IEEE SA STANDARDS ASSOCIATION

IEEE planet positive 2030

Strong Sustainability by Design

PRIORITIZING ECOSYSTEM AND HUMAN FLOURISHING WITH TECHNOLOGY-BASED SOLUTIONS

GLOBAL METHODOLOGIES

An initiative supported by the IEEE Standards Association

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Strong Sustainability by Design

This Compendium has been created by committees of the IEEE Planet Positive 2030 Initiative supported by the IEEE Standards Association (IEEE SA). The IEEE Planet Positive 2030 Initiative community is composed of several hundred participants from six continents, who are thought leaders from academia, industry, civil society, policy and government in the related technical and humanistic disciplines. At least one hundred seventy members of this community from about thirty countries have contributed directly to this Compendium and have worked to identify and find consensus on timely issues.

The Compendium's purpose is to identify specific issues and recommendations regarding sustainability and climate change challenges to achieve "Planet Positivity" by 2030, defined as the process of transforming society and infrastructure by 2030 to:

- Reduce Greenhouse Gas (GHG) emissions to 50% of 2005 GHG emissions by 2030.
- Significantly increase regeneration and resilience of the Earth's ecosystems.
- Be well on the path to achieving net zero GHG emissions by 2050 and negative GHG emissions beyond 2050.
- Continue to widely deploy appropriate technology as well as design and implement new technological solutions in support of achieving technological solutions designed and deployed to achieve "Planet Positivity."

In identifying specific issues and pragmatic recommendations, the Compendium:

- Provides a scenario-based challenge (how to achieve "Planet Positivity by 2030") as a tool to inspire readers to get engaged.
- Advances a public discussion about how to build from a "Net Zero" mentality to a "Net or Planet Positive" ("do more good," that is, doing "more" than "don't harm") societal mandate for all technology and policy.
- Continues to build a diverse and inclusive community for the IEEE Planet Positive 2030 Initiative, prioritizing the voices of indigenous and marginalized members whose insights are acutely needed to help make technology and other solutions more valuable for all. Of keen interest is how to encourage more in-depth participatory design in these processes.
- Inspires the creation of technical solutions that can be developed into technical recommendations (for example IEEE SA recommended practice for addressing sustainability, environmental stewardship and climate change challenges in professional practice, IEEE P7800™) and associated certification programs.
- Facilitates the emergence of policies and recommendations that could potentially be intraoperative between different jurisdictions (e.g., countries).

By inviting the general public to read and utilize *Strong Sustainability by Design*, the IEEE Planet Positive 2030 community provides the opportunity to bring multiple voices from the related scientific and engineering communities together with the general public to identify and find broad consensus on technology to address pressing environmental and social issues and proposed recommendations regarding development,

implementations and deployment of these technologies. You are invited to Join related IEEE activities, such as standards development and initiatives across the organization.

- For further information, learn more at the IEEE Planet Positive 2030 Initiative website
- Get in touch at: PlanetPositive2030@ieee.org to get connected to and engaged with the IEEE Planet Positive 2030 community
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IEEE Planet Positive 2030, an initiative supported by the IEEE Standards Association as part of the Industry Connections Program, Sustainable Infrastructures and Community Development program (SICDP), currently has more than four hundred experts involved, and remains eager for new voices and perspectives to join in this work.

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GLOBAL METHODOLOGIES

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GLOBAL METHODOLOGIES

Future Vision

It is 2030.

And the fundamental imbalance in the relationship between humans and the planet that was out of harmony is now in tune—the planet and all living beings, treated with respect and empathy as a starting point for all personal and civic activities, encompasses global technology and policy. Humans, animals, and the natural spaces they inhabit have become protected in multiple ways that champion the value of lived experiences, communities, and ecosystems.

The awareness of the need to prioritize the planet is present for the majority of people, reflected in their daily activities. Any activity that directly or indirectly involves the use of natural resources has been reimagined, optimized, and modernized to protect, respect, and regenerate the environment. This happened through an evolution in consciousness, a deep global awareness of humans' place in the systems of the Earth, that respect and adherence to the idea of intergenerational stewardship of the world and for the generations of life to come that are now the norm. Regenerative design and sustainable practices and reports [e.g., United Nations Sustainable Development Goals (SDGs) and environmental, social, and corporate governance (ESG)] are used as standards with transdisciplinary collaboration. This applies to modern technologies during the creation, development, and mobilization of products, services, and policies.

This informed agreement has only been made possible due to the identification of a set of methodologies, organized into a global network keeping the methodologies' inherent individual differences and richness. The implementation of this network has taken into consideration different local, regional, and global aspects respecting cultures, tradition, beliefs, and biodiversity across the globe. In this process, regeneration and resilience of Earth's ecosystems has begun and will continue to transform society, further enabling substantial progress toward reducing greenhouse gas (GHG) emissions, improving the social well-being of humanity.

Introduction

An underlying motivator for this work has been the concept of *Ubuntu* (ùɓúnt'ù), a Nguni Bantu term for humanity, translated as "I am because you are," a philosophical belief in interconnectedness—a universal bond that connects humanity through sharing. A shift in mindset to Ubuntu, understanding global interdependence, restored balance and peace and brought happiness and prosperity to all living beings starting in 2022.

In that spirit, this message is offered from Chief Dwaine Perry of the Ramapough Lenape Nation:

> *As we ponder tomorrow, let us remember our grandmother [universe] and begin now to help heal the trauma and degradation which has been visited upon her…for surely each wound, each careless and negative act visited upon Grandma is a scar… a wound visited upon our own health, our future and our children…let us use each moment of this time of restraints as a time to heal our families, our old wounds and our forgotten differences… This is a time to celebrate our humanity…The illness which permeates the atmosphere, impacting our health, may be part of the illness visited upon our Mother [Earth]…May this be a time to renew our spirits. May we reflect on how to become better people–let us live with purpose, may we take the time to listen and understand…Be good to one another, let us live with love for one another. Be encouraged, let us emerge from this difficulty renewed in our traditions, that bring us joy. XwatAnushiik.*
> (MNC Editorial Team, 2021)

The current climate crisis requires identifying avenues for action with no delay. Action will not be perfect, but no action will lead to known devastating consequences. The usefulness of the collective positive planetary ecosystem's proposed recommendations depends on making them operational, with the implementation of ideas that lead to immediate action, change and transformation.

Issue 1: Lack of care for human well-being and sustainability of our planetary biosphere

Background

Current economic and technological trends prioritizing quantifiable outcomes and consumption result in a lack of care for human well-being and sustainability of our planetary environment. Global, regional, and local methodologies for dealing with sustainability issues must do the opposite by embedding care into policies, agendas, expectations, narratives and behaviors. This would include consideration for various continental, geographical, and cultural backgrounds. This definition of *care* includes the well-being of all living beings and longevity of planetary health balanced with a commitment to global sustainability.

This concept of *care* expands the responsibility beyond traditional and modern roles and practices of caretaking (e.g., medical, family) to include all members, organizations, agencies, and institutions in global societies.

Care, in this context, is an ethical theory and practical imperative approach that emphasizes the importance of concern and responsibility for self and others rather than individual rules for compliance (i.e., deontology) or positive consequences for one group (i.e., utilitarianism). Although ethics is a central part in some professions (e.g., medical, legal) this description of care also involves broader applications within natural and social sciences as well as modern technologies. From a state perspective, care refers to the state's inherent obligations toward protecting individuals, especially for those in the ecosystem who are dependent and vulnerable, as described and addressed in the work of several social scientists and social justice activists (e.g., Elinor Ostrum, Rianne Eisler, Rigoberta Menchú Tum, Carol Gilligan, and Nel Noddings).

The lack of care is illustrated by a current trend in the economic marketplace where the majority of players believe competition is needed for survival. This capitalistic trend drives individuals and societies to focus on maximizing product sales and financial profits, which has caused negative consequences to collective human well-being and the living environment. With care as a foundation, success is measured by valuing the well-being of people, planet, and profit versus measuring success solely by financial profit, for example, measuring for well-being and happiness (GNH) versus measuring success based on gross domestic product (GDP).

Science shows that humans are the primary cause for planetary damage; therefore, they have the primary responsibility for mitigation. Damaging factors include shifts to consumer-driven lifestyles, lack of sustainable strategies and structures to accommodate population increases, competing political perspectives, and an emphasis on financial profit (e.g., Daniel Christian Wahl, Dennis Meadows, Paul Polman, John Fullerton). Additional harmful drivers include exploitative economic practices, unequal access to advanced technologies, and other socioeconomic disparities and the need for new models of business practice that consider wellbeing (e.g., James Rhee, Kate Raworth).[1]

Methodologies like Gaia 2.0 (i.e., planetary homeostasis) have explored the self-regulatory ability of Mother Earth (a.k.a. Gaia), which has been disrupted. The Gaia hypothesis states that "living things are part of a planetary-scale self-regulating system that has maintained habitable conditions for the past 3.5 billion years." In this context, the self-regulating capacity of Gaia 2.0 emerged within the Earth's system and over time

[1] This includes standards such as The IEEE Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-Being based on the Wellbeing Chapter of IEEE's Ethically Aligned Design.

altered the climate and atmosphere by enabling the cycling of nutrients. This system operated organically, but the evolution of humans and technologies have interfered negatively. Earth "has now entered a new epoch termed the Anthropocene, and humans are beginning to become aware of the global consequences of their actions" (Lenton & Latour, 2018).

Recommendations

To achieve planetary well-being, we must work to validate the importance of care and proactively bolster care as a methodology that is at once universal and contextually defined through the following actions:

1. **Increase our valuation of care.** By validating and supporting existing care cultures, care professions, and undervalued caretaking work, policy makers can work against current narratives that downplay the universal importance of care. A shift is needed to work toward developing legislative measures and frameworks that foster care and well-being throughout societies into the future. It is important that this focus encompasses supporting human-facing professions as well as those professions oriented towards wildlife and nature conservation.
2. **Prioritize care over profit**. Systems that place efficiency and profits over all else are antithetical to care. To achieve planetary well-being, governments, corporations, and stakeholders must work to prioritize existing care cultures while proceeding with caution and moderation in developing automated mechanisms designed to provide synthetic care, for example, artificial intelligence (AI) chatbot therapy. In practice, this may involve working at the ground level (i.e., holding regular meetings with care practitioners) to understand how to better meet the needs of specific care providers rather than outsourcing growing care responsibilities to third-party systems [e.g., Artificial Intelligence Systems (AIS)]. Here, augmented technology should be created/designed with an idea to empower people instead of replacing them.
3. **Reduce market input on the worth of caregiving**. To drive increased societal valuation of care, we must reduce the role that economic markets play in determining the worth of caregiving. Care for humans, animals, and natural spaces is a collective, longitudinal investment that does not typically lend itself to input–output models of capitalist production. To achieve planetary well-being, supporting and providing care must be viewed as a non-negotiable principle rather than an aspirational anomaly. A key question is how care will be valued and appreciated if it is disconnected from a transactional model with money (and money as a human construct that shapes the planet). For example, can the concept of currency be expanded to value alternative exchanges and interactions (e.g., personal time, carbon credits, etc.)? This will require metrics for human and planetary well-being as described in IEEE P7010™.
4. **Consider and use care as a universal value**. All creatures and spaces require some form of care. As such, it is important to center care as a moral imperative in ongoing discussions of emerging technology, ecological policy, economic frameworks, and updated human rights initiatives while working towards goals for planetary well-being. This includes care for the whole, greater, and the individual self, meeting one's own needs to be able to provide care to others to foster balance and equilibrium. The valuation of care previously engrained (e.g., Adam Smith's maximization principle of own utility/wealth and invisible hand processes in *The Wealth of Nations*, *The Theory of Moral Sentiments*, and *How Adam Smith Can Change Your Life*) vastly misinterpreted the Darwinian narrative of "survival of the fittest," which Darwin revised to "survival of the most adaptable to change."

5. **Define care practices and norms in context.** In recognizing the universality of care as a moral imperative, it is essential to highlight that care practices and norms are contextually defined. In recognizing care practices as locally derived, we can avoid the current proclivity for purporting homogenized ideals as the global standard (e.g., colonialism). Helping ensure that concepts of care that are diverse and rooted in indigenous and local practices defined by the communities can help avoid furthering established colonialist practices.
6. **Provide education and outreach to support the transformation of practicing care.** Clarifying a definition of *care* to include social well-being and values that support the health of the planet and humanity will require outreach and education to invite engagement for this transformation. This also provides opportunities to educate and share knowledge of diverse topics and subject matter that increase learning of different backgrounds, experiences, and cultures (e.g., mindfulness philosophies, practices, and systems). For example, the integration of technology can be employed to support established Indigenous practices.

This responsibility argues that humans, through self-awareness, could make individual conscious choices alongside collective practices that could add to the Earth's regenerative goals for self-regulation, which could become an effective framework for fostering global sustainability (e.g. Jane Goodall, Thich Nhat Hanh, Pope Francis Laudato Si, and Daniel Christian Wahl).

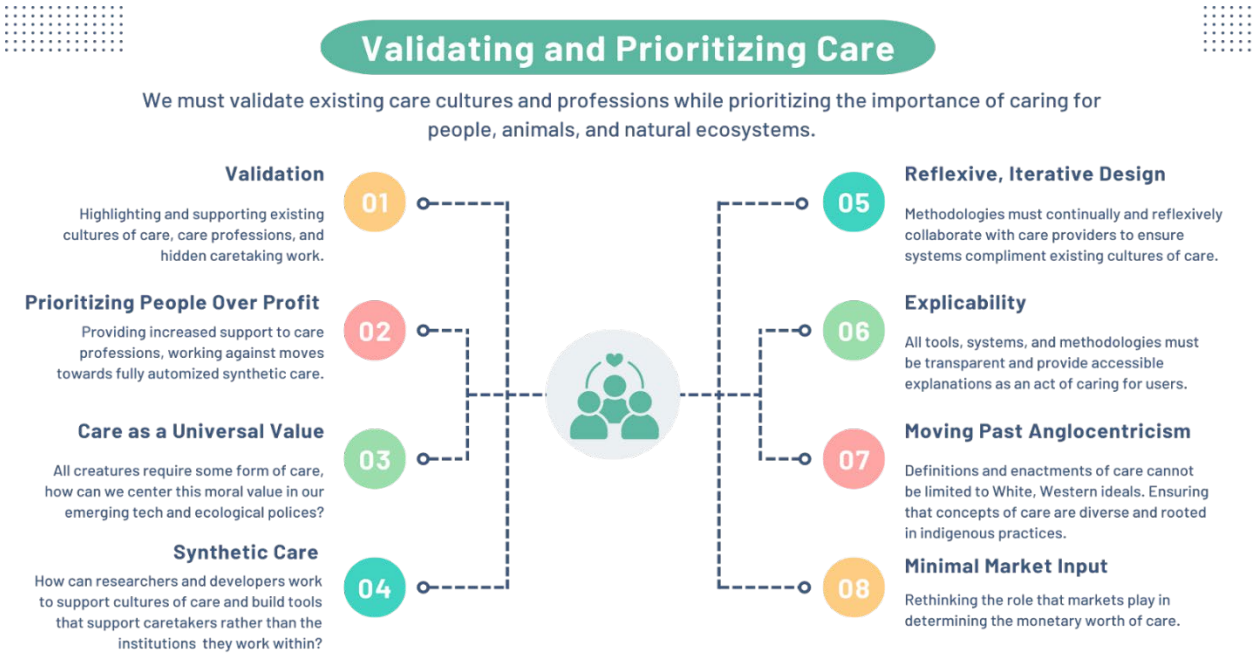

Figure 1. Validating and Prioritizing Care
(Image: Allison Macey Banzon)

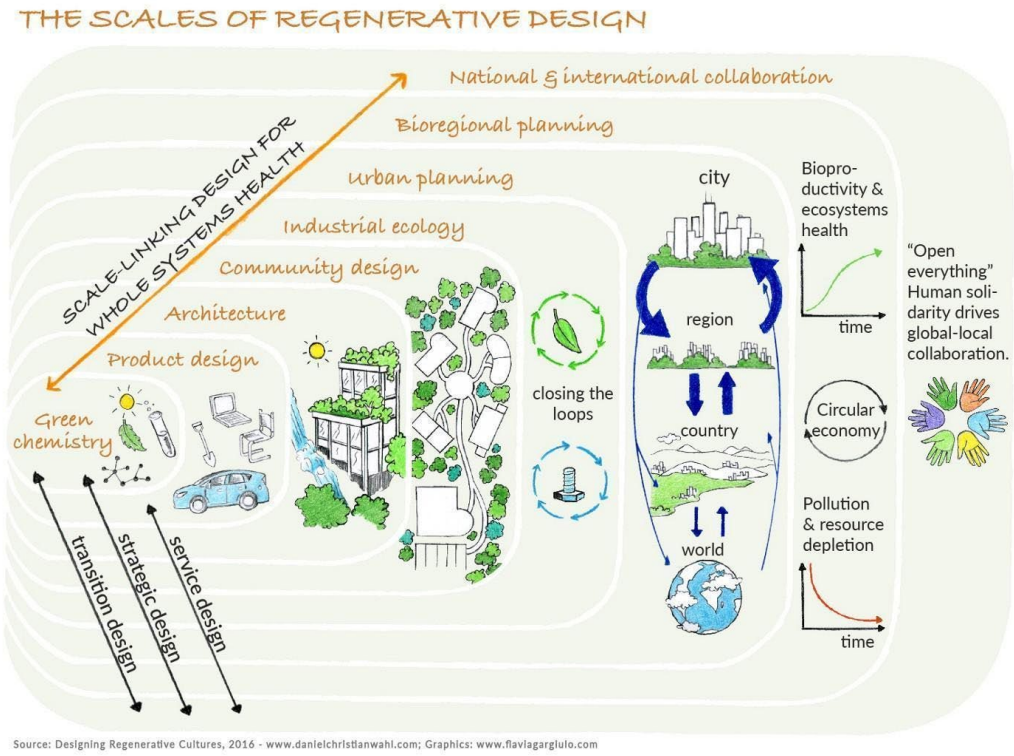

Figure 2. ***Designing Regenerative Cultures***
(Image: Daniel Christian Wahl, Designing Regenerative Cultures, 2016)

Further resources

1. Beever, Jonathan, and Andrew O. Brightman. "Reflexive Principlism as an Effective Approach for Developing Ethical Reasoning in Engineering." *Science & Engineering Ethics* 22 (2016): 275–291.
2. Burgos-Debray, Elizabeth, ed. *I, Rigoberta Menchú. An Indian Woman in Guatemala.* New York and London: Verso, 1984.
3. Center for Partnership Systems (website).
4. The DEAL Team. "What is the Doughnut?" Doughnut Economics Action Lab (DEAL). 15 July 2020.
5. Dermus, Deniz. "Care Ethics and Paternalism: A Beauvoirian Approach." *Philosophies* 7, no. 3 (May 2022).
6. Doughnut Economics Action Lab (DEAL). "About Doughnut Economics."
7. Eisler, Riane T. *The Chalice and the Blade: Our History, Our Future.* San Francisco: Perennial Library, 1988.
8. Eisler, Riane T. *The Real Wealth of Nations: Creating a Caring Economics.* San Francisco: Berrett-Koehler Publishers, Inc., 2007.
9. ETH Zurich Systemic Design Labs (website).
10. Gardels, Nathan. "Planetary Homeostasis." *NOEMA,* 22 July 2022.
11. Gilligan, Carol. "In a Different Voice: Women's Conceptions of Self and of Morality." *Harvard Educational Review* 47, no. 4 (Nov. 1977): 481–517.

12. Global Oneness Project. *Sawubona*. YouTube video. 8 Feb. 2007.
13. Green Swans Book Club. *Regeneration by Paul Hawken*. Volans YouTube video. 9 Nov. 2022.
14. Held, Virginia. *The Ethics of Care: Personal, Political, and Global.* New York: Oxford University Press, 2006.
15. Hug, Laura, Brett J. Baker, Karthik Anantharaman, Christopher T. Brown, Alexander J. Probst, Cindy J. Castelle, Cristina N. Butterfield et al. "A New View of the Tree of Life." *Nature Microbiology* 1, no. 16048 (Apr. 2016).
16. IEEE Standards Association. IEEE P7010™, Draft Recommended Practice for the Well-being Metric for Autonomous and Intelligent Systems (A/IS).
17. Infed (website).
18. International Labour Organization. "50 Million People Worldwide in Modern Slavery." Press release, 12 Sep. 2022.
19. McDonough, William. "William McDonough Articulates Circular Carbon Economy Framework for the G20." William McDonough website. 30 Mar. 2021.
20. Murray, Aphra. "Cobalt Mining: The Dark Side of the Renewable Energy Transition." Earth.org. 27 Sept. 2022.
21. National Park Service. "Indigenous Fire Practices Shape Our Land." Updated 4 Feb. 2022.
22. Noddings, Nel. "Caring: A Relational Approach to Ethics and Moral Education." 2nd ed. Oakland, CA: University of California Press, 2013.
23. Nurture Development. "Asset Based Community Development (ABCD)."
24. Partnerism (website).
25. Pirni, Alberto, Maurizio Balistreri, Marianna Capasso, Steven Umbrello, and Federica Merenda. "Robot Care Ethics Between Autonomy and Vulnerability: Coupling Principles and Practices in Autonomous Systems for Care." *Frontiers in Robotics and AI* 8 (16 June 2021).
26. Prosocial World (website).
27. Resilience (website).
28. Riem Natale, Antonella, and Roberto Albarea, eds. The Art of Partnership: Essays on Literature, Culture, Language and Education Towards a Cooperative Paradigm. Udine, Italy: Forum Editrice, 2003.
29. Royer, Alexandrine. "The Wellness Industry's Risky Embrace of AI-Driven Mental Health Care." Brookings, Tech Stream, 14 Oct. 2021.
30. Slaughter, Anne-Marie. "3 Responsibilities Every Government Has Towards Its Citizens." World Economic Forum, Education, 13 Feb. 2017.
31. UN General Assembly. Universal Declaration of Human Rights. Resolution 217 (III), A/RES/217 (111). 10 Dec. 1948.
32. Wahl, Daniel Christian. "Salutogenic Cities & Bioregional Regeneration (Part I of II)." Medium, Age of Awareness, 20 Mar. 2020.

Issue 2: Need for transdisciplinary collaboration

Background

The novel and interconnected nature of the global challenges calls for a transdisciplinary approach for climate change mitigation and repair. There is a need for holistic observation and analysis of the worldwide challenges in proper context. There is a need to identify and measure more accurately the impact of human behaviors and technologies on the well-being of humans and the living environment. Unfortunately, locally and globally, there is a tendency across sectors to compete and work in silos.

This leads to compartmentalizing disciplines, communities, and stakeholders when it comes to solving the complex problems of sustainability. As noted by Paul Cilliers,

> *Some systems have a very large number of components and perform sophisticated tasks, but in a way that can be analyzed (in the full sense of the word) accurately. Such a system is complicated. Other systems are constituted by such intricate sets of non-linear relationships and feedback loops that only certain aspects of them can be analyzed at a time. Moreover, these analyses would always cause distortions. Systems of this kind are complex.* (Cilliers, 1998)

This idea is illustrated further with a list of characteristics of complex systems (e.g., a “snowflake is complicated, human brain is complex”).

This tendency of working in isolation also limits the emergence of regenerative solutions made possible through inclusion of people in discipline and knowledge areas not typically recognized or included in problem-solving spaces (e.g., Indigenous knowledge, social sciences, creative arts, and the lived experiences of those in the Global South most impacted by climate change).

This tendency of working in isolation also limits the emergence of regenerative solutions made possible through inclusion of people in discipline and knowledge areas not typically recognized or included in problem-solving spaces (e.g., Indigenous knowledge, social sciences, creative arts, and the lived experiences of those in the Global South most impacted by climate change).

The global problems faced by humanity are interconnected yet often have been addressed separately by the people who work in individual fields of expertise typically related to the problem. For example, the problem of renewable energy is mostly being solved by engineers and scientists. For renewable energy to be effectively used by everyone, people who will be using it need to be involved and actively participate in the design process. This will require knowledge of the geographical and community context and a balanced assessment of the pros and cons affecting each stakeholder community (local and global).

Consider “discipline” as ways of knowing or practicing. Many people are not considered to have the “acceptable” credentials to participate in the problem-solving spaces. Transdisciplinary collaboration can increase the problem-solving capacity by widening the field of experience and skills. Transdisciplinary (TD) collaboration mixes “disciplines” together to solve problems (e.g., pairing an electrical engineer and a native person from the Amazon). This includes stakeholders not recognized by some as modern-day professionals. For example, although not recognized by all university-based professions as valid professionals, in regenerative design, Indigenous peoples are considered to be a source of useful knowledge regarding sustainability. Transdisciplinary collaboration also differs from other collaborative approaches (e.g., multidisciplinary, cross-disciplinary, and interdisciplinary). This emergent approach has the potential to unify

branches of knowledge (e.g., technical, natural, social, and health sciences) to form something entirely new that the individual contributors could not create themselves.

To better understand the differences in disciplinary approaches, see Figure 3 below.

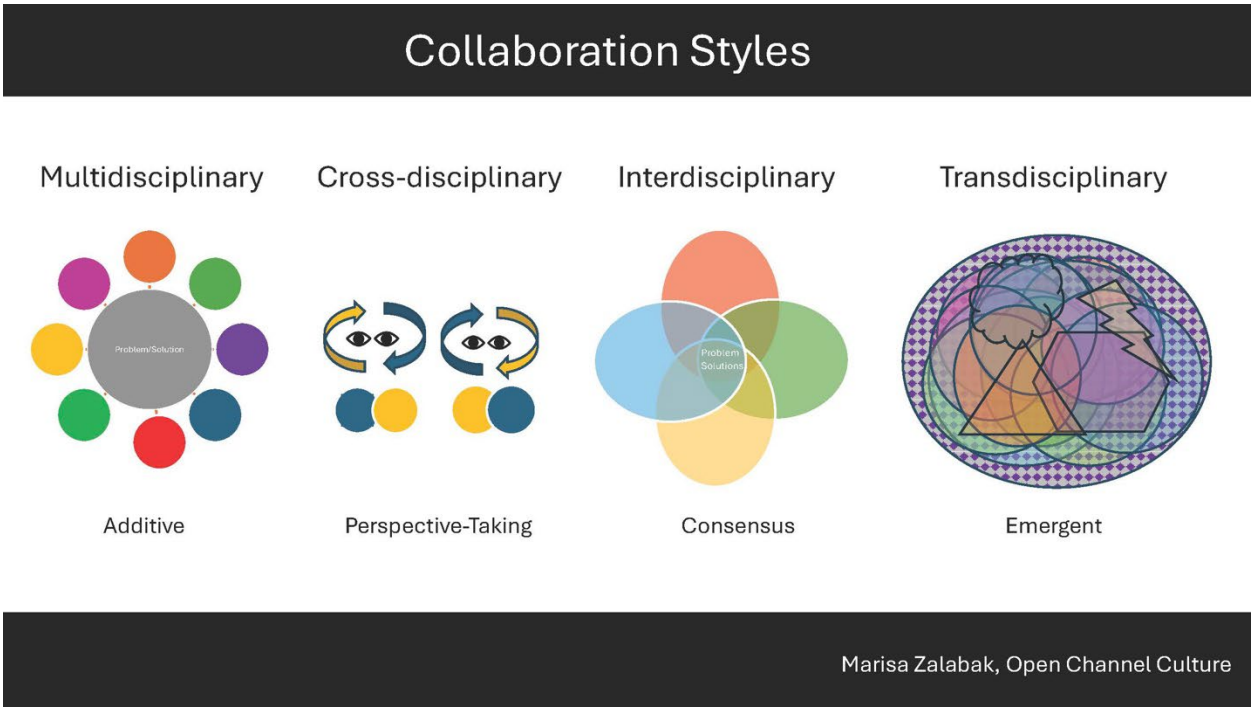

Figure 3. Emergence-Focused Collaboration
(Image: Marisa Zalabak)

Specific differences in disciplinary collaborative approaches are as follows:

- *Multidisciplinary* is additive, meaning that people from several different disciplines, domains, or groups remain within their individual boundaries (e.g., disciplines, specializations, and perspectives) and collaborate by adding ideas to the problem-solving space where the solution is determined by an assigned decision-maker.
- *Cross-disciplinary* is based in perspective taking, where empathy is used to view the problem-space from another discipline's perspective while individual boundaries still remain. For example, an aerospace engineer considers the point of view of a behavioral psychologist and the behavioral psychologist considers the point of view of the engineer when designing the safety features of a plane.
- *Interdisciplinary* is consensus-based, where two or more individual disciplinary boundaries are crossed, like a Venn diagram, identifying a consensus (i.e., all collaborators agree on the solution to the problem). This leads to the creation of a new level of integration—while still remaining within each member's or group's disciplinary framework. Interdisciplinary collaborations can lead to the creation of a new hybrid discipline (e.g., neuropsychology). For example, neuroscientists, psychologists, and medical doctors who have different methods to tackle a problem combine them to find a collectively agreed-upon solution.

- *Transdisciplinary* collaboration, referred to as *xenogenesis* (i.e., between, across, and beyond disciplines), transcends boundaries, unifying individual disciplines, branches of knowledge, and/or intellectual frameworks (e.g., technical, natural, social, and health sciences) to form an entirely new approach, unlike any of the contributing parts. It is a re-creative, emergent, regenerative approach. One key difference is the inclusion of all stakeholders (stakeholders often left excluded). Although transdisciplinary (TD) collaboration is often a messier and less predictable approach, some of the most innovative ideas and concepts emerge. The challenges of the nonconventional approach increase the need for regenerative processes during facilitation (e.g., stretch collaboration, psychological safety). This is an emergent process, and a single identified "field" or approach does not apply.

When using a TD collaboration approach, it is also important to consider social exclusion and the role it plays in limiting perspectives, knowledge, and experiences. Although the challenges facing our planet affect everyone, many people are not considered to have the "acceptable credentials" to participate in the problem-solving spaces. This applies as well to the ethical concerns with collaborations around designing, developing, and mobilizing technologies. With this in mind, TD collaboration can increase equity (as defined in the glossary) and problem-solving capacity by widening the field of experience and skill.

Transdisciplinary collaborations enable diverse collaborations to shine. As a booster for mobilizing innovation, these collaborations have the potential to:

1. Grow psychological resilience and flexibility for navigating unknowns and adversity (e.g., tolerance for ambiguity, ability to express one's point of view while being aware that it is a limited perspective due to one's conditioning and unconscious biases).
2. Reveal unexpected opportunities, risks, and leverage points in the collective field of effect.
3. Create narratives that translate complex experiences into meaningful explanations and contributions while attracting and energizing others to join the learning journey.
4. Increase experiential, educational opportunities through learning from and of others from different backgrounds, perspectives, and expertise (Lennon, Zalabak, & Dajani, 2020).

Recommendations

How we can facilitate effective transdisciplinary collaborations when collaborating in diverse groups seeking global solutions includes the following:

1. **Establish restorative circles practices.** Establish restorative circles practices, an Indigenous practice of deep listening, ensuring all voices are heard and honored, increasing equity, trust, and psychological safety needed to:
    a. Create new pathways for solutions to emerge.
    b. Develop people's ability for navigating the unknown, an essential part of the transdisciplinary process (e.g., tolerance for ambiguity).
    c. Utilize and expand the practice of storytelling of circles by using platforms. These circles can also be continued through diverse platforms (e.g., podcast and messaging apps), attracting and energizing others to join the journey by enabling storytellers to share experiences of doing meaningful work.

2. **Create collaborative agreements (social) that elevate and mobilize collective intelligence.** These agreements should be "living" documents, adapted and amended as needed throughout the collaboration to increase efficacy and meaning. This also serves to incorporate wisdom traditions and best practices for processing conflict constructively. This can be extended to include methodological and technical agreements and protocols. This document will:
    a. Collect feedback for effective ongoing constructive collaboration.
    b. Help demystify the experience of working in a transdisciplinary environment for those who haven't experienced it.
    c. Use transdisciplinary collaborative agreements. For an example, see Figure 4 for the agreement used by the Global Methodologies committee.

Figure 4. Community Agreements Example
(Image: Marisa Zalabak)

3. **Increase equity in the process** (e.g., language, gender, ethnicity, race, socioeconomic status, education, religion, and age). "Equity in the process" includes establishing processes for collecting and sharing information.
    a. Apply multimodal and multi-perspective communication practices between all stakeholders. This includes demystifying the language, concepts, and terminology used in technical professions when sharing information.
4. **Consider what is being measured.** Use of mixed methods (i.e., quantitative and qualitative combined; Schoonerboom & Johnson, 2017) with a translation of how the quantitative data relates to the complexity of human and planetary well-being. Technologies centered around care are modeled after humans; it is important to be aware of who and what is being measured and whose lens is used to process the data. One consideration is that technology is defined as separate from

humans, although humans apply human skills as tools in daily life. Increase education on the causes and effects of climate change. For example, adopt other multimodal forms of communication as tools for weaving human connection and understanding, cognitively aligning and enabling effective innovation (e.g., storytelling, visualizations).

   a. Create solid training models that can be adapted across cultures and backgrounds to reeducate and train a considerable percentage of humans on Earth toward a holistic lifestyle that includes care for all other creatures on the planet and turn things around (e.g., regenerative design, life optimization).

5. **Create open and participatory platform solutions for collaboration.** Use AI and blockchain to create open and participatory platform solutions for transdisciplinary collaboration, unbiased collecting and sharing information, and tracking of issues and progress to better match resources with needs that have solid, positive planetary and financial impact. For example, using the World Intellectual Property Organization (WIPO) for intellectual property policy, services, information and cooperation.

Further resources

1. Binder, Claudia R. "Transdisciplinarity: Co-Creation of Knowledge for the Future." *RCC Perspectives*, no. 2 Minding the Gap: Working Across Disciplines in Environmental Studies (2014): 31–34.
2. Chandha, Saikiran. "Scientific Research Needs to Be More Transdisciplinary Than Ever." *Fast Company*, 19 Aug. 2022.
3. The DEAL Team. "What is the Doughnut?" Doughnut Economics Action Lab (DEAL). 15 July 2020.
4. Doughnut Economics Action Lab. "About Doughnut Economics."
5. Hill, Rosemary, Chrissy Grant, Melissa George, Catherine J. Robinson, Sue Jackson, and Nick Abel. "A Typology of Indigenous Engagement in Australian Environmental Management: Implications for Knowledge Integration and Social-Ecological System Sustainability." *Ecology and Society* 17, no. 1 (2020).
6. IEEE Standards Association. *IEEE P2890, Draft Recommended Practice for Provenance of Indigenous Peoples' Data*.
7. Kaiser, Matthias, and Peter Gluckman. "Looking at the Future of Transdisciplinary Research." *Center for Science Futures*, 2023.
8. Kim, Milena Kiatkoski, Michael M. Douglas, David Pannell, Samantha A. Setterfield, Rosemary Hill, Sarah Laborde, Laura Perrott, Jorge G. Álvarez-Romero et al. "When to Use Transdisciplinary Approaches for Environmental Research." *Frontiers in Environmental Science* 10 (9 May 2022).
9. Kuban, Adam. "Transdisciplinary Collaboration: An Introduction." National Association of Geoscience Teachers.
10. Marchant, Natalie. "Thinking Like Leonardo da Vinci Will Help Children Tackle Climate Change." World Economic Forum, *Behavioral Science*, 11 May 2021.
11. Mâsse, Louise C., Richard P. Moser, Daniel Stokols, Brandie K. Taylor, Stephen E. Marcus, Glen D. Morgan, Kara L. Hall, Robert T. Croyle, and William M. Trochim. "Measuring Collaboration and Transdisciplinary Integration in Team Science." *American Journal of Preventive Medicine* 35, no. 2S (Aug. 2008).

12. McPhee, Chris, Martin Bliemel, and Mieke van der Bijl-Brouwer. "Editorial: Transdisciplinary Innovation (August 2018)." *Technology Innovation Management (TIM) Review* 8, no. 8 (Aug. 2018): 3–6.
13. Pokojska, Justyna. "Competencies of the Future as a Transdisciplinary." *Proceedings of the 13th International Multi-Conference on Complexity, Informatics and Cybernetics* (IMCIC 2022).
14. Polman, Paul, and Andrew Winston. "The Net Positive Manifesto." *Harvard Business Review Magazine*, Sept.–Oct. 2021.
15. Project Drawdown (website).
16. Project Drawdown. "Climate Solutions 101."
17. Regenesis Group (website).
18. Root-Bernstein, Robert. "Correlation between Tools for Thinking; Arts, Crafts, and Design Avocations; and Scientific Achievement among STEMM Professionals." *Proceedings of the National Academy of Sciences of the United States of America* 116, no. 6 (Feb. 2019): 1910–1917.
19. Science and Nonduality. *Story Disruption & Morphogenesis, Charles Eisenstein*. YouTube video. 27 Nov. 2015.
20. Taylor Wesselink, Keisha. "Interdisciplinary and Transdisciplinary—Creating Maps for the Maze and Our Labyrinth." SHAPE-ID, 5 Oct. 2020.
21. Taylor Wesselink, Keisha, and Doireann Wallace. "System of Preconditions for Successful Arts, Humanities and Social Sciences Integration." *Zenodo*, 28 Jan. 2021.
22. "Tolerance of Ambiguity." *Science Direct, 2015.*
23. Tötzer, Tanja, Sabine Sedlacek, and Markus Knoflacher. "Designing the Future—A Reflection of a Transdisciplinary Case Study in Austria." *Futures* 43, no. 8 (2011): 840–852.
24. Zingale, Nicolas, Julieta Matos-Castaño, Abigail Poeske, and Anouk Geenen. "Transdisciplinarity and the Future: Conversations between Cleveland State University and University of Twente." Change Forward: Visions and Voices of Higher Education's Future 2021–2022. University Innovation Fellows, 28 Oct. 2022.

Issue 3: Technical barriers to achieving regenerative sustainability

Background

When proposing global methodologies for climate change mitigation, it is important to consider technical barriers to achieving intended solutions. *Technical barriers* can be geographic, scientific, and technological. These barriers can affect the design, development, production, and mobilization of individual mitigation strategies. When solving complex problems with technologies, collateral damage as in unintended and unanticipated consequences can emerge at every phase of the proposed solutions from inception to completion to end of life/use, for example:

- Materials and supply chains involved in battery-operated cars currently depend mostly on batteries created with lithium, while the noncircular disposal and replacement of batteries can result in negative impacts.
- The fossil fuels currently used to produce wind turbines may reduce the positive impacts of clean energy created by the turbines.
- Dam construction in the Northwest of the United States initially produced low-cost, high-value electricity but resulted in an expense to society by reducing the available food source produced by salmon fisheries (NPCC, “Dams”).
- The recycling of plastics can result in microplastics in the atmosphere as well as other ways plastics have become embedded and integrated into natural ecosystems.
- Manufacture of single-use plastics, e.g. for potable liquids, result in the production of plastic debris polluting the oceans and dispersing throughout the environment (i.e., wicked problems) and the exposure to virtually forever chemicals contaminating the environment.

Technical barriers are complicated by a lack of continual real-time evaluation with protocols and metrics that effectively measure negative impacts on the well-being of entire socioeconomic systems (e.g., The Gross National Happiness (GNH) measure from Bhutan). Another contributor to technical ineffectiveness includes barriers to implementation. Implementation of solutions for transforming the planet to regenerative, sustainable ecosystems. Regenerative ecosystems are holistic and co-evolving. They focus on the wellbeing of the entire system (e.g., rainforests, “circular” communities, or the body of any living being, where the wellbeing of the whole system is reliant on the health of all its parts) (Elo et al., 2024). Regenerative businesses, societies and agriculture, essentially practice biomimicry, that is, mimic nature. These societal structures connect people to places, natural systems, and technologies. This is also often sabotaged by human barriers and social pressures (e.g., access to technology, lack of resources, energy sources, political conflicts, economic preferences for profit and gain). Although some barriers to mitigation can be effectively solved by technology, these approaches can conflict with current socioeconomic systems in place around the world (recording can be found at the link).

Global methodologies are still developing. No single methodology can address the entirety of diverse global societies, environments, and natural world issues. Many of these methodologies are originally proposed in silos—they have no clearly defined links to connect them. As methodologies develop, links that integrate objectives, strategies, targets, metrics, and impacts need to be refined.

As new technologies are discovered to improve climate change mitigation, it is essential to understand the potential impacts outside of the focus area. For example:

- In the shipping industry, there is movement to help ensure that the design of every ship must consider the entire life span of each component so that ships that are retired won't show up as trash in another part of the world, perpetuating the problem.
- The use of plants to replace biofuels may result in food shortages, poor food quality, or inflation.
- The communications technology created to provide more access and connectivity globally can end as electronic waste in landfills, damaging the planet.

Because of these potential negative impacts, we need to be mindful of existing gaps and barriers that inevitably occur whenever different technological concepts, languages, methods, and disciplines interact. As a consequence, some of these gaps prevent effective technical solutions from being globally applied. If a community cannot understand the technical concept and implications of a solution, they cannot apply it themselves or keep it running sustainably after implementation. For example, different climate change forecasting models (including formatting and data collection) do not always have shared languages and methods. They sometimes result in conflicting predictions when applied in diverse geographic locations.

In addition, unpredictable challenges can surface as technologies evolve without their long-term vetting (e.g., cost-benefit analysis or life-cycle effects), for example, cobalt used to mobilize electric vehicles resulting in disposal and mining issues or sulfur dioxide seeding to improve reflective qualities of the atmosphere and cool the planet resulting in acid rain. Careful vetting is also often limited by a lack of shared information following negative technical incidents (e.g., registry). Although the nature of vetting can require countless rounds of experimentation for improvement, it can provide the necessary guardrails to help prevent significant negative, unintended impacts. When well vetted in partnership with governmental support, like smart farming systems, technologies can improve efficiency and reduce resource consumption with fewer negative side effects.

Recommendations

1. **Link and integrate major global methodologies.** To address technical barriers that inhibit achieving a positive sustainable turnaround by 2030, major global methodologies should be linked and integrated through meaningful and practical objectives, strategies, targets, and metrics. Consider Malcolm Gladwell's description of the *tipping point:* the "magic moment when an idea, trend, or social behavior crosses a threshold, tips, and spreads like wildfire" (Gladwell, 2000).
2. **Incentivize collaboration between organizations.** Create a global communications campaign to incentivize outreach between organizations and entities for exchange and collaboration.
3. **Encourage compatibility /interoperability of technical standards.** Align the technical standards used around the globe and /or by global entities to proactively drive the integration of the various methodologies
4. **Create maps of methodologies.** Leverage AI technology to create maps of methodologies that identify the domain concepts and the relationships among them to harmonize them across domains and dimensions (as illustrated in a map included later in this chapter), including the following:

a. The development of global maps of methodologies should considers that a methodology that works in one location does not always work well in another. Allow for context-specific, community-driven, and localized application of methodologies.

b. Utilize AI applications to match organizations and individuals and improve communication of shared goals, connecting the purpose of initiatives in alignment with the sustainable development goals (e.g., SDG and ESG).

c. Create maps or detailed registries of wicked problems discovered in vetting and deployment, including notable incidents in time to prevent future damage (e.g., "test and invest", IEEE P7010™,).

d. Create applications for wicked problem prediction and mitigation.

5. Encourage governments to deploy tools like incentives and reminders to encourage collaboration and cooperation among stakeholders. Create incentives and systemic reminders (i.e., nudge theory and choice architecture, discussed by Richard H. Thaler) at the government level to encourage cooperation and collaboration between technical entities and stakeholders to achieve holistic innovations (e.g., organizations, institutions, agencies, businesses, nonprofits, communities, and individuals).

6. **Verify applicability of methodologies.** Provide some form of valuation/metric for each methodology that communicates the success of the methodology, and consider the following:

    a. Create deterrents to avoid innovating for things that are not really necessary. For example, reduction in production may be a solution because it seems like societies continue to create products, run into issues they cause, then create rules and regulations to minimize those issues. Some societies keep doing this cycle after cycle, while no amount of knowledge and advancement has helped them find a sense of contentment and "enoughness." We have become an "issue-creating, issue-solving species" that can potentially never be satisfied.

Further resources

1. Achlim, Yasmina. "Environmental Impact of Salmon Farming." One Green Planet Earth.
2. Adams, Chris, Rym Baouendi, Tim Frick, Tom Greenwood, and Dryden Williams. "Estimating Digital Emissions." Sustainable Web Design. Updated 17 Apr. 2022.
3. "Application of Southern California Gas Company (U904G) for Authority to Establish a Memorandum Account for the Angeles Link Project." *Before the Public Utilities Commission of the State of California. Application 22-02.* Filed 17 Feb. 2022.[2]
4. B Corporation (website).
5. Boutros, Tristan. "The Ego: The Biggest Barrier to Success and Leadership." Process Excellence Network (PEX). 17 May 2015.
6. Carbon Trust. "Briefing: What Are Scope 3 Emissions?"
7. Brondizio, Eduardo, Sandra Díaz, Josef Settele, S. Díaz, and Hien T. Ngo, eds. The *Global Assessment Report on Biodiversity and Ecosystem Services.* Bonn, Germany: IPBES Secretariat, 2019.

[2] Green Hydrogen solution.

8. Chibvongodze, Danford T. "Ubuntu is Not Only about the Human! An Analysis of the Role of African Philosophy and Ethics in Environment Management." *Journal of Human Ecology* 53, no. 2 (2016): 157–166.
9. Climate Change AI. "AAAI 2022 Fall Symposium: The Role of AI in Responding to Climate Challenges."
10. Conspicuous Capitalism (website).
11. Davis, Shawna. "Having Chickens Reduces Your Food Waste, and There's Proof." dengarden, 30 Dec. 2022.
12. Donoff, Elizabeth. "Nobel Prize for the Discovery of the Blue LED." *Architect Magazine*, 6 Dec. 2016.
13. Earth Charter (website).
14. Elkington, John. *Green Swans: The Coming Boom in Regenerative Capitalism*. New York: Fast Company Press, 2020.
15. Etieyibo, Edwin. "Ubuntu and the Environment." In *The Palgrave Handbook of African Philosophy, edited by* Adeshina Afolayan and Toyin Falola. New York: Palgrave Macmillan, 2017.
16. Global Oneness Project. *Sawubona*. YouTube video. 8 Feb. 2007.
17. Government of Canada. "RETScreen Clean Energy Management Software." Natural Resources Canada; Maps, Tools, and Publications; Tools; Data Analysis Software Modelling Tools.
18. Hagens, Nate. *The Great Simplification: Film on Energy, Environment, and Our Future*. YouTube video, 19 May 2022.
19. Henfrey, Thomas. "Designing for Resilience: Permaculture as a Transdisciplinary Methodology in Applied Resilience Research." *Ecology & Society* 23, no. 2 (2018).
20. Hickel, Jason, Sam Fankhauser, and Kate Raworth. "How to Save the Planet: Degrowth vs Green Growth?" The Smith School, School of Geography and the Environment. Video recording. 2 Sep. 2022.
21. Hougaard, Rasmus, and Jacqueline Carter. "Ego is the Enemy of the Good." *Harvard Business Review*, 6 Nov. 2018.
22. "Investment Theme: Sustainability." S&P Dow Jones Indices.
23. Jacobson, Mark Z., Anna-Katharina von Krauland, Stephen J. Coughlin, Emily Dukas, Alexander J. H. Nelson, Frances C. Palmer, and Kylie R. Rasmussen. "Low-Cost Solutions to Global Warming, Air Pollution, and Energy Insecurity for 145 Countries." *Energy & Environmental Science* 15, no. 3343 (2022).
24. Kumar, Pushpam. "This Index Measures Progress and Sustainability Better Than GDP." Columbia Climate School, Climate Earth, and Society, State of the Planet, 9 Oct. 2018.
25. Lai, Charmaine, Subutai Ahmad, Donna Dubinsky, and Christy Maver. "AI Is Harming Our Planet: Addressing AI's Staggering Energy Cost." *Numenta* (blog), 24 May 2022.
26. Lewis, Barnaby. "How Smart Farming Is Changing the Future of Food." ISO News, 15 June 2022.
27. Liew, Robert. "Can Wind Power Become Truly Carbon Neutral?" Wood MacKenzie, 8 July 2021.
28. Lin, Janice. *Beyond Power: Opportunities and Challenges for Green Hydrogen*. Green Hydrogen Coalition, June 2020.

29. Lipták, Béla. "Hydrogen Is Key to Sustainable Green Energy." Control, 24 Jan. 2022.[3]
30. Mann, Paul. "Can Bringing Back Mammoths Help Stop Climate Change?" *Smithsonian Magazine*, 14 May 2018.
31. McDonough, William. "William McDonough Articulates Circular Carbon Economy Framework for the G20." William McDonough, 20 Mar. 2021.
32. Melanie Goodchild (website).
33. "Mining Landfills." *Mission 2016: The Future of Strategic Natural Resources*, MIT.edu.
34. National Academies of Sciences, Engineering, and Medicine. *Gaseous Carbon Waste Streams Utilization: Status and Research Needs*. Washington, DC: The National Academies Press, 2019.
35. Newcomb, Tim. "Scientists Are Reincarnating the Woolly Mammoth to Return in 4 Years." *Popular Mechanics*, 20 Jan. 2023.
36. Partnerism (website).
37. ProSocial World (website).
38. Purpose (website).
39. Regeneration (website). "Methodology."[4]
40. Resilience (website). "Daniel Christian Wahl."[5]
41. Maersk. Sustainability at Maersk, Our ESG Priorities. "Responsible Ship Recycling."
42. SYSTEMIQ. "Introducing the Global Commons Stewardship Framework." SYSTEMIQ Earth, 19 May 2022.
43. Terblanché-Greeff, Aida C. "Ubuntu and Environmental Ethics: The West Can Learn from Africa When Faced with Climate Change." In *African Environmental Ethics*. Chemhuru, M., ed. *The International Library of Environmental, Agricultural and Food Ethics* 29 (2019). Springer, Cham.
44. UN Department of Economic and Social Affairs. "The 17 Goals." Sustainable Development.
45. Weaver, John Fitzgerald. "LA Could Soon Be Home to the Nation's Largest Green Hydrogen Infrastructure System." *PV Magazine*, 17 Feb. 2022.[6]
46. "What is the Seventh Generation Principle?" *Indigenous Corporate Training Inc.* (blog). 30 May 2020.
47. World Climate Tech Summit (website).
48. Yeung, Peter. "The Toxic Effects of Electronic Waste in Accra, Ghana." Bloomberg CityLab, 29 May 2019.

[3] Green Hydrogen solution.
[4] Regenerative Methods/Models (Paul Hawken).
[5] Regenerative Methods/Models (Paul Hawken).
[6] Green Hydrogen solution.

Issue 4: Human barriers to achieving regenerative sustainability by 2030

Background

Since technological barriers are so often interwoven with human capacities to solve problems in diverse paradigms, advantages and disadvantages emerge together that must be considered. The complexity of human diversity—individual, collective, and social (e.g., socioeconomic, cultural, political, and geographic realities and experiences)—presents barriers for coordinated actions that lead to effective outcomes. While we face global challenges as humans living on the same planet, like climate change, the place in which we live influences how we can solve the problem. To better understand and apply appropriate interventions and mitigations it is essential to use methods and approaches that are capable of differentiating needs, causes and effects, for example, "location intelligence" (e.g., Life Map) and other methods that research the specific energy consumption in each location, the energy consumption resulting from natural systems, and the technologies used (e.g., AIS). In addition to the energy use, other factors like water use and product lifecycle must be considered.

A lack of social coherence also plays a big role in continuing destructive social behaviors, calling for applications for mitigating conflict and increasing peacemaking within, between, and across local and global boundaries. Conflicts fed by perceived threats to basic psychological human needs (safety, security, etc.) too often result in natural reactive behaviors (e.g., fight, flight, or freeze) driven by emotions (e.g., fear, anxiety, anger, sadness).

Political norms in varying countries also influence the ability to create change. In some countries, citizens have the power to create movements of change (e.g., a democracy), while in others the ruling party controls what can be done. In addition, political norms, cultural norms, socioeconomic structures, and psychological factors affect the ability to inspire people's minds to change (e.g., see Jared Diamond: Collapse). Positive change in behaviors and social practices require new mindsets that deeply engage all levels (e.g., individual, social, industrial, communal) accounting for the interconnectedness of all life and elements on Earth. As Bernard Shaw wrote, "Progress is impossible without change, and those who cannot change their minds cannot change anything" (Bernard, 2018). As described in this Chapter's Issue 1, *care* is of universal relevance. Despite all contextual and cultural differentiation, care is a golden, connective thread. A collection of effective methodologies is necessary to support cooperation and combined efforts to meet these challenges and realize the aspirations for planetary well-being.

As data-driven technologies scale and exploitative economic practices have grown unchecked, cultures of care (as described in our Issue 1), continue to be diminished. Prioritizing quantifiable outcomes over well-being (e.g., GDP vs GNH) can inevitably lead to a decline of cultures of care across public and private sectors, resulting in challenges to human and animal rights as well as the preservation of natural spaces. In addition, the proliferation of misinformation increases divisiveness that hinders changes in behavior.

Fortunately, some methodologies bridge Indigenous wisdom traditions, effective for thousands of years (e.g., Seven Generations and Ubuntu) to newer methodologies (e.g., conscious capitalism, Doughnut economics, and B Corp Certification). Currently, with a few expectations, most of these methodologies exist in silos and do not capitalize on the vast overlap, potential synergies, and possible symbiotic relationships. While the UN Sustainable Development Goals (SDGs) represent the biggest global attempt to bridge silos for sustainable, life-promoting policies today, there is still a lack of consensus that negatively affects meaningful action. For

example, divides exist for many corporations and government entities. There are those who prefer to base their actions solely on environmental, social, and corporate governance (ESG) metrics versus the SDGs, preventing aligned actions. For example, most ESG metrics valued by business enterprises do not encompass the needs of the entire ecosystem (e.g., farmers, schools, not-for-profit services). In addition, methods that are currently recommended as roadmaps (e.g., SDGs) have evolved and will continue to evolve from their original forms. Consequently, no single framework or methodology will be sufficient.

Within the wider context of global knowledge (e.g., sociology, geography, and regional sciences) there are two distinguishable factors: individual and environmental. *Individual* relates to the personal experience of a human being within day-to-day parameters, while *environmental* relates to external events, which may affect wider groups, regions, and nations. The interaction between the individual and environmental spheres is where impact resides, raising the key performance indicators' (KPIs') every iteration, so that each methodology is more ambitious than the one before. This can be exemplified by the current European Green Deal, which targets much more ambitious goals as opposed to the plans in the prior programming periods. But there is little emphasis on the societal processes and behaviors that need to occur to translate these targets into concrete actions.

There are several layers of considerations, which impact the implementation of various frameworks and contexts. There is an initial local context (e.g., individual or environmental), the regional geographic context, and the global context. Each of these present a different space for implementation of green methodologies and technologies that may present a new wave of challenges. In addition, the temporal nature and regional context of methodological approaches are barriers for implementation, which include traditional geopolitical competitions that prevent countries from working as true global partners.

Other major barriers to achieving the goals of planetary well-being include human perceptions and biases based on personal locations, habits, cultures, beliefs, and educational backgrounds as well as political and social preferences. Although diversity is an advantage socially and biologically, aggressive differences and lack of consensus can result in little or no action. Despite often-cited climate change skepticism, the UN Peoples' Climate Vote demonstrated that a significant percentage of the world's population is concerned and shares the desire to live in a sustainable and responsible manner.

An additional hindrance is created by the financial concerns and incentives driven by old models for profitability. Even though a sustainable-oriented business may be created with the best intentions, in the end it is often taken over or merged into large profit-driven corporations (where many prioritize exponential growth models measured primarily by fiscal metrics in isolation, rather than including metrics for human and planetary well-being). Often this forces smaller, sustainable businesses into luxury niches that few people can afford (e.g., the merger of European chocolate companies). The lack of models or profit with purpose that fit within the constraints of sustainability (e.g., Doughnut Economy, Net Positive) also hinders progress.

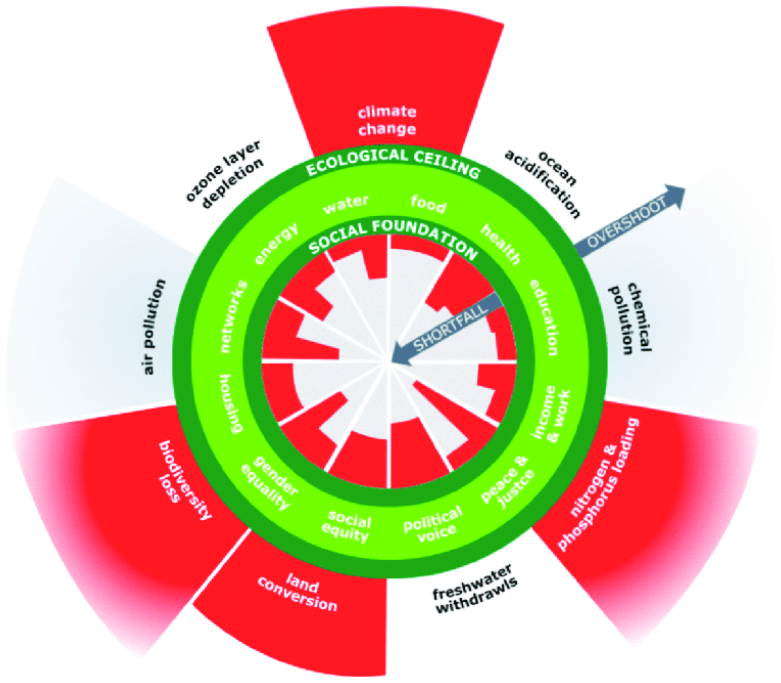

Figure 5. ***Doughnut Economics***
(Image: The Doughnut of social and planetary boundaries (Kate Raworth and Christain Guthier)

A barrier to change is individuals' mindsets, due to limitations of current mental models created by personal experiences and self-reinforcing habits learned over a lifetime and mental models and belief systems developed over time by life experience. This results in blind spots, making it difficult for individuals to see clearly and objectively—to say what they think, do what they say, and see what they do.

Conflicts occur individually, interpersonally, and socially given the reactions to threats created by climate change. Understanding basic human psychological needs (i.e., safety, security, belonging, respect, love, and self-actualization) is essential. Many reactions, although presented as opposition to taking action, are based in fear and sadness regarding the effects and potential consequences of the climate warming.

A fundamental shift in mindset is required to overcome these barriers. A shift is required to a more holistic approach, where sustainability is inherently valued, is a core expectation, and is measured, monitored, and designed accordingly, both for compliance and to drive sustainable innovation. In order to shift paradigms of entrenched mindsets, deeper levels and methods of learning are required to develop awareness of other belief systems and holistic thinking. These deeper insights can lead to seismic shifts of perception and effective consequential action.

Recommendations

In order to benefit from the establishment of technologically advanced and environmentally conscious societies, observe the following recommendations.

1. **Coordinate action via all existing and emerging sustainability-oriented methodologies.** What is urgently needed at this point in history is coordinated action via all existing sustainability-oriented methodologies alongside improving human factors that impact processes. Linking these

methodologies and technologies in a meaningful and pragmatic manner is paramount for reaching the tipping point for a positive turnaround (see mind maps discussed in Issue 5).

2. **Share information about process possible improvement widely.** When implementing processes, information about proposed improvement iterations should be made accessible to as many affected stakeholders as possible, reaching all levels in societies. Engagement at all levels to improve the impact of the various goals and innovations is paramount.
3. **Develop and share impact assessment reports.** To engage more people, impact assessment reports will be needed, differentiated by target, goals, and focus of impact. This includes the need for the impacts of current and proposed technologies.
4. **Incorporate sustainability and climate change related education widely.** Education in sustainability and climate change must be incorporated in general pre-K to 12 education and in every sector of society for all generations.
5. **Foster democratization.** Assign ownership of individual's data to the individuals. Democratization is needed in data-driven technologies to foster global creative societies (e.g., Society 5.0). To achieve this democratization, individuals' data should be made available to them as owner and access and use granted by them.
6. **Create methods to bridge communication gaps between diverse demographics.** Create methods to bridge differences and gaps in communication between diverse demographics (e.g., semantics) and provide access to conflict management and peacemaking.
7. Urgently address climate change adaptation and mitigation.
8. **Prevent misinformation.** Create systems and processes to address misinformation driven by personally and/or politically driven actors intending to mislead the general public about the realities of climate change.
9. **Address ecoanxiety.** Create programs/approaches to address ecoanxiety: locus of control (Krockow, 2023) and binary and nonbinary thinking including the following:
    a. Incorporate a range of practices for constructive conflict mediation. This includes Indigenous cultural and religious practices, as well as practices from social sciences that create opportunities for conflicts to result in a win–win outcome versus a temporary compromise. This includes empathetic listening, establishing a shared language for conceptual understanding, respect for individual, cultural, and religious values, and distinguishing between what is wanted and what is needed by all parties and the community involved. Some examples include Indigenous-based restorative circles, nonviolent communication, relational thinking, indigenous wisdom traditions' "original ways of knowing" (Anishinaabe Gikendaasowin) (see Goodchild, 2021) and the United Nations General Assembly. One example of a technical augmentation is an app created to help users apply empathic, perspective-taking strategies in daily life to mediate conflicts constructively.
10. **Encourage changing mindsets.** A fundamental change in the mindset of individuals, communities, and nations is required in order to overcome their blind spots, to let nature work, and to reestablish and unleash the capacity for self-healing. The following is an example:
    a. Applying the Presencing Institute model, Theory U: Theory U has been utilized by the United Nations Development Coordination Office together with the Presencing Institute in 2021 to assist 14 countries in the adoption of the UN Sustainable Development Goals (SDGs) to advance the UN Agenda 2030. Theory U is used to counter illusive, unhealthy, ego-driven social habits. In support of developing a heightened sense of systems thinking through

complex systems, Theory U fosters collaboration and action learning by encouraging the creation of new prototypes that help to identify different levels of the emerging knowledge and understanding and how consequential action comes into being. This approach supports authentic change by:

i. Holding spaces for deep listening.

ii. Observing while suspending judgment.

iii. Sensing what is occurring with an "open mind, open heart, and open will."

iv. Increasing participants' ability for "presencing," the "capacity to connect to the deepest" sources of self and to access an inner place of stillness where inherent "knowing" is more able to surface.

v. Crystallizing and committing to a shared purpose.

vi. Prototyping, which involves "integration of thinking, feeling, and will in the context of practical applications and learning by doing."

vii. Coevolving as a group, convening the right sets of players to help them to co-sense and cocreate at the scale of the whole.

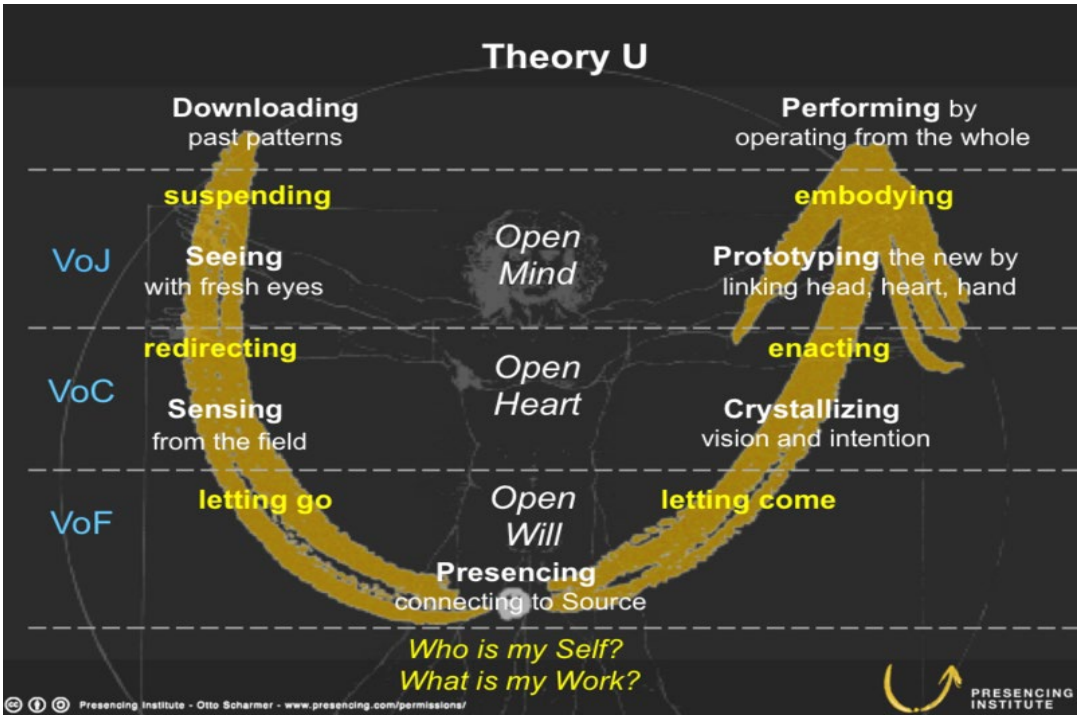

Figure 6. *Theory U*
(Image: u-school for Transformation and the Presencing Institute)

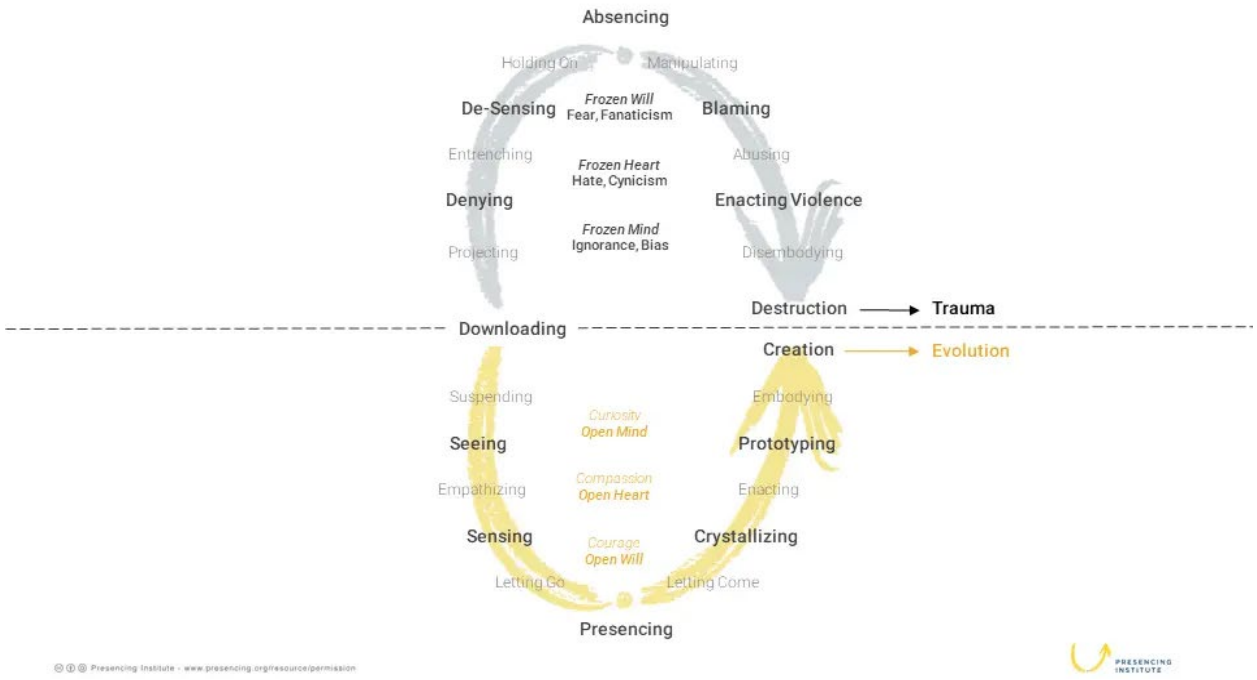

Figure 7. ***Theory U—Presencing and Sensing Process***
(Image: u-school for Transformation and the Presencing Institute)

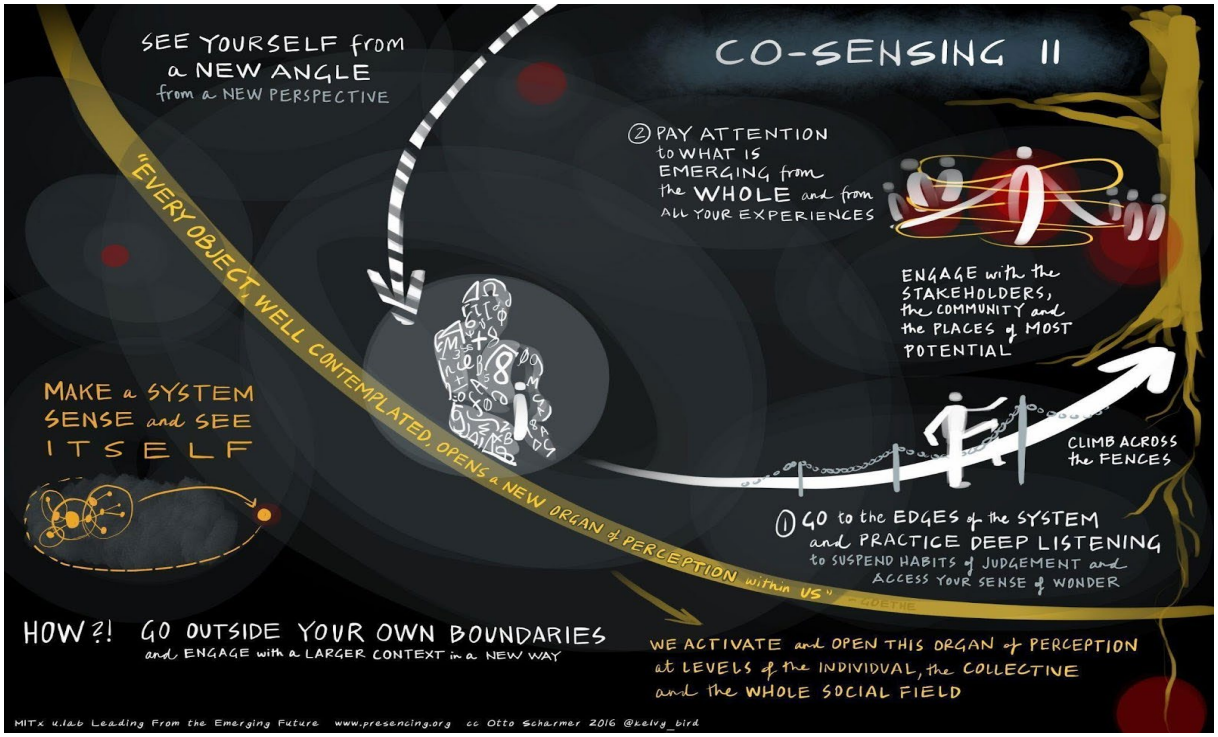

Figure 8. ***Theory U—Co-Sensing***
(Image: u-school for Transformation and the Presencing Institute)

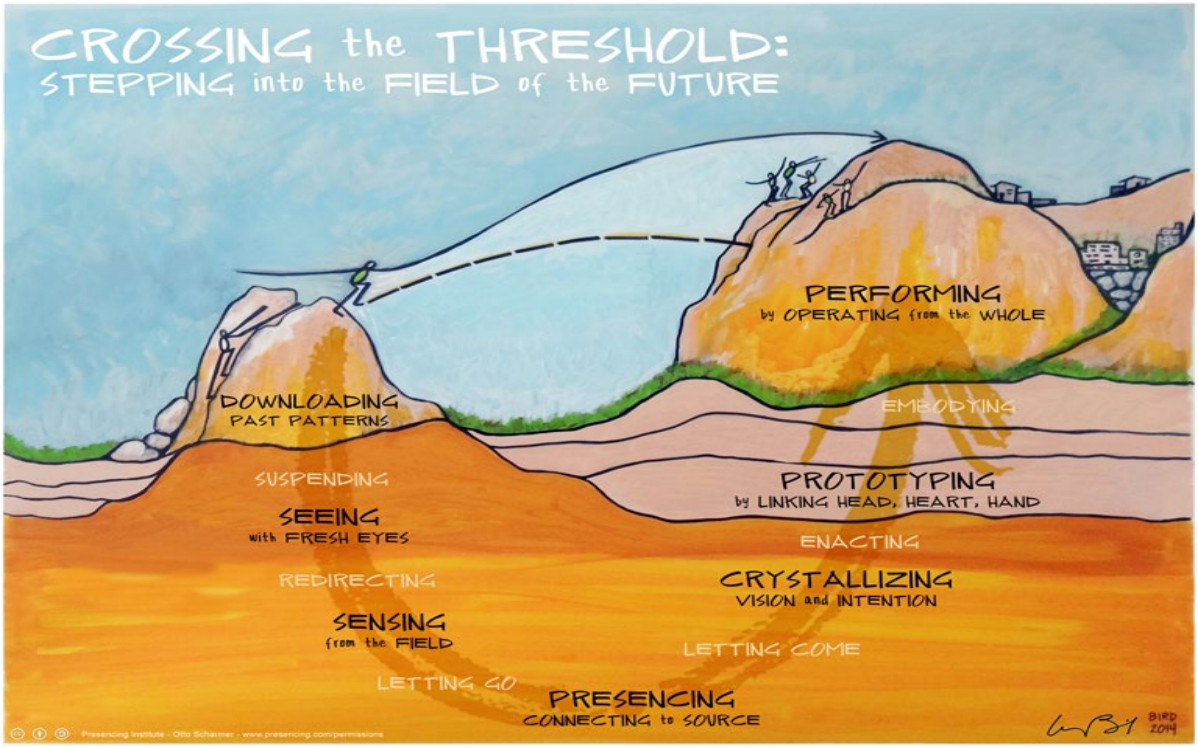

Figure 9. ***Theory U—Stepping into the Field of the Future***
(Image: u-school for Transformation and the Presencing Institute)

Further resources

1. Adhanom Ghebreyesus, Tedros. "Conflict, Climate Crisis and COVID: World Needs 'Peace for Health and Health for Peace'." World Health Organization, Commentaries, 7 Apr. 2022.
2. Bernier, Andrew. "Sustainability Storytelling is Not Just Telling Stories about Sustainability." In Reference Module in Earth Systems and Environmental Sciences, edited by M.I. Goldstein and D. A. DellaSala, 430–437. Encyclopedia of the World's Biomes 5, Elsevier (2020).
3. Buhaug, Halvard, Tor A. Benjaminsen, Elizabeth A. Gilmore, and Cullen S. Hendrix. "Climate-Driven Risks to Peace Over the 21st Century." *Climate Risk Management* 39, no. 100471 (2023).
4. Curiosity Stream. "Going Circular."
5. DePaul University. Asset-Based Community Development Institute (ABCD).
6. European Commission. "Business & Biodiversity." Energy, Climate Change, Environment, *Green Business*.
7. European Parliament. "EU Measures Against Climate Change." Topics, Climate and Environment, Climate Change., 7 Aug. 2018.
8. Goodchild, Melanie. "Relational Systems Thinking: The Dibaajimowin (Story) of Re-Theorizing 'Systems Thinking' and 'Complexity Science'." *Journal of Awareness-Based Systems Change* 2, no. 1 (2022).

9. Hentsch, Rachel. "SDG Leadership Labs: Supporting UN Country Teams to Achieve Agenda 2030." *Medium, Field of the Future* (blog), 10 Dec. 2021.
10. Krey, V., O. Masera, G. Blanford, T. Bruckner, R. Cooke, K. Fisher-Vanden, H. Haberl et al. "Annex II: Metrics & Methodology." In *Climate Change 2014: Mitigation of Climate Change.* Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, edited by O. R. Edenhofer, Y. Pichs-Madruga, E. Sokona, S. Farahani, K. Kadner, A. Seyboth, I. Adler et al.
11. Lazard, Olivia. *The Blind Spots of the Green Energy Transition.* TED Talks, TED Countdown New York Session 2022.
12. MDPI Sustainability. "Sustainable Education and Approaches." MDPI Sustainability.
13. Scharmer, C. Otto. *Theory U: Leading from the Future As It Emerges*. Oakland, CA: Berrett-Koehler Publishers, Kindle Edition, 2016: 29–114.
14. Schmitt, M. T., S. D. Neufeld, C. M. L. Mackay, and O. Dys-Steenbergen. "The Perils of Explaining Climate Inaction in Terms of Psychological Barriers." *Journal of Social Issues* 76 (2020): 123–135.
15. Ship Recycling Transparency Initiative. "Using Transparency to Drive Progress on Responsible Ship Recycling."
16. Swim, Janet, Susan Clayton, and George Howard. "Human Behavioral Contributions to Climate Change: Psychological and Contextual Drivers." *American Psychologist* 66, no. 4 (2011): 251–261.
17. u-school for Transformation by Presencing Institute. "SDG Leadership Labs: Supporting UN Country Teams to Achieve Agenda 2030." 9 Dec. 2021.
18. u-school for Transformation by Presencing Institute. "Theory U."
19. UN. Conflict and Climate (blog). United Nations, Climate Change. 12 July 2022.
20. UN, Security Council. "Climate Change 'Biggest Threat Modern Humans Have Ever Faced', World-Renowned Naturalist Tells Security Council, Calls for Greater Global Cooperation." Press release, 23 Feb. 2021.
21. Wahl, Daniel Christian. "Salutogenic Cities & Bioregional Regeneration (Part I of II)." Medium, *Age of Awareness*, 20 Mar. 2020.
22. Weder, Franzisca, Amornpan Tungarat, and Stella Lemke. "Sustainability as Cognitive "Friction": A Narrative Approach to Understand the Moral Dissonance of Sustainability and Harmonization Strategies." *Frontiers in Communication* 5 (Feb. 2020).
23. Werrell, Caitlin, and Francesco Femia. "Climate Change Raises Conflict Concerns." *The UNESCO Courier*, 2018-2, e-ISSN 2220-2293.
24. "What is 'Double Materiality' and Why Should You Consider It?" *Greenstone, A Cority Company* (blog), 25 Aug. 2021.
25. "What is the Seventh Generation Principle?" *Indigenous Corporate Training Inc.* (blog). Working Effectively with Indigenous Peoples, 30 May 2020.
26. The World Bank. "Social Dimensions of Climate Change."

Issue 5: Lack of linking and mapping

Background

Since technical and human barriers are linked, there is a difficulty in achieving consensus and resolving divergent priorities when selecting plans, policies, and actions to achieve the objectives for planetary well-being (e.g., reducing GHG emissions) and improving the well-being of a global population.

The participating stakeholder communities are expected to be large and very diverse. As a consequence, considerable resources and supporting methodological protocols and tools should be made available to facilitate obtaining consensus and consilience among stakeholders (e.g., among advocates, practitioners, and nontechnical people and cultures). This includes metrics that accurately reflect ongoing effectiveness.

In addition, with the lack of effective tools, the complexity of connections between social and technical aspects of interventions is often unclear and difficult to comprehend. The diversity of human and environmental factors—as well as the evolution of technological advancements—calls for effective tools (e.g., maps, libraries) that support visualization and comprehension. For example, tools are needed to fully understand the impacts of specific geographic regions and environments in designing effective towns and cities (such as critical regionalism).

Ongoing accumulation of this kind of knowledge is critical. For example, Project Drawdown[7], one of the most current successful approaches for climate change mitigation, has recently introduced a library of effective methods and solutions for a diverse global audience; they are encouraging others to contribute by proposing additional tools for sharing information.

Recommendations

1. **Use effective technological and non-technological solutions to achieve consensus.** The difficulty in achieving consensus and resolving conflict can be minimized through technological and non-technological solutions. Some proposals are stated in the following recommendations.
2. **Create mind maps for methodologies systems.** Create and expand a methodologies systems mind maps (for an example, see Figure 3 below) with updates of emerging methodologies (e.g., Project Drawdowns' Solutions Library[8] recently added to the Project Drawdown approach or Edward Darling's LifeMap with CODES Action Plan as discussed by David Jensen[9]).
3. **Create networks maps of global methodologies.** Improve and create networks map of global methodologies, including the methodologies used globally for specific branches and purposes that align to the overall purpose SDGs. Build in a process to reassess inputs and outputs, including human behaviors.

[7] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

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[9] This information is given as an example for the convenience of users of this document and does not constitute an endorsement by the IEEE. Similar or equivalent products and services may also be available from other companies and organizations.

4. **Map effective methods by focus area.** Identify and map effective applied methods that support the focus of each specialized focus area (e.g., cities and towns, villages, lakes, metrics).
5. **Provide clear inclusive communications.** Create appendices, glossaries, and indexes supporting clarity and communication to increase inclusion of diverse stakeholder groups with real-time updates.
6. **Include destination-specific information and approaches.** Include destination-specific approaches as the maps evolve with innovation and geographic changes. This is already an approach ingrained in the Horizon Europe framework—with its destinations and ground-up approach—which should be present within the implementation of private and public green strategies as well as the growth of green technologies, for example, destination-specific approaches like critical regionalism in architecture.

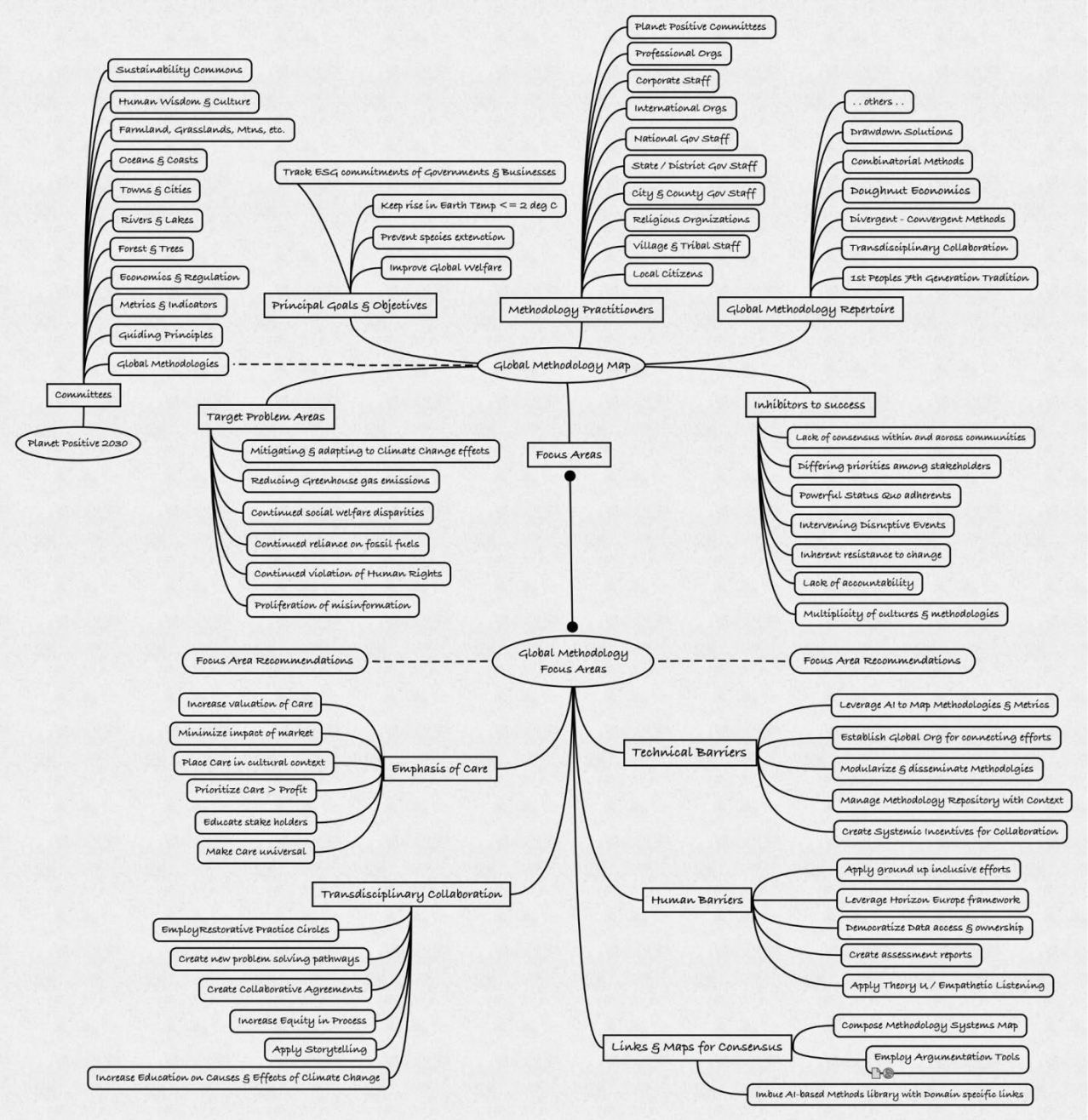

Figure 10. Methodologies Systems Mind-Mapping
(Image: Mike Houghtaling)

Further resources

1. Atkinson, Katie. "Value-Based Argumentation for Democratic Decision Support." *Proceedings of the 2006 Conference on Computational Models of Argument: Proceedings of COMMA 2006.* Amsterdam: IOS Press, 25 May 2006: 47–58.

2. Conklin, Jeff. "Growing a Global Issue Base: An Issue-Based Approach to Policy Deliberation." *Directions and Implications of Advanced Computing: Conference on Online Deliberation*, DIAC-2008/OD2008.
3. Evoqua Water Technologies. "Sustainability Impact Map." Evoqua Water Technologies.
4. Gray, Erin, and Charlie Bloch. "INSIDER: Systems Mapping—A Vital Ingredient for Successful Partnerships." World Resources Institute, Technical Perspective, Finance, 17 Aug. 2020.
5. Green, Nancy L., Michael Branon, and Luke Roosje. "Argument Schemes and Visualization Software for Critical Thinking about International Politics." *Argument and Computation* 10, no. 10 (2018): 1–13.
6. International Trade Centre. "Sustainability Map."
7. ITC Sustainability Map (website).
8. Janjua, N. K., O. K. Hussain, F. K. Hussain, and E. Chang. "Philosophical and Logic-Based Argumentation-Driven Reasoning Approaches and their Realization on the WWW: A Survey." *The Computer Journal* 58, no. 9 (2014).
9. MIT Global System for Sustainable Development (GSSD). "Mapping Sustainability." Updated 27 Aug. 2020.
10. NASA and Columbia University, Socioeconomic Data and Applications Center (SEDAC). "Maps."
11. Romo, Adam. "Polygon Power: Putting Sustainability Systems on the Map." iseal, 18 Nov. 2020.
12. Reed, Chris, Katarzyna Budzynska, Rory Duthie, Mathilde Janier, Barbara Konat, John Lawrence, Alison Pease, et al. "The Argument Web: An Online Ecosystem of Tools, Systems, and Services for Argumentation." *Philosophy & Technology* 30, no. 2 (2017): 137–160 .
13. Wahl, Daniel Christian. "Salutogenic Cities & Bioregional Regeneration (Part I of II)." Medium, *Age of Awareness*, 20 Mar. 2020.

Case Studies

This information is given solely for the convenience of users of this document as examples of case studies that were known at the time of publication, and does not constitute an endorsement of any company, product, service or organization by the IEEE or IEEE Standards Association (IEEE SA).

1. US Climate Change Dashboard

US government dashboard application CMRA (Climate Mapping for Resilience and Adaptation) that integrates information from across the federal government to help people learn about climate-related hazards: CMRA home site.

   a. Case studies listed at CMRA site
   b. Open data at CMRA site.
   c. Southwest Sky Islands case sample
   d. Bracing for Heat case example

References

1. Bernard, Václav. "Remembering George Bernard Shaw with Ten of His Wittiest Quotes." Bernard's, News. 6 Aug. 2018.
2. Cilliers, Paul. *Complexity and Postmodernism: Understanding Complex Systems.* London and New York: Routledge, 1998.
3. Diamond, Jared. Collapse: How Societies Choose to Fail or Succeed. New York: Penguin, 2005.
4. Elo, Merja, Jonne Hytönen, Sanna Karkulehto, Teea Kortetmäki, Janne S. Kotiaho, Mikael Puurtinen, and Miikka Salo, eds. *Interdisciplinary Perspectives on Planetary Well-Being*. Oxon, England: Routledge, 2024.
5. Gladwell, Malcolm. The Tipping Point: How Little Things Can Make a Big Difference. New York: Little, Brown, 2000.
6. Goodchild, Melanie. *Gichi Gaakinoo'imaatiwin (Original Ways of Knowing)*. Vimeo video. Updated 2021.
7. IEEE Standards Association. *IEEE 7010™-2020, IEEE Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-Being*.
8. Jensen, David. "How Can You Support the Launch of the CODES Action Plan on 2 June at Stockholm +50." SparkBlue, 21 May 2022.
9. Krockow, Eva M. "What's Your Locus of Control—And Why Does It Matter?" *Psychology Today*, 24 April 2024.
10. Lennon, Michael, Marisa Zalabak, and Lubja Dajani. "Activating Collective Intelligence to Engineer Transdisciplinary Impacts." *2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC)* (Oct. 2020): 2762–2769.
11. Lenton, Tim, and Bruno Latour. "Gaia 2.0: Could Humans Add Some Level of Self-Awareness to Earth's Self-Regulation?," *Science* 361, no. 6407 (14 Sept. 2018): 1066–1068.
12. MNC Editorial Team. "The First Faces of Manhattan." MessyNessyChic, 31 May 2021.
13. Northwest Power and Conservation Council (NPCC). "Dams: Impact on Salmon and Steelhead."
14. Project Drawdown. "Solutions Library."
15. Schoonerboom, Judith, and R. Burke Johnson. "How to Construct a Mixed Methods Research Design." *Kölner Zeitschrift für Soziologie und Sozialpsychologie* 69, suppl. 2 (5 July 2017): 107–131.
16. Sydney Business Insights. "Richard H. Thaler on Nudges and Choice Architecture." *Sydney Business Insights* YouTube channel. 15 Oct. 2021.
17.

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