nielsen, K. S., Nicholas, K. A., Creutzig, F., Dietz, T., & Stern, P. C. (2021). The role of high-socioeconomic-status people in locking in or rapidly reducing energy-driven greenhouse gas emissions. *Nature Energy*, 6(11), Article 11. <https://doi.org/10.1038/s41560-021-00900-y>
- O. Táíwò, O. (2022). *Reconsidering Reparations*. Oxford University Press.
- Paulson, L., & Büchs, M. (2022). Public acceptance of post-growth: Factors and implications for post-growth strategy. *Futures*, 143, 103020. <https://doi.org/10.1016/j.futures.2022.103020>
- Piketty, T. (2018). *Capital in the Twenty-First Century*. <https://doi.org/10.4159/9780674982918>
- Rees, M. (2018). *On the Future: Prospects for Humanity*. Princeton University.
<https://ubdata.univie.ac.at/AC15061618>
- Renn, J. (2020). *The evolution of knowledge: Rethinking science for the Anthropocene*. Princeton University Press.
- Rockström, J. (2022). Speeding up state-of-the-art assessments on global sustainability: Introducing the Cambridge Sustainability Commissions. *Global Sustainability*, 5. <https://doi.org/10.1017/sus.2022.1>
- Rovenskaya, E., Kaplan, D., & Sizov, S. (2021, January). *Transformations within reach: Pathways to a sustainable and resilient world - Strengthening Science Systems* [Monograph]. IIASA-ISC.
<https://covid19.iiasa.ac.at/isc/>
- Schmelzer, M., Vansintjan, A., & Vetter, A. (2022). *The future is degrowth: A guide to a world beyond capitalism* (AC16507245). Verso.

- Schrödinger, E., Schrödinger, E., & Schrödinger, E. (1992). *What is life? The physical aspect of the living cell; with, Mind and matter; & Autobiographical sketches*. Cambridge University Press.
- Scoones, I., Stirling, A., Abrol, D., Atela, J., Charli-Joseph, L., Eakin, H., Ely, A., Olsson, P., Pereira, L., Priya, R., van Zwanenberg, P., & Yang, L. (2020). Transformations to sustainability: Combining structural, systemic and enabling approaches. *Current Opinion in Environmental Sustainability*, 42, 65–75. <https://doi.org/10.1016/j.cosust.2019.12.004>
- SEI, IISD, ODI, E3G, and UNEP. (2021). *The Production Gap Report 2021*. <http://productiongap.org/2021report>
- Sperling, F., Havlik, P., Denis, M., Valin, H., Palazzo, A., Gaupp, F., & Visconti, P. (2020, December 29). *Transformations within reach: Pathways to a sustainable and resilient world - Resilient Food Systems* [Monograph]. IIASA-ISC. <https://covid19.iiasa.ac.at/isc/>
- Srivastava, L., Gomez Echeverri, L., Schlegel, F., Denis, M., Deubelli, T., Havlik, P., Kaplan, D., Mechler, R., Paulavets, K., Rovenskaya, E., Sizov, S., Sperling, F., Stevance, A.-S., & Zakeri, B. (2021, January). *Transformations within reach: Pathways to a sustainable and resilient world - Synthesis Report* [Monograph]. IIASA-ISC. <https://covid19.iiasa.ac.at/isc/>
- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: The Great Acceleration. *The Anthropocene Review*, 2(1), 81–98. <https://doi.org/10.1177/2053019614564785>
- Stewart, J. E. (2014). The direction of evolution: The rise of cooperative organization. *Biosystems*, 123, 27–36. <https://doi.org/10.1016/j.biosystems.2014.05.006>
- Stoddard, I., Anderson, K., Capstick, S., Carton, W., Depledge, J., Facer, K., Gough, C., Hache, F., Hoolohan, C., Hultman, M., Hällström, N., Kartha, S., Klinsky, S., Kuchler, M., Lövbrand, E., Nasiritousi, N., Newell, P., Peters, G. P., Sokona, Y., ... Williams, M. (2021). Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve? *Annual Review of Environment and Resources*, 46(1), 653–689. <https://doi.org/10.1146/annurev-environ-012220-011104>
- Torres, P. (2019). Facing disaster: The great challenges framework. *Foresight*, 21(1), 4–34. <https://doi.org/10.1108/FS-04-2018-0040>
- UN. (2021). *The Sustainable Development Goals Report 2021*. <https://unstats.un.org/sdgs/report/2021/>

- van der Leeuw, S. (2020). *Social Sustainability, Past and Future: Undoing Unintended Consequences for the Earth's Survival*. Cambridge University Press. <https://doi.org/10.1017/9781108595247>
- van der Leeuw, S., & Folke, C. (2021). The social dynamics of basins of attraction. *Ecology and Society*, 26(1). <https://doi.org/10.5751/ES-12289-260133>
- WBCSD. (2020). *Vision 2050: Time to Transform*. <https://www.wbcsd.org/Overview/About-us/Vision-2050-Time-to-Transform/Resources/Time-to-Transform>
- Wilson, E. O. (2017, October 3). *What Is Human Nature? Paleolithic Emotions, Medieval Institutions, God-Like Technology*. Big Think. <https://bigthink.com/videos/eo-wilson-what-makes-us-human-paleolithic-emotions-medieval-institutions-god-like-technology>
- Zakeri, B., Paulavets, K., Barreto-Gomez, L., Gomez Echeverri, L., Pachauri, S., Rogelj, J., Creutzig, F., Urge-Vorsatz, D., Victor, D., Boza-Kiss, B., Zimm, C., Alexander, S., Bazilian, M., Fritz, S., Gielen, D., Hande, H., McCollum, D., Nesler, C., Rossini, M., ... Srivastava, L. (2021, January). *Transformations within reach: Pathways to a sustainable and resilient world - Rethinking energy solutions* [Monograph]. IIASA-ISC. <https://covid19.iiasa.ac.at/isc/>

7. Appendix

Table 1: IIASA–ISC Phase-1 recommendations

Selected Recommendations from IIASA–ISC Transformations within Reach (Phase-1)	Further Reference from Phase-1 Reports	Correspondence with Structural Enablers	Association with Enhancing Agency
Repurpose and redesign global institutions for the complexities of the 21st century	TwR1 Synthesis (Srivastava et al., 2021, p. 14), TwR1 Governance for sustainability (Mechler et al., 2021, p. 16)	Polycentric dispersion of power, Social-ecological security framework	Holistic information processing, Multi-level coordination
Strengthen knowledge base on, and preparedness for, compound and systemic risks	TwR1 Synthesis (Srivastava et al., 2021, p. 11), TwR1 Strengthening Science Systems (Rovenskaya et al., 2021, p. 27)	Transdisciplinary Knowledge	Holistic information processing
Advance toward smart, evidence-based, adaptive, good governance arrangements at all levels	TwR1 Synthesis (Srivastava et al., 2021, p. 17) TwR1 Governance for sustainability (Mechler et al., 2021)	Polycentric dispersion of power	Holistic information processing
Create a pervasive, sustainable knowledge society	TwR1 Synthesis (Srivastava et al., 2021, p. 23), TwR1 Strengthening Science Systems (Rovenskaya et al., 2021)	Transdisciplinary Knowledge, Polycentric dispersion of power	Holistic information processing, Eudaemonic value orientations
Reset economic infrastructure and development for sustainability	TwR1 Synthesis (Srivastava et al., 2021, p. 26)	Sustainable needs-driven production models	Convivial technologies, Eudaemonic value orientations
Understanding of human security must be broadened to include systemic resilience	TwR1 Synthesis (Srivastava et al., 2021, p. 31)	Social-ecological security framework	Eudaemonic value orientations, Multi-level (international) co-ordination
(Systemic) resilience as a core government priority in the center of government	TwR1 Governance for sustainability (Mechler et al., 2021, p. 21)	Social-ecological security framework	Multi-level coordination, Eudaemonic value orientations
Enhance knowledge diffusion within science systems	TwR1 Strengthening Science Systems (Rovenskaya et al., 2021, p. 42)	Transdisciplinary knowledge	Holistic information processing
Enhance communication of scientific knowledge, public understanding, and trust in science	TwR1 Strengthening Science Systems (Rovenskaya et al., 2021, p. 36)	Polycentric dispersion of power, Transdisciplinary Knowledge	Holistic information processing
Improve quality and efficacy of science–policy interface at national, regional, and global levels	TwR1 Strengthening Science Systems (Rovenskaya et al., 2021, p. 46)	Transdisciplinary knowledge, Polycentric dispersion of power	Holistic information processing
Expand the benefits, reach, and duration of social safety nets	Resilient Food Systems Report (Sperling et al., 2020, p. 33)	Social-ecological security framework	Eudaemonic value orientations

Adopt ambitious biodiversity and ecosystem conservation targets to guard human and environmental health across scales, coupled with a strengthening of regulations, monitoring capacities, and enforcement mechanisms	Resilient Food Systems Report (Sperling et al., 2020, p. 37)	Social-ecological security framework, Transdisciplinary Knowledge	Convivial technologies, Holistic information processing, Multi-level (international) coordination
Advance early warning and near real-time monitoring capacities to rapidly detect potential shocks, risks, and vulnerabilities that undermine the functioning of food systems	Resilient Food Systems Report (Sperling et al., 2020, p. 33)	Social-ecological security framework, Transdisciplinary knowledge	Convivial technologies, Holistic information processing, International multi-level coordination
Expand mechanisms for stakeholder engagement in framing narratives for co-developing resilient and sustainable food systems	Resilient Food Systems Report (Sperling et al., 2020, p. 42)	Sustainable needs-driven production models, Social-ecological security framework	International multi-level coordination
Advance decentralized and resilient energy systems, including energy efficiency improvement measures	TwR1 Rethinking Energy Solutions Report (Zakeri et al., 2021)	Sustainable needs-driven production models, Social-ecological security framework	Convivial technologies
Reinvent urban space, infrastructure, and mobility	TwR1 Rethinking Energy Solutions Report (Zakeri et al., 2021, p. 29)	Sustainable needs-driven production models	Convivial technologies
Reimagine consumption through the advancement of a circular and sharing economy and citizen engagement	TwR1 Rethinking Energy Solutions Report (Zakeri et al., 2021, p. 28)	Sustainable needs-driven production models	Eudaemonic value orientations
Harness the new consciousness in the society	TwR1 Synthesis (Srivastava et al., 2021, p. 33)	Social-ecological security framework, Transdisciplinary knowledge	Eudaemonic value orientations