

Strong Sustainability by Design

**PRIORITIZING ECOSYSTEM AND HUMAN FLOURISHING
WITH TECHNOLOGY-BASED SOLUTIONS**

EXECUTIVE SUMMARY



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.
- Please, [subscribe to the IEEE Planet Positive 2030 newsletter here](#).

If you're a journalist and would like to know more about the IEEE Planet Positive 2030 Initiative, please contact: Standards-pr@ieee.org.

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Strong Sustainability by Design is not a code of conduct or a professional code of ethics. Engineers and technologists have well-established codes, and the IEEE Planet Positive 2030 community respectfully recognizes the formative precedents surrounding issues of sustainability and the professional values these codes represent. These codes provide the broad framework for the more focused domain addressed in this Compendium, and it is hoped that the inclusive, consensus-building process around its design will contribute unique value to technologists and society as a whole.

This Compendium is also not a position, or policy statement, or formal report of IEEE or any other organization with which IEEE is affiliated. It is intended to be a working reference tool created through an inclusive process by those in the relevant scientific and engineering communities prioritizing sustainability considerations in their work.

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A Note Regarding Recommendations in This Document

Strong Sustainability by Design was created in two versions ("draft" and this current edition) that were iterated over the course of two years. The IEEE Planet Positive 2030 Initiative follows a specific consensus building process where members contributing content identify specific potential issues and proposed recommendations.

Membership

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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Request for Input Draft (“Version One”) Published June 2023.
First Printing November 2024.
Printed in the United States of America.

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PDF: ISBN 979-8-8557-0935-3 STDVA27090
Print: ISBN 979-8-8557-0936-0 STDPT27090

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How to cite Strong Sustainability by Design:

The IEEE Planet Positive 2030 Initiative. *Strong Sustainability by Design: Prioritizing Ecosystem and Human Flourishing with Technology-Based Solutions*. IEEE, 2024. <https://sagroups.ieee.org/planetpositive2030/our-work/>

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Acknowledgements and Thank You!

There are many who have led us to this stage of the IEEE Planet Positive 2030 Initiative.

We sincerely thank ALL Contributors, Participants and Supporters and Supporting Organizations.

- The more than four hundred participants and more than two hundred active contributors to the IEEE Planet Positive 2030 Initiative and their organizations
- The IEEE leadership - volunteers and staff
- The IEEE - SA volunteers and staff for supporting this initiative, especially the Sustainable Infrastructures & Community Development Program as part of IEEE SA Industry Connections
- The many members, committees and groups across IEEE working on addressing sustainability and climate change challenges:
 - The 2022, 23 IEEE Ad Hoc Committee to Coordinate IEEE's Response to Climate Change and the 2024 IEEE Ad Hoc Committee on Technology for a Sustainable Climate
 - IEEE Technology Center for Climate
 - The IEEE Industry Engagement Committee
 - The Joint IEEE Organizational Units (OU) Sustainable Development Ad-hoc committee
 - The IEEE TAB Climate Change Program
 - The IEEE TAB Future Directions Committee
 - The IEEE FDC SusTech Initiative
 - The IEEE Humanitarian Technologies Board (formerly the Humanitarian Activities Committee)

- All the organizers of conferences and events supporting members of The IEEE Planet Positive 2030 Community

- The speakers, interviewees and interviewers (IEEE Industry Engagement Committee), participants, partners and organizers of the 2022 IEEE Planet Positive 2030 Initiative Workshop at Stanford University

- The speakers, participants, partners and organizers of the 2022 IEEE Planet Positive 2030 Initiative Workshop with the University of Delft in The Hague

- IEEE SA staff including the marketing, IT and editing teams

- The IEEE legal team

A special Thank You to Sophia Muirhead, Thomas Coughlin, Jose' M. F. Moura Konstantinos Karachalios, Alpesh Shah, Robert S. Fish, James E. Matthews, Bruno Meyer, and John Verboncoeur.

A very sincere Thank You to all of you and everyone else who have contributed to and supported this extraordinary endeavor.

All your tireless support, creativity, and never-ending commitment and enthusiasm made this work possible.

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With Deep Gratitude

The members of the Planet Positive 2030 community wish to express their deep gratitude to Brian Friedrich who played a pivotal role on our Metrics Committee and in the Initiative. It is with deep sadness we mourn his passing during the development of *Strong Sustainability by Design*. We celebrate his warmth, humor, enthusiasm for and seminal insights contained in this work.

STRONG SUSTAINABILITY BY DESIGN

PRIORITIZING ECOSYSTEM AND HUMAN FLOURISHING WITH TECHNOLOGY-BASED SOLUTIONS

Executive Summary

Imagine the future we¹ can build together.

This is the vision driving the work of **IEEE Planet Positive 2030**, an initiative created and supported by the IEEE Standards Association² that brings together a global, diverse, open community of experts to help chart a path for all people to achieve a flourishing future for 2030 and beyond.

The first step to imagine this future is to recognize the planet Earth and all its ecosystems and biodiversity form a part of all of us.³ The air we breathe, the water we drink, and the food Earth provides comprise who we are. We cannot continue to treat planet Earth as a “resource” from which to be extracted—planet Earth is finite with finite resources.⁴ We should, instead, prioritize the health of our planetary biosphere and recognize that we humans are a part of the system, not above it or outside it.

In 1987, the United Nations Brundtland Commission defined “sustainability” as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”.⁵ This implies “sustainability” is the long-term resilience of people and the planetary biosphere in unison. Achieving sustainability for millennia to come requires a shift from the zeitgeist of competition defining the Anthropocene⁶ era to a culture of care for the land and one another, a “culture of sustainability,” the ultimate goal/vision we can imagine, share, and achieve together.

A key intersection for sustainability involves technology and the context of how and when it is applied and/or used. Quoting *Herbert Simon (1916–2001), Nobel prize laureate 1978, A. M. Turing award 1975*:

“We must look ahead at today’s radical changes in technology, not just as forecasters but as actors charged with designing and bringing about a sustainable and acceptable world.”

¹ “We” refers to “all of us people”—our responsibility for “Now” and “Future Generations” of humanity and the Earth’s biosphere.

² IEEE Planet Positive 2030 is part of [the Sustainable Infrastructures and Community Development Industry Connections program](#) of [IEEE SA](#).

³ “Us” refers to all people on Earth.

⁴ For instance, according to the 2024 [World Wildlife Fund’s 2024 Living Planet Report](#), there is “an average 73% decline in wildlife populations since 1970.” In other words, nature is dying.

⁵ See the definition of “sustainable development” on page 41 of [Our Common Future: Report of the World Commission on Environment and Development from the UN General Assembly, Development and International Economic Co-operation: Environment, A/42/427 \(annex\)](#), originally published 4 Aug. 1987.

⁶ From [Anthropocene](#) by Andrew Goudie: “Paul Crutzen and colleagues introduced the term ‘Anthropocene’ (e.g., [Crutzen 2002](#); [Steffen, et al. 2007](#)) as a name for a new epoch in Earth’s history—an epoch when human activities have ‘become so profound and pervasive that they rival, or exceed, the great forces of Nature in influencing the functioning of the Earth System.’”

New knowledge gives us power for change: for good or ill, for knowledge is neutral. The problems we face go well beyond technology: problems of living in harmony with nature, and most important, living in harmony with each other. Information technology, so closely tied to the properties of the human mind, can give us, if we ask the right questions, the special insights we need to advance these goals.”⁷

The IEEE Planet Positive 2030 process builds on IEEE experience considering the potential positive and negative impacts of the applications of technologies on people⁸ to also address impacts to our planet. It leverages previous work and vision created by IEEE taking an in-depth look at Artificial Intelligence, its applications and potential impacts as detailed in *Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems*:⁹

*“Ultimately, our goal should be **eudaimonia**, a practice elucidated by Aristotle that defines human well-being, both at the individual and collective level, as the highest virtue for a society. Translated roughly as ‘flourishing,’ the benefits of eudaimonia begin with conscious contemplation, where ethical considerations help us define how we wish to live.”¹⁰*

Human well-being has many facets: health, education, social networks among others. Fundamentally, it is dependent on planet Earth, its climate, and the health of the Earth’s ecosystems. It requires that nature be honored so it can flourish in unison with all people and species, that we as individuals and organizations recognize and respect planetary boundaries, the role of and limits to natural capital. This leads to the concept of **Strong Sustainability**.

“Strong Sustainability” builds on the concept of “Sustainability” and stipulates that substitutability of natural capital and ecosystem services (by manufactured capital) be severely restricted to ensure availability of these resources for future generations, for human existence and well-being. The “consumption of natural capital is usually irreversible” (for example, loss of biodiversity).¹¹ Strong Sustainability provides boundary conditions for technological design and implementation based on the reality that Earth’s ecosystems will function and evolve as they will despite any human economic or cultural imperatives.

Put simply: We need Nature. Nature doesn’t need us.

It is this recognition of our need to account for and honor Earth that the title of our compendium is ***Strong Sustainability by Design: Prioritizing Ecosystem and Human Flourishing with Technology-Based Solutions***.

⁷ Salvatore T. March and Fred Niederman, “[The Future of the Information Systems Discipline: A Response to Walsham](#),” *Journal of Information Technology* 27, no. 2 (2012). Includes quote by Herbert A. Simon (2000).

⁸ Technology and Society,” IEEE Society on Social Implications of Technology (SSIT), <https://technologyandsociety.org>.

⁹ The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, *Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems*, 1st ed. (IEEE, 2019).

¹⁰ In *Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems*, the first [three principles](#) are:

1. **Human Rights** – Artificial Intelligence Systems (AIS) shall be created and operated to respect, promote, and protect internationally recognized human rights.
2. **Well-being** – Artificial Intelligence Systems (AIS) creators shall adopt increased human well-being as a primary success criterion for development.
3. **Data Agency** – Artificial Intelligence Systems (AIS) creators shall empower individuals with the ability to access and securely share their data, to maintain people’s capacity to have control over their identity.

¹¹ Jérôme Pelenc, Jérôme Ballet, and Tom Dedeurwaerdere, “[Weak Sustainability versus Strong Sustainability](#),” brief for GSDR 2015.

Eudaimonia must embody conscious contemplation, “healing,” and conservation of our planetary biosphere, that is our natural world with a healthy atmosphere and ecosystems for all the living organisms it contains.

The name of the IEEE Planet Positive 2030 Initiative tells the story of how we¹² are approaching and doing our work:

- **Planet:** Our focus. The Earth we must heal, protect, and sustain for humans and nature to flourish for seven generations¹³ and beyond.
- **Positive:** Our purpose. The design to give back more to the planet with technology than is removed and not to harm the biosphere/planet¹⁴.
- **2030:** Our urgency. The timeframe guiding our work inspiring responsible, bold, systems thinking to inspire accountable contextualized solutions, standards, policy, and pragmatic change.

Each chapter of *Strong Sustainability by Design* begins with a “IEEE Planet Positive vision of 2030” written as if the expert committee members authoring the content are in that future positive reality where the two “impossible goals”¹⁵ have been achieved. Discussions of “Issues” and “Recommendations” provide a pathway to get from today’s reality to the visions of 2030 as will be complemented by the feedback received as part of this process.

Many experts have collaborated, cooperated, and shared their insights to prepare this living document in an effort to not only imagine the future we can build but also identify potential technologies, standards, and solutions that can be implemented now to achieve “planet positivity” by 2030.

Now we call on you, on all interested people, to provide advice, input, and suggestions.

You are invited.

Imagine the future we can build together.

Your participation and insights will help build this future.

To achieve Planet Positivity for 2030 and beyond.

¹² We—the many contributors and participants of the Planet Positive 2030 Initiative.

¹³ For more information about the Seventh Generation Principle, see the 30 May 2020 blog post of the Indigenous Corporate Training, Inc., entitled “[What is the Seventh Generation Principle?](#)” When involving Indigenous communities, it is recommended to consider and prioritize the rights of Indigenous peoples, including the principle of free, prior, and informed consent. For more details, see: UN Human Rights, Office of the High Commissioner, “Free, Prior and Informed Consent of Indigenous Peoples,” from Sept. 2013.

¹⁴ Versus a “climate neutral” mindset.

¹⁵ Goal One: Transform society and infrastructure to achieve Planet Positive 2030 means reducing GreenHouse Gas (GHG) emissions to 50% of 2005 emissions by 2030 and significantly increasing regeneration and resilience of Earth’s ecosystems (as noted in the UN Convention on Biological Diversity’s [First Draft of the Post-2020 Global Biodiversity Framework from 5 July 2021](#), created as part of [COP 15 UN Biodiversity Conference](#)). Goal Two: Identify the current technological solutions that need to be deployed widely as well as technology gaps for which we need to design, innovate, and deploy new technological solutions to reach Planet Positive 2030.

The Foundation

The need for a flourishing planet, human rights, and values

The foundation for the guiding principles is the need for a long-term flourishing planet Earth to sustain all life. The guiding principles are built upon the [United Nations Universal Declaration of Human Rights](#); [Declaration on the Rights of Indigenous Peoples](#); [Declaration on the Rights of Disabled Persons](#); [Declaration on the Right to Development](#); [Rio Declaration on Environment and Development](#); [Resolution on the Human Right to a Clean, Healthy and Sustainable Environment](#); [Convention on the Rights of the Child](#); regional human rights declarations; and the [IEEE Code of Ethics](#).

Human dignity and the human values of peace, freedom, social progress, and equal rights form the values basis underlying *Strong Sustainability by Design*. Enshrined within the UN's Charter and its Universal Declaration of Human Rights for nearly three-quarters of a century, these broad values have guided the UN's efforts to fairly represent the world's diverse nations and cultures.

Alignment with UN values embraces a powerful declaration for universal human values that guide human societies. Having those values form the basis for *Strong Sustainability by Design's* guiding principles provides a powerful, cultures-wide foundation for guiding the efforts of humans as caretakers and caretaker advocates of a flourishing planet.

Essential to the success of the guiding principles are awareness of the problem, accountability, transparency, freedom of expression, and protection of whistleblowers. The goal is a long-term flourishing planet Earth with a thriving biosphere—all nations, all peoples, all life, and all that supports life.

The goal of a long-term, flourishing planet Earth, planet Earth with a healthy planetary biosphere, can be attained if the current warming trend of the Earth's atmosphere is first halted and then reversed. Reduction of current and future GHG emissions as well as—in the longer term beyond 2050—reduction of the elevated GHG levels in the atmosphere is a paramount goal. Achieving this goal is imperative, but it is not sufficient to attain a long-term healthy planetary biosphere. While shifting from fossil fuel-based economies to largely GHG-free economies is the foremost agenda to address the looming climate crisis, it is equally important to transform the current, mostly linear, resource management into a circular economy (see Ellen MacArthur Foundation, "What is a Circular Economy" and "The Circular Economy in Detail"), along with regenerative practices and environmental stewardship. Throughout, we, that is humans, need to observe a balance for all stakeholders between the urgency of today's environmental, biodiversity, and societal needs, the urgency of avoiding tomorrow's looming climate catastrophe and achieving a long-term, flourishing planet Earth.

Embracing complexity throughout the pursuit of this goal is vital. The increasing recognition of interdependencies between society and the environment, our home, means that the transition to a sustainable future is a complex or "wicked problem" (Rittel & Webber, 1973). The process of transitioning to a planet-positive society will not be easy or straightforward. Competing goals and problem sets, different

cultural and/or governance approaches, and moving and/or unmeasurable targets imply that this journey will not be linear and will not be without political—or other forms of—disagreements or conflict. Indeed, addressing and responding to the realities of global warming may be the most important and complex problem humanity has ever faced. Failure to do so will have lasting harmful impacts and consequences for all stakeholders, including present and future humanity and the planetary biosphere. Honoring, recognizing, and including the large diversity in stakeholder cultures and in local, regional, and global conditions and needs requires flexibility and a diversity of approaches to creating a planet-positive society.

The very succinct **definition of planetary sustainability** by an unknown participant from Africa at the United Nations meeting in Johannesburg ([Rio + 10](#)), “**Enough for All—Forever**” can serve as a key guidepost. Individual, institutional, business, industry, government, organizational, academic, and societal stakeholders share the responsibility to “take care” of the planet Earth and its biosphere, humanity’s—our—home.

The **guiding principles** of *Strong Sustainability by Design* are intended to provide a framework for the document’s strategies and recommendations capturing both the desire for long-term planetary sustainability and the complexity that is inherent in fulfilling this desire. They embody the overall “impossible” goals of the IEEE Planet Positive 2030 Initiative.

Ten Guiding Principles

These Principles are designed to provide high-level considerations and are not listed in any order of importance. This has been done purposefully so readers can provide recommendations including the potential ranking of these Principles by specific criteria that address the needs of their audience and stakeholders.

1. **Responsible and ethical leadership from governments, individuals, businesses, organizations, academic institutions, and communities**

The responsibilities of individuals, organizations, academic institutions, and communities should be broadened to include an increased role in addressing the challenges of climate change, sustainability, and socioeconomic and environmental stewardship. New knowledge brings responsibility and demands action. Leadership requires collaboration and cooperation with all stakeholders impacted by decisions. Implementation of technology and policy development should always consider environmental flourishing and human wellbeing in accordance with specifics established by guidelines such as the United Nations Sustainable Development Goals (UNDESA, “The 17 Goals”).

2. **Justice, diversity, equity, and inclusion**

Championing justice, diversity, equity, and inclusion should be a part of sustainability, regeneration, and climate change strategies recognizing that climate change impacts are often felt most by those with the least resources. It is the responsibility of those with the most resources to support those who lack resources in an equitable manner. Addressing climate change impacts and environmental and sustainability challenges should reduce conflict, violence, and inequity.

3. **Global energy systems transformation**

The transition from a fossil fuel-based energy system to a system that is based on clean and sustainable sources of energy should maintain energy accessibility, affordability, sustainability, reliability, and resiliency through all phases of the transition. This transition should also help ensure access for all to affordable, reliable, sustainable, and modern energy (UNDESA, Goal 7). A successful energy transition will enable GHG emission reductions not only in the energy/power sectors but in all sectors using energy, thereby supporting the decarbonization and electrification of these sectors.

4. **Climate change mitigation and adaptation**

In responding to the challenge of climate change, and to prevent a climate catastrophe, society needs to both mitigate (that is, reduce) GHG emissions and adapt to the impacts of a changing climate. Both goals require urgent action. The goals of mitigation and adaptation may come into conflict, society will have to balance these conflicts.

5. **The regenerative imperative and a circular economy**

Thinking, planning, and action must broaden beyond current economic, business, societal, and resource utilization models to achieve sustainability and for people and the Earth's biosphere to flourish for many generations to come. Future economic, societal and cultural, and business models should emphasize new public imperatives and values such as circularity, ecological regeneration, zero waste, and human flourishing and well-being.

6. **Balance between today's needs and the needs of the future**

In the course of transitioning societies and the global economy toward a sustainable future, today's short-term needs must balance with the long-term, global aspirations for a flourishing planet. This balanced approach should address all human needs, including access to food and clean water, health care, and other essential goods and services necessary for a healthy standard of living, and the need for healthy ecosystems globally.

7. **Alignment of global goals with local goals and actions**

The transition to a more sustainable future will be driven and implemented by local actions that should also produce positive global benefits. Local actions and global goals should support each other.

8. **Culture of sustainability**

Strategies and actions should move societies toward building a culture of sustainability and "doing good" that is based on respect for all living beings and for the planet Earth. Sustainability efforts must move beyond minimizing harm to restoring and regenerating human and environmental systems.

9. **Responsible use of technology and technology labeling**

The design, development, implementation, use, and handling/treatment at end-of-current-use of technology should be a dynamic ongoing process for evolving an appropriate, timely response to both negative impacts—the unforeseen consequences of technology on people and planet—and positive impacts—the opportunities to relieve suffering, increase flourishing and equity, and better steward the planet.

10. **Knowledge-based decisions, transparency, and accountability**

Decisions should be based on metrics, sound data, relevant information, context, experience, and perspective; these factors all contribute to informed decisions, knowledge, and accountability. Knowledge-based decisions are thus made on the basis of good evidence and sound reasoning; this, in turn, can make hard decisions more defensible and accountable. Application of appropriate metrics and reevaluation of decisions should be carried out at appropriate time intervals to enable accountability, transparency, and corrective actions.

The Following text extracts identified issues from the various chapters of the compendium. For a detailed description of backgrounds to issues and recommendations, please visit the individual chapters.

Metrics/Indicators

List of Issues

- Issue 1: Metrics development does not universally honor nature
- Issue 2: Sustainability reporting standards and indicators fail to measure accomplishment of sustainability goals and impact of actions taken
- Issue 3: Operational sustainability metrics and data are not consistently accurate, reliable, and practical
- Issue 4: Lack of interconnectedness and trade-offs between society, economic development, and planetary regeneration
- Issue 5: Lack of recognition of global ecological and environmental interdependence
- Issue 6: Lack of socioeconomic transformation toward sustainability
- Issue 7: Technology does not always contribute to socioeconomic evolution towards ecosystem regeneration and sustainability goals
- Issue 8: Metrics do not always validate compliance with standards, laws, and regulations
- Issue 9: Lack of consistent, mandatory, enforced standards and interoperable regulations regarding sustainability measurement, reporting, and verification

Economics and Regulation

List of Issues

- Issue 1: Conundrum between economic growth and exacerbation of climate crisis
- Issue 2: Growth as the sole indicator of progress
- Issue 3: Need for transparency and stricter laws that reflect ecological norms and ethics
- Issue 4: Adverse mental health fallouts not given enough attention
- Issue 5: Helping rural economies thrive
- Issue 6: The problem of landfills
- Issue 7: Lack of openness about data, models, predictions, assumptions, and trade-offs relating to sustainability
- Issue 8: The challenge of greenwashing
- Issue 9: Placing onus of protecting the climate on the consumer alone
- Issue 10: Negative impacts of tourism

Global Methodologies

List of Issues

- Issue 1: Lack of care for human well-being and sustainability of our planetary biosphere
- Issue 2: Need for transdisciplinary collaboration
- Issue 3: Technical barriers to achieving regenerative sustainability
- Issue 4: Human barriers to achieving regenerative sustainability by 2030
- Issue 5: Lack of linking and mapping

Forests and Trees

List of Issues

- Issue 1: Deforestation and forest degradation are key drivers in the climate crisis
- Issue 2: There is no assignment of value for the existence of nature
- Issue 3: The sudden death of forests from infectious diseases is a major concern in the management and conservation of forests worldwide
- Issue 4: Global reforestation potential has a large and cost-effective mitigation potential when done right
- Issue 5: Monitoring, verification, and reporting of nature-based solutions is capital- and labor-intensive
- Issue 6: Nature-based carbon offsets currently lack trust and integrity standards, harming the world's climate
- Issue 7: Individual tree accounting is almost nonexistent, making various techniques such as selective logging and selection cutting difficult to execute, monitor, and verify
- Issue 8: Despite the social media-driven push for corporate engagement on tree planting, numerous organizations have advocated that the process of tree and forestry protection is much more effective than that of virgin tree planting

Rivers and Lakes

List of Issues

- Issue 1: Water access rights are becoming increasingly complex, especially with transboundary waters
- Issue 2: Humans treat water as an endless resource that causes unnecessary waste
- Issue 3: Community overexpansion can overtax water resources, whereas the scaling effect, while seemingly efficient from a financial sense, may have the unexpected impact of overtaxing available water resources
- Issue 4: City infrastructure detracts from healthy river and lake ecosystems
- Issue 5: Excess fertilizer, pesticide, and animal waste pollute water sources and increase the chances for toxic harmful algal blooms (HABs)
- Issue 6: Water flow diversions disrupt critical ecosystems
- Issue 7: Growing water-intensive crops in arid zones accelerates water scarcity
- Issue 8: Physical trash/plastics pollute freshwater ecosystems and play a significant role in ecosystem degradation and destruction
- Issue 9: Chemical and hazardous waste adversely affects river and lake ecosystems
- Issue 10: Raw human sewage pollution causes degradation of river and lake ecosystems
- Issue 11: Invasive species threaten freshwater ecosystems
- Issue 12: Engineering education lacks sufficient ecological literacy content
- Issue 13: Freshwater ecosystems face multiple challenges

Towns and Cities

List of Issues

- Issue 1: Need for harnessing positive innovation ecosystems
- Issue 2: Lack of access to affordable clean energy
- Issue 3: Unsustainable use of legacy fossil-fuel urban transportation and infrastructure
- Issue 4: Lack of clean air and potable water
- Issue 5: Need for ensuring reliable access to food, improving food distribution, and decreasing food waste
- Issue 6: Need for fostering sustainable and regenerative communities
- Issue 7: Need for curbing the growth of energy consumption by computing and communications application technologies
- Issue 8: Lack of livable shared urban spaces for work–life balance and a well–being economy

Ocean and Coasts

List of Issues

- Issue 1: Imminent threat of sea-level rise to coastal communities
- Issue 2: Warming and acidification of the ocean
- Issue 3: Impacts of unsustainable ocean-based food production
- Issue 4: Destruction of important biodiverse and climate-resilient habitats
- Issue 5: Urgency of preventing coral reef bleaching and die-offs
- Issue 6: Ocean pollution due to offshore extraction and processing of fossil fuels, and the difficulties associated with attributing damage to specific polluters
- Issue 7: Influx of excess nutrients is polluting the ocean environment
- Issue 8: Unsustainable marine transportation industry operations
- Issue 9: Path to decarbonization for new and existing ships is unclear
- Issue 10: Increased noise from ships is destroying underwater habitats
- Issue 11: Waste streams and emissions from ships in the ocean are difficult to trace
- Issue 12: Ubiquitous presence of micro- and macro-plastics in the ocean
- Issue 13: Management and the lack of global ocean data

Farmlands and Grasslands – Mountains and Peatlands

List of Issues

- Issue 1: Extraction—Taking without replenishment
- Issue 2: Extraction—Pollution and biodiversity losses undermine human survival
- Issue 3: Extraction—Food waste and food loss contribute to human consumption overshooting beyond planetary boundaries
- Issue 4: Transition—Lack of investment in land sustainability
- Issue 5: Environmental degradation—Upstream over downstream mitigation
- Issue 6: Need for integration—Use ancestral wisdom to sustain land with a diversity of global and local voices

Human Wisdom and Culture

List of Issues

- Issue 1: The need for an expanded mindset—the role of humans in the evolution of planet Earth
- Issue 2: The lack of understanding of the regenerative and sustainability story and concepts
- Issue 3: The materialistic worldview is devoid of a wisdom-centric philosophy
- Issue 4: Duality, (either/or) thinking, a human bias, dominates decision making
- Issue 5: Lack of awareness of “I am because we are”—Ubuntu philosophy
- Issue 6: The dominance of the Global North in policy development and in the use of technology
- Issue 7: Unsustainable resource extraction and economic growth considerations prevail in global policy, technology design, and deployment
- Issue 8: Lack of inclusion of arts, creativity, and culture in proposed solutions to achieve long-term sustainability
- Issue 9: The need to expand knowledge while respecting and highlighting the added value of other cultures and their wisdom
- Issue 10: Purpose over productivity needs to be a priority for positive environmental impact
- Issue 11: Lack of commons—shared resources and an asset-based approach are needed for a community-based development approach
- Issue 12: Omission to invite existing caretakers of the planet hinders ecosystem regeneration, restoration, and maintenance efforts, as well as intergenerational stewardship thinking and design
- Issue 13: The lack of a stage for new leaders from vulnerable/marginalized communities hinders the development of sustainable solutions
- Issue 14: Disregard of past/traditional sustainable technologies can hinder environmental stewardship

- Issue 15: Lack of transparent tracking of human rights, the need for ethics-based trackable measurability, monitoring, and accountability
- Issue 16: Confusion regarding nature versus technology OR nature plus technology

Sustainability Commons

List of Issues

- Issue 1: Thinking in silos
- Issue 2: Lack of long-term viability of previous “commons” projects
- Issue 3: Limited access to knowledge and expertise
- Issue 4: Need for accessible common “language”
- Issue 5: Need for shareable and verifiable data and models
- Issue 6: Need for transparent and inclusive governance
- Issue 7: Steps to help building a sustainability commons initiative

The Arts

List of Issues

- Issue 1: The need to make people feel the urgency of climate change—emotions push people into action
- Issue 2: The need to enforce society’s relational capital in the fight for climate change—how to increase opportunities to engage with art
- Issue 3: The urgency to tackle the complexity of environmental change—expressing powerful contexts through art
- Issue 4: Need to sensitize business leaders to act through art interventions
- Issue 5: The need for artists and scientists to join forces toward achieving environmental sustainability—the power of STE(a)M
- Issue 6: Artificial intelligence needs art to confront the multifaceted challenges posed by AI systems’ emergence
- Issue 7: The need to grow understanding of the effects of climate change in all factions of society—use of art and digital technologies to make these concepts more accessible
- Issue 8: Define “climate art” as a new language of aesthetics to create new ideas for articulating climate concerns to provoke action
- Issue 9: The need for waste and waste management as a space for innovation and change of attitude toward waste
- Issue 10: The need to invent new sustainable materials through artistic practices
- Issue 11: Need to increase the dialogue between artists, policymakers, and the public to use art as a platform for environmental activism
- Issue 12: The need to connect arts to the SDGs—use arts to generate the narrative

- Issue 13: The need to choose a problem-solving approach to reach sustainability—the Bauhaus design and policy approach to reach sustainability
 - Issue 14: The need to create empathy toward the environment—artistic listening exercises
 - Issue 15: Reconnecting with nature is essential for humans to devise integrated strategies to meet climate change challenges—tapping into inner knowing and guidance
 - Issue 16: Effective “narratives” about climate change are urgently needed for people to get engaged—use the work of Indigenous artists to educate and inform wider audiences about the impact of climate change to create possible solutions stemming from Indigenous wisdom?
 - Issue 17: Effective narratives about climate change are urgently needed for people to get engaged—using polyphonic storytelling and poetry as methodologies
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RAISING THE WORLD'S STANDARDS FOR SUSTAINABLE STEWARDSHIP

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