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planet positive 2030

Strong Sustainability by Design

METRICS/INDICATORS

An initiative supported by the IEEE Standards Association

ieeesa.io/PP2030

SSbD Chapter 02, draft version 1, 2023 - 07 - 05

IEEE

Strong Sustainability by Design - Version 1 (Draft)

Request for Input

Public comments are invited on the first version of ***Strong Sustainability by Design: Prioritizing ecosystem and human flourishing with technology-based solutions*** that identifies specific issues and pragmatic recommendations regarding sustainability and climate change to achieve "Planet Positivity" by 2030.

This draft compendium has been created by committees of the Planet Positive 2030 Initiative[1] that is supported by IEEE Standards Association (IEEE SA). The 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 fifty members of this community have contributed directly and have worked to identify and find consensus on timely issues.

The document's purpose is to identify specific issues and candidate 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 emissions by 2030[2]
- Significantly increase regeneration and resilience of earth's ecosystems[3]
- Be well on the path to achieving net zero GHG emissions by 2050 and negative GHG emissions beyond 2050
- Continue to widely deploy 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 document:

- Provides a scenario-based challenge (how to achieve "Planet Positivity by 2030") as a tool to inspire readers to provide contextual technical and general feedback as part of this RFI.
- Advances a public discussion about how to build from a "Net Zero" mentality to a "Net or Planet Positive" ("do more good") societal mandate for all technology and policy.
- Continues to build a diverse and inclusive community for the Planet Positive 2030 Initiative, prioritizing the voices of indigenous and marginalized members whose insights are acutely needed to help ensure technology and other solutions are valuable for all. Of keen interest is how we can encourage more in-depth participatory design in our processes.
- Inspires the creation of technical solutions that can be developed into technical standards (IEEE Standards Association, for example ICT and power & energy related standards, IEEE P7800™ series) and associated certification programs.
- Facilitates the emergence of policies and regulations; regulations that would potentially be interoperative between different jurisdictions (countries).

[1] Planet Positive 2030is part of The Sustainable Infrastructures and Community Development Industry Connections program

[2] As described in the United Nations Climate Change Conference (COP 21) Paris Agreement of 2015.

[3] According to the High Ambition Coalition for Nature and People, "In order to address both the biodiversity crisis and the climate crisis, there is growing scientific research that half of the planet must be kept in a natural state….experts agree that a scientifically credible and necessary interim goal is to achieve a minimum of 30% protection by 2030." Protection for land and water of "30 x 30 by 2030" was recommended during COP15 United Nations Convention on Biological Diversity.

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By inviting comments for *Strong Sustainability by Design*, the Planet Positive 2030 community provides the opportunity to bring together multiple voices from the related scientific and engineering communities 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.

Details on how to submit public comments are available in the **Submission Guidelines**.

Comments in response to this request for input will be considered by the Planet Positive 2030 Initiative committees for potential inclusion in the first public edition of *Strong Sustainability by Design* ("*Strong Sustainability by Design*, First Edition") anticipated to be made available to the general public during the fourth quarter of 2023.

- For further information, learn more at the Planet Positive 2030 Initiative website.
- For our Frequently Asked Questions (beyond RFI submission), please click here.
- Get in touch at: PlanetPositive2030@ieee.orgto get connected to a committee or any other reason.
- Please, subscribe to our newsletter here.

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

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Disclaimers

Strong Sustainability by Design is not a code of conduct or a professional code of ethics. Engineers and technologists have well-established codes, and we wish to respectfully recognize 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 document, and it is our hope that the inclusive, consensus-building process around its design will contribute unique value to technologists and society as a whole.

This document is also not a position, or policy statement, or formal report of IEEE or any other organization with which is affiliated. It is intended to be a working reference tool created in 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 is being created via multiple versions that are being iterated over the course of two to three years. Planet Positive2030 is following a specific concurrence-building process where members contributing content are proposing “candidate” recommendations so as not to imply these are final recommendations at this time. This is also why the word, “Draft” is so prominently displayed.

Our Membership

Planet Positive2030, 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 400 experts involved in our work, and we are eager for new voices and perspectives to join our work.

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Request for Input Draft ("Version One") Published June 2023

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PDF: ISBN978-0-7381-xxxx-x STDVxxxxx
Print: ISBN 978-0-7381-xxxx-x STDPDVxxxxx

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Metrics/Indicators

Future Vision

It is 2030. Sustainability has become an overall institutional framework that drives the human mindset and goal setting, rather than simply being a compliance exercise. This shift informed decision-making and clear commitments (e.g., targets, action steps, and transparent relevant information sharing) brought about by globally converging regulatory changes, and by interlocking mission-driven (Mazzucato,2015, 2018) innovation-enabling programs incentivizing regenerative socioeconomic transformations at both the company and global supply chain levels.

These alterations have been duly reflected in national and globally supported accounting and reporting rules. The Industrial and Information Ages brought innovations and developments that tied individuals and communities across our world closer together but also led to direct and indirect impacts on our planet, as evidenced by data from individual, societal, company, and government programs on sustainable development outcomes. Companies from all industries across the world have now recognized the necessity for every organization, individual, and society to work together to address gaps in the achievement of sustainable development goals.

By gaining knowledge and understanding of the problems, factors, and contributions to climate change through support and collaboration among organizations, a growing number of corporations now base their operations' success on data-driven decision-making and key performance indicators (KPIs reflecting how the products and services they design and develop increase long-term environmental and human flourishing). Countries, companies, and communities have changed their organizational structure and socioeconomic means to be results-driven, positive, and appreciative of global sustainability goals that improve life on Earth for current populations and for future generations to come.

Prices for products and services reflect the true and relative ecological footprint cost of overall resources, so net-zero or net-positive products and services are comparatively less expensive and much more attractive. Products are incentivized to be built to be sustainable and upgradable, rather than being disposable. These products and services are of benefit to poor countries in particular, which are more sensitive to rising temperatures and extreme weather due to reliance on rain-fed agriculture as well as a lack of financing and institutional capacity to implement programs in response to climate change.

These socioeconomic, institutional, and cultural shifts would not have been possible without the development of metrics and systems to measure, monitor, and influence progress towards a net-positive, regenerative society in ways that are innovative and flexible. Standard setters and policymakers have collaborated to ensure that metrics used to identify, measure, monitor, and report on the impacts of sustainable development and climate risks on organizations and the impact of organizations on the environment are understandable, meaningful, and consistent.

Countries have taken on board the principles as set out in the 2015 Paris Agreement goals

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and by the subsequent follow-up events and mechanisms serving its implementation, including the UN Sustainable Development Goals or Diversity, Equality & Inclusion targets and parameters.

Countries are now reporting more transparently on actions taken and progress in climate change mitigation, adaptation measures, and support provided or received. This has further driven stakeholders, agencies, organizations, and companies to take the necessary actions to ensure agreed targets are met, with failure to meet these requirements resulting in increased costs of securing debt and reconstruction efforts required by the increasing number and disruptive effects of events constitutive of the accelerating climate crisis. The information gathered through the increasingly sophisticated prevention and monitoring processes feeds into the global inventory, which assesses the collective progress toward long-term climate goals.

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Introduction

Metrics and indicators are essential because, as the adage says, “what gets measured gets managed.” Without metrics, we have no baseline, no means to measure against standards or requirements, and no means of assessing progress. Well-defined, consistent, and practical frameworks of metrics and indicators are the foundation for capacity building towards effective monitoring and management processes, fair and objective incentive and reward systems, enforcement programs, and accountability systems. By organizing and establishing a set of metrics, this allows for data-driven decision-making in addressing issues that our planet faces.

New climate change and sustainability-oriented measurements are essential to align *systems* with transparency and accountability for the single and collective impact on individuals, organizations (e.g., government, organizations, academia, and industry, also stakeholders), societies, and total ecosystems. New infrastructure design is required to support real-time agility, to adapt to changes, and to develop these systems with increased capability considering the limits to growth (Meadows et al., 1972), while improving life quality for all humans, species and the planet

Metrics and indicators provide measurements that afford us better understanding of processes, tracking of results, and discovery of optimized pathways, enabled by effective application of technology to deliver scenarios and prescriptive intelligent models, both as stand-alone systems as well as being part of a larger ecosystem. The science of measurements, standardized reporting frameworks, glossaries and definitions of terms, and weighted values of both quantifiable and qualitative measures are dimensions to overall sustainability that universally affect and interplay with all organizations and living systems.

To measure and guide this transition, it is imperative to leverage digital and other technologies for a sustainable future. If used responsibly, technology can have a profoundly positive impact on the environment and global sustainability goals, while also holding accountable technology’s effect on our environment.

These technological applications will be aided by interdisciplinary approaches utilizing high-dimensional statistical models supported by artificial intelligence (AI)/machine learning (ML) approaches. In short, development of *holistic* designs that provide quantitative/qualitative measures of ecosystem impact and map pathways with evidence-based data will facilitate our reaching goals of shared benefit to people and the planet.

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Issue: Metrics development should honor Nature

Background

A balance of metrics and indicators is needed to shift away from the current win/lose focus of developing a "business case" driven by classical and neoclassical economics where scarce resources need to be allocated among projects that pit profits against social goals. Instead, metrics and indicators need to enable decision-making that facilitates improved resource access and enactment that supports the full vision of prosperity aiming to improve the life quality of present and future generations (Brundtland Commission, 1987) to live in harmony with nature.

The necessary paradigmatic change towards nature-prioritized metrics is intertwined with a profound multi-institutional shift toward a non-zero-sum decision-making approach that enables identifying and implementing multiple-win solutions regarding resource allocation. Such a shift, enabling extended and upgraded (mass) cooperation, has to be intertwined with recognizing and implementing in practice the consequences of human–nature interdependence. This pattern facilitates moving away from the institutional dual primacy of a zero-sum approach and resource scarcity view that generates exploitative, dominance seeking, competitive, and collisional socio-economic dynamism.

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From an ethical perspective, this shift indicates priority given to ethics based on virtues, care and duties instead of utility. It logically entails a drive toward social and economic equilibriums that are not influenced by pre-established power balance and can be, therefore, truly inclusive and fair with respect to remote and less affluent regions of the planet (Brandt Report, 1980).

Sustainability should become a core value of human culture rather than just a compliance exercise and, therefore, be considered a system-level goal rather than a behavioral constraint. In such a broader context, the focus on quality metrics will be to help organizations assess if their actions are achieving what they value, rather than if they are hitting compliance targets. Such a robust cultural shift will also lessen the current tendency for short-term thinking driven by perceived immediate gains/targets (Barton, 2011). Instead, it can facilitate social innovation, business models, and pursuit of technologies that aim and show long-term potential of sustainable value creation and altruistic benefits.

Recommendations

Given the complexity of the types of metrics and systems needed to measure full environmental impacts and support the pursuit of strong sustainability goals (Daly, 1991), there is a distinct need for technological tools to support the growingly automatic measurement, monitoring, reporting, and visualization of the aggregation of transformational sustainability-oriented processes. The proper sets and implementation dynamics of metrics and measurements enable us to elaborate on and implement effective methodologies aiming to radically lower emissions by allowing the "technologies of nature" to work and increase the regeneration, restoration, and resilience of Earth's ecosystems.

- New, genuinely net-positive businesses are required that promote and implement regenerative approaches (Robinson & Cole, 2015). These are aiming to and capable of generating profit by restoring previously triggered (environmental and social) damage, that is, by going beyond avoiding further damage. These models facilitate personal and collective life quality improvements through fulfillment of nature-prioritized metrics instead of prioritizing mass consumption and self-serving growth.

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Civil society can and must play an active role in the elaboration and implementation of such business models by generating favorable demand patterns, legislative (including taxation) environments, and supportive public resourcing. The civil society players have to identify and get access to proper metrics and indicators, as well as to the capacity of modeling and simulating the possible contents and impacts of the interplay among the multiple components of the required societal and institutional changes that should unfold in various fields.

The emergence of an altered green digitalization can be mutually catalytic and constitutive of an emerging Next Society (Reichel, 2012) of a new, collaborative era—a networked knowledge-driven civil society characterized by a more global cooperative and sharing social dynamism (Toffler, 1980, 1995; Perlas, 2000; Benkler, 2006, 2011; Rifkin, 2004, 2011; Reichel, 2012; Chase, 2012). These new systems interplay with robust institutional (Giddens, 1984) alterations that can aggregate into a societal culture characterized by new dynamics of cooperation going also beyond organizational boundaries. Such cultural transformation can unfold through alterations in the taken-for-granted perceptions that shape the everyday life of citizens (Perez, 2002) ready for "commoning" (Bollier, 2016) and acting as "prosumers" (Toffler, 1980). Civil society players need access to proper metrics and indicators enabling them to carry out social agency by "going after the small picture" (Giddens, 1984).

Technological Insights and Recommendations

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Further resources

1. Barton, Dominic. "Capitalism for the Long Term." *Harvard Business Review,* Mar. 2011.

2. Benkler, Yochai. *The Penguin and the Leviathan: The Triumph of Cooperation Over Self-Interest*. New York: Crown Business, 2011.

3. Bollier, D. (2016, June 25.) Beyond Development: The Commons as a New/Old Paradigm of Human Flourishing. Benkler, Yochai. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven and London: Yale University Press, 2006.

4. Brandt, Willy. *North-South: A Program for Survival.* Brandt Report. Cambridge, MA: MIT Press, 1980.

5. Brundtland Commission. *Our Common Future*. World Commission on Environment and Development. Oxford University Press, 1987.

6. Crawford, Kate. *The Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*. Yale University Press, 2021.

7. Daly, Herman E. *Steady State Economics*. 2nd ed. Washington DC: Island Press, 1981.

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8. Frank, Adam, David Grinspoon, and Sara Walker. "Intelligence as a Planetary Scale Process." *Cambridge University Press* 21, no. 2 (Feb. 2022).

9. Giddens, Anthony. *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge, MA: Polity Press, 1984.
10. Mazzucato, Mariana. The Entrepreneurial State: Debunking Public vs. Private Sector Myths. New York: Public Affairs, 2015.

11. Mazzucato, Mariana. Mission-Oriented Research & Innovation in the European Union: A Problem-Solving Approach to Fuel Innovation-Led Growth. European Commission Directorate-General for Research and Innovation Publications Office, 2018.

12. Meadows, Donella H., Dennis L. Meadows, Jørgen Randers, and William W. Behrens. *The Limits to Growth*. A Potomac Associates Book. New York: Universe Books, 1972.

13. Perez, Carlota. *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham, UK and Northampton, MA: Edward Elgar, 2002.

14. Perlas, N. *Shaping Globalization: Civil Society, Cultural Power and Threefolding*. Center for Alternative Development Initiatives, Global Network for Threefolding, 2000.

15. Reichel, André. "Civil Society as a System." In *Civil Society for Sustainability: A Guidebook for Connecting Science and Society,* edited by Ortwin Renn, André Reichel, and Joa Bauer. Bremen, Germany: Europaeischer Hochschulverlag GmbH and Co. KG, 2012.

16. Rifkin, Jeremy. *The End of the Work, The Decline of the Global Labor Force and the Dawn of the Post-Market Era.* New York: Penguin, 2004.

17. Rifkin, Jeremy. *The Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World*. Palgrave Macmillan, 2011.

18. Robinson, John, and Raymond J. Cole. "Theoretical Underpinnings of Regenerative Sustainability." *Building Research and Information* 43, no. 2 (Mar. 2015).

19. Sarkar, C. "The Rise of the Collaborative Economy." Interview with Jeremiah Owyang in *The Marketing Journal,* 12 Mar. 2016.

20. Toffler, Alvin. *The Third Wave*. New York: William Morrow, 1980.

21. Toffler, Alvin, and Heidi Toffler. *Creating a New Civilization: The Politics of the Third Wave*. Atlanta: Turner Publishing, 1995.

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Issue: Sustainability oriented metrics and indicators need to measure what matters

Background

"What gets measured, gets managed," so it is essential to measure climate and nature-based data and resources that are not currently incorporated into most financially oriented or prioritized Corporate Social Responsibility (CSR) reporting.

Metrics and indicators provide:

- a baseline against which progress toward sustainability goals can be benchmarked;
- evidence of compliance with sustainability standards or requirements;
- evidence-based results to strengthen Net Zero / sustainability commitments and accountability; and
- tools to catalyze and drive the accumulation of changes into transformations facilitating the pursuit of net and nature positive goals and impacts.

Well-defined frameworks of metrics and indicators are the foundation for effective monitoring and capacity building, fair and objective incentive and reward systems, enforcement programs, and accountability systems. These systems need to be adapted and utilized to focus on evaluating and monitoring factors that make a difference in the pursuit of net-zero and net-positive-enabling regenerative outcomes.
The choice of metrics is also not a "one-and-done" exercise. Given the vast complexity and interdependence of global and socioeconomic systems, decision makers must recognize that metrics will need to be reevaluated as society moves to adopt sustainable development goals as set forth in the Paris Agreement or similar foundational goals. Unforeseen and unintended consequences will need to be identified and addressed. For example, in order to provide Scope 3 (indirect) emissions disclosures, large companies will require information from suppliers, but what will be the impact on smaller organizations that don't have the means to gather the needed information? Will they be excluded from the market? As another example, what happens if the practical measures aiming to decrease the world's dependence on beef and increase plant-based foods lead to unfavorable shifts in biodiversity? These types of questions will require ongoing consideration.

Finally, it is also important to recognize that when metrics are used to support cost and/or value estimates that an organization intends to use for disclosure purposes or to evaluate a project, measurement methods must fully reflect true costs and values. For example, if a company is evaluating the potential return on investment of offering a new product line, the costs included in the evaluation should reflect all costs to develop and produce the product responsibly (in other words, in a manner that adequately considers the needs of employees and other stakeholders, reflects the true value of resources consumed, and provides for remediation of environmental harms and regenerative actions.[4] Projects should not be deemed profitable if

[4]In accounting terms, this is typically referred to as Natural Capital Accounting defined by The European Commission as, " a tool to measure the changes in the stock and condition of natural capital (ecosystems) at a variety of scales and to integrate the flow and value of ecosystem services into accounting and reporting systems in a standard way."

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they create problems that harm the environment, animals, or human wellbeing that others will need to fix. This is fundamental to accountability.

Recommendations

In terms of measuring what matters, it is important that metrics (or sets of metrics) work together to support holistic decision-making, reflect priorities, and clearly align with the outcomes being sought.

To achieve this, metrics and indicators must be broad enough to support multidisciplinary decision-making across the range of environmental, social, and governance issues that need to be measured and monitored on a country-to-country basis. In a particular context, this might include elements of emissions produced, resources used, biodiversity impacts, human and social impacts, and other relevant factors to better assess the holistic impact of actions. For example, in addition to environmental impacts, consideration should be given to social consequences of societal shifts, such as:

- job losses in sectors being reduced and retraining that will be needed to shift jobs to sustainable industries;
- inequity in access to resources that support desired changes (such as access to public transit or plant-based food alternatives); and
- unintended impacts on land development or biodiversity.
- How legal rights for the planet are shifting, such as the acceptance of the legal personhood of rivers (New Zealand) and other ecosystems provides examples of the way ahead for accepting and respecting the intrinsic value of nature.[5]

Failure to consider the full scope might lead to short-sighted decisions without due consideration of the big picture. Therefore, the following should be observed:

- Metrics should identify, distinguish, and support measurements of direct (primary) and indirect (secondary, tertiary, etc.) factors that cover the entire lifespan of the product/project. This provides a more complete and realistic impact assessment to evaluate options and disclose outcomes.
- Metrics must reflect the tensions between human development and broader biodiversity. Robust metrics help decision makers guard against unintended consequences that improve one factor from a human perspective but harm another element. For example, green energy sources such as water turbines and windmills can significantly threaten fish and birds, and these threats also need to be measured and monitored. From a biodiversity perspective, metrics must enable decision makers to interact with and manage the wicked problems emerging from complex systems whose interplay is driving the emergent Anthropocene[6] era.
- Innovation is essential to determine appropriate metrics and indicators that will provide the necessary scope of information. An example of an innovative metric for a particular context is when measuring

[5] Patrick Barkham, "Should Rivers Have the Same Rights As People?," The Guardian, 25 July 2021, https://www.theguardian.com/environment/2021/jul/25/rivers-around-the-world-rivers-are-gaining-the-same-legal-rights-as-people.

[6] The Anthropocene era, as defined by Wikipedia, is a proposed geological epoch dating from the commencement of significant human impact on Earth's geology and ecosystems, including, but not limited to, anthropogenic climate change.

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circularity[7] of a project (where its design is intended to favor reduction, reuse or recycling of materials and resources versus favoring a linear process) consider measuring the "radius of the circle." Nature evolves using small circles in tight geographic areas. In contrast, humans might find a "circular" solution, but if that means building products on one side of the globe, shipping them around the world, then shipping the obsolete product back around the world for it to be disassembled and reused, the radius of circularity is huge, and likely is linear in nature and much more wasteful than a smaller radius project.

- Metrics and indicators need to implement more integrated reporting systems that better track progress along net-zero roadmaps and more quickly highlight areas where further action is required. Such systems should enable more regular, reliable reports to be provided at the board level to ensure that sustainability is at the heart of organizational strategy.

- Metrics and indicators need to consider not just outputs or outcomes, such as emissions or water use, but also indicators that measure changes in desired behaviors, such as individuals choosing to support organizations that prioritize the circular economy or increased awareness and popularity of plant-based food options.

- Metrics and indicators need to support investigation of root causes and beneficial actions that both can and should be undertaken to help validate or discredit assumptions that don't measurably increase sustainability goals.

Technological Insights and Recommendations

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[7] "Circularity" refers here to concepts in design or statistics often referred to as Circular Design, defined by The Ellen MacArthur foundation as, "A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature."

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Issue: Sustainability oriented Metrics need to be accurate, reliable, and practical

Background

Metrics must reliably and accurately measure the factors that are needed to support decision making, using the best proven, evidence-based methods available. From a practical perspective, they also need to reflect factors that can be reliably and consistently measured, rather than factors that are believed to be important, but where the technology to measure the factors is not readily available, or where there is no agreed-upon best-practice approach for measuring or calculating values.

Effective, evidence-based decision-making relies on the ability to evaluate data that is accurate and reliable. For example, when measuring and reporting on emissions levels, water use, or waste production of an organization or jurisdiction, it is essential that estimates be based on measurements and estimates that are as accurate and consistent as possible.

The climate and ecosystems being measured are complex and dynamic, and more is being learned on an ongoing basis. It is, therefore, important that metrics be flexible and adaptable to changes as new measurement methodologies emerge. For example, for years, a focus for climate-oriented metrics was on measuring carbon dioxide (CO_2) emissions, but current best practice suggests that GHGs should be measured using an enhanced GHG protocol that disaggregates measurement of relevant gasses such as methane, nitrous oxide, and CO_2, and considers their dynamic interplay.

In order for metrics to be practical, it is essential that they be defined in such a way that the necessary measurement information can be observed and collected. It does no good to define a metric if there is no reliable way to determine its value. For example, standard setters and regulators such as the United States Securities and Exchange Commission (US SEC) and the International Sustainability Standards Board (ISSB) started implementing requirements for corporations to disclose their Scope 3 emissions. While significant concerns have been raised by some stakeholders because of the challenges of accurately measuring Scope 3 emissions, improved methodologies, technologies and policies around these issues are bringing changes to address these needs[8].

Accurate, reliable, and consistent measurement and monitoring will be made more practical by employing technology and keeping up with enhancements made available by innovation. Depending on the specific application, this might include:

- Machine Learning and Artificial Intelligence technologies for data collection, interpretation, scenario modeling, prediction, and analysis (including the concept of a "digital twin[9]");
- immersive technologies such as virtual reality (VR) and augmented reality (AR) that facilitate simulations that allow for estimates to be determined for metrics in uncertain situations;

[8] One idea on improving Scope three emissions reporting can be found in the concept of "e-liability" reporting as espoused by Robert S. Kaplan and Karthik Ramanna in, *Accounting for Climate Change* (Harvard Business Review, 2021) utilizing traditional auditing methodologies to better balance accountability in overall supply chain reporting.

[9] Digital Twin: a concept providing digital or virtual copies of specific portions of the earth to model potential climate, weather or ecosystem scenarios based on satellite or other aggregated data.

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- data analysis and storage using computing power centers and programs (e.g., cloud computing platforms and API providers); and

- blockchain and decentralized systems for data provenance that support reliability.

Evaluating metrics is made more relevant by benchmarking results against those of comparable projects, organizations, or jurisdictions. For example, investors and lenders are interested in current sustainability results and future potential of corporations, and benchmarking against other similar companies helps with decision-making. More broadly, organizations gain valuable insights as to their comparative progress by benchmarking against similar organizations. This requires reliable data for benchmarking to be publicly available.

Depending on the context, necessary measurement data for benchmarking can be derived from:

- Socioeconomic models [e.g., gross domestic product (GDP), Genuine Progress Indicator (GPI), the Human Development Index (HDI); and the UN Sustainable Development Goals (SDG) Index];

- Earth observation technologies for data acquisition [e.g., National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Institute for European Energy and Climate Policy (IPCC)]; and

- "Opt-in" data portals (for example, see "CDP Open Data Portals" in the Tools and Dashboards resources below), with suitable anonymization to protect sensitive information.

Benchmarking results against data repositories does come with a caveat: it is important to recognize that data gets outdated quickly in some contexts and that it often does not transfer from one context to another. This is especially important when training AI (in addition to the general awareness of the impact of potential data bias).

Recommendations

Climate and nature-based Metrics need to be chosen that are science-based[10], objectively measurable, practical, and reliable. To achieve this:

- When choosing metrics and indicators, consider the challenges and limitations of data collection/measurement issues and choose metrics that are practical to measure and interpret to support their consistent application (within and between organizations and over time) in order to more objectively gauge changes and facilitate progress.

- Take advantage of technological innovation to measure, analyze and monitor progress, while being mindful of the limitations of the technologies used.

[10] The Science Based Targets Network is an established and respected organization that provides metrics along these lines providing "a collaboration of leading global non-profits and mission driven organizations working together to equip companies as well as cities with the guidance to set science-based targets for all of Earth's systems. This will help them define a clear pathway to ensure they are doing enough across their value chain to address their impacts and dependencies on nature."

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- Stay alert to new measurement approaches, recognizing that systems and countries are complex, adaptive, and interdependent with significant uncertainty and the potential for unintended consequences (both negative and positive).

- Recognize that metrics ultimately need to be adequately documented such that they can be independently verified (both for internal confidence and to meet regulatory requirements).

- Benchmark results against trusted data, both internally (to track progress) and externally (to compare results against competitors, best practice results),

- Implement data collection and measurement methods that enable efficiency by allowing data to be collected once and used in multiple ways or formats to meet reporting requirements (subject to privacy legislation).

- public health programs [e.g., the World Health Organization (WHO), WHO Collaborating Centers, the Centers for Disease Control and Prevention (CDC), and TEPHINET[11].

Technological Insights and Recommendations

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Further resources

1. Clutton-Brock, Peter, David Rolnick, Priya L. Donti, Lynn H. Kaack, Nicolas Miailhe, Raja Chatila, Marta Kwiatkowska, et al. *Climate Change & AI: Recommendations for Government Action*. Climate Change AI, Centre for AI & Climate, and the Global Partnership for Artificial Intelligence (GPAI), 2021.

2. Coalition for Digital Environmental Sustainability (CODES). *Action Plan for a Sustainable Planet in the Digital Age*.2022.

3. Levidow, Les, and Sujatha Raman. "Sociotechnical Imaginaries of Low-Carbon Waste-Energy Futures: UK Techno-Market Fixes Displacing Public Accountability." *Social Studies of Science* 50, no. 4 (Feb. 2020).

4. Sovacool, Benjamin, Noam Bergman, Debbie Hopkins, Kirsten E. H. Jenkins, Sabine Hielscher, Andreas Goldthau, and Brent Brossmann, "Imagining Sustainable Energy and Mobility Transitions: Valence, Temporality, and Radicalism in 38 Visions of a Low-Carbon Future," *Social Studies of Science* 50, no. 4 (May 2020).

[11] Training Programs in Epidemiology and Public Health Intervention Networks (TEPHINET), https://www.tephinet.org/.

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Issue: Need for interconnectedness and trade-offs

Background

Change will require new mindsets and deep engagement of all levels of society, industry, and communities in a systematic way that reflects the interconnectedness of all life and various, often distant, elements on Earth, which must cooperate and combine their efforts to meet these challenges and enable continuous improvement and progress toward real-world aspirations for achieving net-positive results.

A shift in mindset is needed toward a more holistic, nonlinear 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. This shift should be supported by a focus on core values that restore dignity and respect for *all life* so that humans can be proud of humanity. Change will require deep engagement at all levels of society, industry, and communities to meet the transformational challenges humanity faces in the coming decade. Monitoring and controlling changes probably will require the capacity to shift among metrics and measurements in various settings as changes unfold, resulting in managing decision trade-offs. The benefit of one decision and focus on a few metrics may in the long-term lean to an imbalance in the system, affecting another metric which may be yet to be identified. The ability to understand the interdependencies and trade-offs can be fostered through physical reminders and simulations.

Recommendations

A fundamental change in mindset is required in order to let nature work, to reestablish its self-healing capacity. Aside from—and beyond—the prevention of new harms and destructions, the human players should monitor and, if necessary, support the (sets of) natural processes that are providing feedback and that can contribute to reestablishing the balanced operation of (particular) ecosystems and their interplay.

- By experiencing interdependence in practice, we recognize ourselves, our teams, and our societies as interacting parts, active components of the various interplaying ecosystems. It is important to overcome the destructive perception of being capable of dominating and freely reshaping nature. Instead, we must accept that humans, countries, and their organizations are part of nature, and we must relearn to live in harmony in order to improve our quality of life. Such a fundamental shift in human perception is intertwined, fed back with profound alterations in types and compositions of the various metrics and indicators to be used. The metrics may need to be balanced across the planet, suggesting interdependencies in countries, geographies, and industries. Thus, metrics can help us identify the changes that we need to make and measure the changes and the shifts. Embedding such new perspectives in education, from preschool to universities, will play a crucial role in achieving the desired mindset change and in building awareness and lifelong learning opportunities.

- The ability to simply focus on the physical reality that is relevant to communities is important. This will help local communities measure the effectiveness of various tools to educate and encourage more socially conscientious behavior by harnessing the power of the individual. For example, Copenhagen's waste system is an architectural wonder that sits visibly in the middle of the city. What impact has this had on the awareness of the public and their behavioral choices? Metrics need to be able to measure success in these areas, that is, measure and monitor what is resonating with people to support different methods of using tech and education (high and low tech) to change behaviors by improving self-image, self-awareness, and so forth. At the same time, however, we need to recognize that measuring and

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predicting the outcomes that will result from policy changes is inherently very difficult, given the complexity of the systems and because of the added complexity that results from *human behaviors*, which human models do not fully capture.

- There is merit in evaluating new technologies to simulate various realistic scenarios. These technologies will allow the user to understand factors that can change future economies: geography, politics, ecology, biodiversity, and human impact. Through these simulations, the individual will gain an understanding of their own role in the ecosystem and what they can personally do to contribute to the wellness of the planet.

- One example of such a technology is the use of met averse concepts (extended reality simulations of both augmented and virtual reality), where real-time tracking and alternative future scenarios can be created. These overly personalized immersive experiences at various levels of society might enable individuals and collectives to review and assess their own and others' contributions to the ecosystems of the planet, as well as enabling the understanding of how they can contribute to the future wellness of the earth. Further, the simulations can also help test and validate theoretical models and the appropriateness of specific metrics that have been chosen in a given context. Care will be needed, of course, to avoid unintended consequences by carefully assessing the psychological and physiological impacts of these immersive technologies. And with any simulation, diligence will be required to see if the metrics are sufficient, the data relevant, and the models performing as anticipated under dynamic conditions.

- Personalization (such as a visualization of the green and sustainable transformation of an individual's own neighborhood) will educate and provide awareness of the pathways and agency of each participant to create meaningful change in the world and will contribute to the change of current worldviews and the mindset in some societies that tends to favor the individual at the expense of the collective good. Such personalization can capitalize on improved collective capacity of modeling and simulating diverse scenarios and (sets of) impacts of changes. For example, the simple act of advising you of your carbon footprint when booking a flight may change consumer behavior and indirectly affect industry choices.

- Transition design methods and tools will include alternative scenarios played out through computer simulations linked to interdependent multiple variables that combine as interlinked systems with other variables that individuals can manipulate to create realistic simulations of outcomes by changing and controlling these variables. Variables as input will be not just based on historical or current data but include qualitative variables, particularly relevant for creating long-term images of the future. For instance, variables and systems analysis may be simulated, for example, on the basis of the original "Limits to Growth" study by the Club of Rome in 1972, and subsequently updated since then. This computer simulation of planetary boundaries showed that the planetary system cannot support current rates of economic and population growth indefinitely and that this limit can be projected and defined and is dependent on specific resource factors such as agricultural production, population increase, hydrocarbon energy depletion, pollution, and industrial outputs, which are extrapolated into the future.

- Computer (serious) gaming simulations will be another method for creating visual scenarios of the future, creating opportunities for participants to not only view and change variables but to actually experience each of the projected images of the future. These methods will be critical for creating visceral and fundamental change of mindsets and worldviews, particularly among those with significant power to make fundamental changes in society.

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- Similarly, at a stakeholder level, impact assessment tools that incorporate simulation methodologies will allow organizational decision makers to better predict and evaluate the impacts (positive and negative) of their strategic and operational plans. If these tools are reliable, they will help to shift the mindset and priorities of senior leadership and government functionaries, by presenting consequences in a manner that is more certain and less deniable.

- All technologies used for scenario simulations and design must be governed for ethical use and application through strong ethical frameworks and standards, such as the Organisation for Economic Co-operation and Development's (OECD) AI Principles, the upcoming European Union AI Act, and those under development by the IEEE Standards Association.

- The technology requirements include tools that assist with training; behavior outcomes are from the individual (e.g., coaching) to the community to the organizational stakeholder's level and are integrable, comparable, and adaptable based on environmental contexts and circumstances as well as educational (empathetic) contexts across cultures, circumstances, and ecosystems. AI and immersive reality technologies are not as sustainable as we would wish them to be, hence the trade-offs are important.

Technological Insights and Recommendations

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Issue: Global ecological and environmental interdependence

Background

In an era when individualism favors instant perceived gratification, joining together around the globe to reach net-zero and net-positive goals provides an essential opportunity to restore dignity and respect for all life.

The recognition and acceptance of our global interdependence with nature ensures that humans will approach the planet with the aim of being in harmony with it rather than trying to dominate it. Respecting life and accepting that every living thing has intrinsic value that should be respected enables humans to seek stewardship rather than domination of nature—using it solely as a tool and resource to further our own pursuits. By seeing ourselves as dependent—but active—parts of nature, we can approach harmonic relationships with the world around us. But this perspective requires overcoming the still mostly dominant, mistaken, destructive—and *self*-destructive—utilitarian perception of seeing humanity as an independent ruler that exists at a remove and freely exploits nature.

Humans are not the only species that inhabits planet Earth, but we are the species that has evolved toward an illusion of domination of the planet and control of its destiny. The responsibilities that result from acceptance of this view have not been adequately considered. The journey of the human race has been one filled with innovation, from learning how to fashion tools and making fire to inventing the wheel, the industrial revolution, and various traveling machines as well as the first computer, the world wide web, and—forthcoming—quantum computing. Until the past 200 years, at no stage did much thought appear to be given to the consequences of our actions on the planet that has greatly benefited past and current generations; instead, humans failed to consider the impact on the generations that will follow. Thankfully, this failure has at least been recognized in the UN's definition of *sustainable development*:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[12]

However, this definition appears to only recognize the human perspective of future generations and should be widened to better reflect biodiversity and the future sustainability of all life on this planet. This would increase alignment with the specific sustainable development goals, which do reflect broader life forms, albeit to a lesser degree. A simplistic example of the domination of the human interest is depicted when a plane is hit by a bird strike. No thought is ever given to the birds destroyed by the plane's engines. Humans were not given wings or wheels, but their ingenuity in enhancing their lifestyle has resulted in threats to other species that inhabit this planet, as can be seen by the amount of wildlife accidentally killed by vehicles on the roads and marine life sickened by industrial waste.

In accepting that interdependence together with a non-zero-sum approach should have institutional primacy, it is important to recognize also the intrinsic value of every—and any—living being. However, the current attempts to use "financialization" and the price signal to set a market value for other species are pointing us in the wrong direction, strengthening a utilitarian, exploitative, and dominance-seeking approach.

[12]Parliament of Canada, Statutes of Canada 2019, Chapter 28, "An Act to enact the Impact Assessment Act and the Canadian Energy Regulator Act, to amend the Navigation Protection Act and to make consequential amendments to other Acts."

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Therefore, there is a need for the human race to recognize and address the risks faced by other species. Some humans have already adopted this mindset as they seek to ensure that endangered species are preserved. This can only happen if more humans take personal responsibility for our actions. This starts with the leaders of the world. The world cannot tolerate the risk of a war that could result in an almost uninhabitable planet on which very few species would survive. This is not a political issue, but the extent to which power is in the hands of just a few individuals is of great concern, as there are no appropriate safeguards to mitigate that risk.

There is also a real risk that the future of the planet will not be determined by the many but by the few who currently dominate the technological powerhouses that, in some ways, govern our lives. There must be a world in which its resources are more equitably shared to allow many more to enjoy a better life. There also needs to be proper accountability, where individuals are held to account for their actions.

There is also the need to consider the future implications of Artificial General Intelligence (AGI) if and when that will be reached. A future with AI raises questions and concerns: Will there be a need to respect the rights of the AI robots or other AI "species"? Is such a circumstance a possibility? To what extent are these concerns relevant for the development of a sustainable future? What metrics and indicators should be monitored to ensure that human influence in global evolution continues to be constructive?

While these debates must be held, in the interim, technology will assist us in helping the planet by:

1. Helping ensure that to appropriately mitigate risks of global warming as described in this chapter. Doing so will not only benefit the human race but all other living things on this planet.

2. Providing better data on the location of endangered species, thereby assisting in their protection (e.g., the use of infrared sensor technology with AI has assisted in monitoring the location and population of koala bears in Australia, where many have been killed by the recent increase in bushfires).

3. Breaking down language barriers with more effective real-time translation.

4. Providing a better understanding of the thought and communication processes of other life forms to build broader empathy.

5. Assisting in true value assessments, calculations, and feedback loops of the things that are essential for life on this planet.

6. Assisting in more accurately predicting incoming asteroids and other space debris that could cause serious damage to Earth and facilitating means by which we can divert the trajectory of such threats, in the interest of all living things on this planet.

Recommendations

- **Resolve the "hierarchy of rights" of species on planet Earth per country.**
  Genuine changes require overcoming attempts of financialization in order to reflect the (true market) "value" of life, living beings, and nature as we know it. There is a need to properly consider how the broader ecosystem can be prioritized over the desire for exponential growth. This is a key matter to be resolved, as if we do not have air and water, humans will not have a planet to inhabit. These will be complex matters to reach agreement on, but only by addressing these issues can we create the appropriate legal foundations to better ensure the sustainable development of the human race and all

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other life-forms on this planet. Regulation can be a slow process and can take time to change minds, but one must remember the ultimate success of laws that have undoubtedly changed human attitudes and behaviors, for example, bans on smoking in public places.

- **Metrics and indicators must align with the new work to properly reflect true cost and value**
  The acceptance of the legal personhood of rivers (New Zealand) and other ecosystems provides examples of the way ahead for accepting and respecting the intrinsic value of nature. This approach leads to a paradigm shift that feeds back with overarching transformations in our system of metrics and indicators. These should reflect and contribute to a robust transformation at the institutional level, including our fundamental socio-cultural values serving as drivers of our socioeconomic activities. Because robust economic transformations also affect accountancy, other related changes must take place. As well as establishing the true cost of using natural resources, we must also determine their true value.

- **Holistic assessments of consequences of human actions**
  As we move towards a net-positive future, we must also guard against unintended consequences that improve one factor from a human perspective but harm another element. For example, green energy sources such as water turbines and windmills can significantly threaten fish and birds. Short-term human well-being cannot come at the cost of indiscriminate further harm to other life-forms and natural systems. This mandate must be built not only into human decision-making but also into intelligent systems that we develop to aid sustainability, particularly before they are given autonomy over their actions. Moreover, we need to ensure that we simultaneously prioritize reversing past harms, where possible, through regenerative efforts.

The journey has begun but much more has to be done to enable this vision to become a reality. As Earth continues its journey hurtling around the sun at an average speed of 30 km/s, the clock is ticking and there is much to be done, but the connected ingenuity of the human race, augmented by an ethically deployed AI, can make us all proud to be human again.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

Further resources

1. A Call to Action in Response to the Nature Crisis. Global Accounting Alliance.
2. Barkham, Patrick. “Should Rivers Have the Same Rights As People?.” The Guardian, 25 July 2021.
3. Bennett-Jones, Owen. “Should Animals Have the Same Rights as Humans?” BBC News, 26 May 2015.
4. Wikipedia, s. v. “Animal Rights.” Last modified 17 Apr. 2023.

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Issue: Lack of socioeconomic transformation toward sustainability

Background

We need to build broader accountability for strong sustainability by design and develop a clear understanding of the true impacts of phenomena similar to environmental, social, and corporate governance (ESG) that, if well deployed and governed, can potentially facilitate and contribute to genuine regenerative socioeconomic transformations.

Effectively tackling the multiplying challenges of the climate crisis requires through profound and robust socioeconomic transformations decreasing global material and energy flows, while exceeding neither environmental nor social limits as described, for example, in the doughnut model (Raworth, 2018). Targeted robust and transformative systemic level changes can provide powerful and even game-changing contributions to the necessary transformations. To have real benefit, however, changes need to achieve buy-in and leverage the power of key players, such as the 'Carbon Majors' that are currently the source of more than 72% of the global GHG emissions.[13]

The likelihood of genuinely transformational alterations can be significantly enhanced by building on business models that enable preservation of the planet and improve outcomes through truly sustainable and also regenerative activities. Such business models must enable the owners and operators to reallocate stranded assets, frequently overcoming trillions in US dollars in market value, through truly regenerative activities.

The pathway to transformation requires the definition of goals that will serve to measure results, and indicators that measure progress towards these goals. The ability to communicate these results in new and meaningful ways provides transparency and new accountability.

There is a growing awareness and popularity of ESG-related financial activities, products, (hedge) funds, advisors, ratings, and other related investment services that are important users of sustainability-related metrics and indicators along with the underlying complex models and simulations. However, there is still some confusion and lack of consistency about what the ratings are actually measuring. The investment funds often focus on the investors' risks by gauging how well an organization is addressing climate risks from the perspective of *organizational* sustainability (how likely the company is to survive or thrive[14]). These pay less attention to whether the company is positively or negatively impacting environmental and social ecosystems. For example, MSCI's ESG ratings "aim to measure a company's management of financially relevant ESG risks and opportunities" using "a rules-based methodology to identify industry leaders and laggards according to their exposure to ESG risks and how well they manage those risks relative to peers."[15] While this is valuable information for investors, it doesn't answer the larger questions of overall impact of the company and their commitment to ESG innovation and progress.

[13] "Carbon Majors," Climate Accountability Institute, https://climateaccountability.org/carbonmajors.html.

[14] What is often termed as single materiality versus double materiality as outlined here.

[15] See "ESG Ratings" on the MSCI website at https://www.msci.com/our-solutions/esg-investing/esg-ratings.

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Use and explanation of the proper metrics, measurements, and indicators are needed to enhance awareness as well as to catalyze targeted education and knowledge dissemination among decision makers, including members of corporate governance bodies and other market and public sector players.

The reporting of quality metrics is an essential element in holding organizations accountable for setting and meeting meaningful goals and complying with regulatory requirements. Under the Sarbanes-Oxley Act in the United States, for example, chief executive officers (CEOs) and chief financial officers (CFOs) of public companies are required to personally certify the accuracy and completeness of annual and quarterly reports and the adequacy of internal controls with respect to these disclosures. As requirements evolve to include disclosure of sustainability metrics, similar certification exigencies should be mandated for the responsible C-suite positions to ensure that key decision makers are publicly accountable for the information released by their organizations. In addition, organizations should be encouraged to make the CEO directly responsible for sustainability. For example, IKEA has combined the CEO and chief sustainability officer (CSO) positions at the country level (so country-level CEOs also hold the CSO title). Moreover, the personal *remuneration* (salary and benefits) of persons in C-suite positions and individuals active on boards and governing bodies should also be connected with the environmental performance and footprint reduction of the organization(s) for which they are responsible. In the interim, voluntary certification should also be encouraged.

Recommendations

In order to effectively reduce the global material and energy flows, it is of paramount importance to systematically build and strengthen transparency, especially for corporate accountability. The enhanced transparency can establish trust in reported impact and commitment to goals and promote the effectiveness of actions being taken primarily by the economic players.

- Without effectively monitoring their genuine impacts, the large investments often described as sustainability-driven and sustainability-focused constructions can become major facilitators of destructive green washing.

- To effectively encourage innovation and net-positive performance (Polman & Winston, 2021), this accountability should be reflected in monetary and nonmonetary rewards for an organization's leadership team and employees at all levels to encourage and reward expected behaviors. The board of directors can further build accountability for executives in making commitments and taking actions to achieve sustainability by incorporating the relevant performance metrics into the measures shaping their *remuneration*.

- A proper set of metrics and measurements is required that effectively gauges the firms' GHG emissions and carbon footprint while measuring the effect of the transformational business models and such innovative financial tools as ESG. It is of crucial importance to provide visibility for company achievements that simultaneously facilitate enhanced regenerative and financial/profit outcomes while successfully implementing innovative business models.

- By creating community ratings or other effective sustainability indexes on ESG and performance, all stakeholders—individuals, organizations, corporations, various local peers—could receive feedback and, through transparency, the firms can be benchmarked against other stakeholders and held accountable in their community for their results. Such transparency can promote the culture of sustainability and quality-of-life-focused public policies in communities and countries by sharing knowledge and following

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circular economic patterns while using locally available natural resources in networks of green communities, smart cities, and other initiatives building and capitalizing on regenerative efforts.

- Individuals and their self-organized teams also can use their purchasing power: buying goods and services from responsible organizations and selecting net-positive products and services by using information from reliable sources such as validated consumer labeling.

- Convergence among the relevant metrics and standards can facilitate enhanced awareness and transparency. These, in turn, can contribute to a broadening cultural transformation that reflects and puts into daily socioeconomic practice a robust shift that promotes the genuinely regenerative paradigm (Robinson & Cole, 2015) enabling management of the multifaceted challenges of the climate crisis.

- A broadly accepted set of relevant metrics and standards can facilitate elaborative models, carrying out simulations similar to EN-Roads (n. d.) and making their findings broadly accessible and personally engaging through visualization by using tools such as dashboards, gamification, AR tools, the metaverse, and so forth.

- The growing popular awareness can contribute to an emerging culture of care and stewardship and, in turn, catalyze both quality-of-life-focused new patterns of (mass) consumption favoring sufficiency and regenerative initiatives of economic players. This interplay can facilitate and capitalize on the emergence of positive feedback loops. An important feature of the dynamic (e.g., rolling) sets of metrics and standards serving effective accountability should be their capacity to facilitate due transformations. These should enable making visible, measurable, and controllable the aggregation of the feedback from changes contributing to these overarching transformations.

- The technology requirements include tools that quantify and define engineering systems and infrastructure to consumption and environmental output levels across demographic, cultural, sustainability, educational, and socioeconomic (e.g., accountability) factors.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

Further resources

1. Climate Accountability Institute. “Carbon Majors Project.”

2. Climate Interactive. The EN-ROADS Climate Solutions Simulator (online resource).

3. Polman, Paul, and Andrew Winston. Net Positive How Courageous Companies Thrive by Giving More Than They Take. Harvard Business Review Press, 2021.

4. Raworth, Kate. Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist. Chelsea Green, 2018.

5. Robinson, John, and Raymond J. Cole. “Sustainability.” Building Research and Information 43, no. 2 (Mar. 2015).

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Issue: Technology not always aiding our socioeconomic evolution towards a regenerative and sustainable path

Background

Achieving meaningful change will require moving beyond mere compliance to a higher level of planetary progress and innovation. To reach this, a new green economy and sustainable alternatives must be inherently attractive at an individual and institutional level, rather than being seen as a cost of doing business.

Different issues in this chapter describe the necessary shift in mindset that is required of all individuals, communities, and organizations in order to realize the necessity of making significant changes in behaviors and operations and embracing a set of values that puts the planet first. The more that sustainability and the acceptance of interdependence become core values, rather than just part of a compliance exercise, the greater the ability for everyday economic activities to also become regenerative. In other words, as societies shift to recognizing the inherent benefits of sustainable living as the norm, our normal economic activities will not only fulfill genuine human needs but will simultaneously enable and contribute to the recovery from previously caused social harms and environmental destruction.

Well-designed regulatory environments connected with target-oriented public funding and grants (see Mazzucato 2015, 2018) on mission-oriented public innovation management can provide a favorable framework for providing an attractive and catalytic environment for progress. Well-orchestrated public facilitation of target-oriented projects can accelerate change to achieve profitability through truly regenerative business models and economic activities. Remunerating efforts that contribute to restoring previously generated damages can effectively motivate and incentivize the transformations. Focused public financing for genuine moon-shot projects (i.e., innovative projects with ambitious and lofty goals, requiring intense collaborative efforts) carried out on Earth can bring about significant multiplicative effects during the process of securing funding. As an example, carbon removal research is uncertain, more expensive than planting trees, and doesn't hit company metrics on the typical dashboard, so it is currently underfunded. Recognizing both a need and an opportunity, Frontier Climate, a market maker to fund uncertain projects, is facilitating funding through an advance market commitment to buy an initial $925 million of permanent carbon removal between 2022 and 2030.

The support of the co-creation and operation of the modeling and simulation capacities for the potential contributors of such collective efforts can accelerate the preparation and catalyze the implementation of such efforts having robust transformational impact. Moreover, they serve to build community and reset individual and collective expectations of what is possible and worth pursuing. Such positive impacts can help the public realize that transformations facilitating deep sustainability are fundamentally working in their favor, instead of limiting or prohibiting individual life choices. The resulting demand-side changes can provide simultaneously significant contributions to trigger and catalyze robust attractive trends on which both market and public players can capitalize.

An economy aiming to improve harmony with nature will demand significant alterations in metrics and measurements to be used as drivers and monitoring tools of individual and corporate decision-making and of the daily operations of organizations in all sectors. These metrics and measurements presuppose and contribute to regular enactment of state-of-the-art technology sets including AI, ML, and big data. Similar

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technologies provide capacity for both daily monitoring and modeling/simulation of the potential ecosystem-level impacts stemming from the expected operational patterns. However, qualitative and/or low-technology information collections for measurements and indicators should be used to include aspects of the environment, communities, and societies that are not amenable to real-time, periodic, or historical data collection, particularly where access to remote locations, communications, or the internet is unavailable, fragmented, or unreliable or where a greater harm may result within the society due to high-technology presence or intervention. It is important to think holistically and systematically about how to collect information about the entirety of planetary health and experience. Therefore, alternative methods should be used and integrated with the state-of-the-art technology and associated data sets and analysis mentioned previously, and the outcome of the data processing must be freely available and consciously shared with affected stakeholders.

Deploying such capacity will facilitate the development and implementation of regulatory steps and business strategies that simultaneously drive and utilize the aggregation of local changes into the global transformations required to handle the growing challenges of climate change.

Dashboards are an effective tool for presentation. For example, the dashboard developed with regard to IEEE Std 7010™-2020 indicates links between human well-being and the impact of autonomous and intelligent systems. Developing a similarly styled dashboard to indicate impact on GHG emissions can provide another practical example of increasing—or the ability to trace—the potential impacts of demand-side changes on decreasing environmental footprints and improving life quality. The mass uptake of demand patterns' alterations can capitalize on target-oriented enhancement of awareness and engagement providing genuine empowerment and readiness to contribute to solutions. Similar organization of massive voluntary contributions can be facilitated in multiple ways, including using serious gaming. Such efforts can combine the deployment of freely available interactive tools similar to En-ROADS and C-ROADS developed in frame of the MIT Sloan Sustainability Initiative[16] with methods similar to backcasting (pathfinding to nontrivial solutions by "walking back" from normative long term positive visions) and role-playing (e.g., representing participants of the Paris climate conference and/or COP events).

Sufficient and effective governance, security, data provenance, and privacy must be provided and maintained around all information collected for the purpose of planetary measurements and indicators. It is important to ensure that data provenance and ownership resides within the same society that the data collected represents and that planetary monitoring does not become a surveillance society, as this would create additional harms to the planet and may be misused against the individuals within the society.

Recommendations

Transforming the enactment of engineering technologies into drivers of a regenerative economy requires their conscious combination with social technologies (at multiple levels).

- Maintaining and expanding regulations prevent further environmental (and social), per country, harms are of paramount importance. However, tools capable of providing an improved profitability for regenerative efforts can become even more effective drivers of due changes at a systemic level,

[16] Climate Interactive, https://www.climateinteractive.org.

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subsidized and incentivized by national governmental bodies that may lead to commercial companies and new green markets.

- The fragmented grants and subsidies (frequently triggered by powerful lobbies) often disperse available resources without incentivizing necessary (and overdue) transformations. The availability of proper, effective metrics and measurements and publicly available capacities for truly data-driven decision-making can be of crucial importance to effect required changes.

- Visualization tools, similar to dashboards from the International Monetary Fund (IMF), the Massachusetts Institute of Technology (MIT), and so forth, will be used to broaden awareness and facilitate alterations in consumer demand (e.g., IEEE Std 7010™-2020).

- Real-time data collection and analysis, which are quantifiable and reproducible, will be integrated where appropriate with low-technology and qualitative methods to provide a holistic picture of planetary health in both technology-heavy and non-technology environments.

- Appropriate and relevant governance around the use of data collection will be undertaken to ensure individual and societal privacy, ownership, and provenance is established and maintained, according to international standards bodies such as the IEEE Standards Association, the European Union's General Data Protection Regulation, and so forth.

- The technology requirements suggest tools that quantify and enable discovery, innovation, simulation, and implementation of engineering systems and infrastructure to consumption and environmental output levels across demographic, cultural, sustainability, educational, and socioeconomic (e.g., accountability) factors.

- Regulatory decisions can reward and penalize market players (e.g., stakeholders, communities, and individuals) by matching access to and costs of financing and resources with efforts and policy to provide genuine contributions to prevent and address climate crisis related issues.

Technological Insights and Recommendations

This space is intentionally left blank to encourage technically oriented feedback for public Request for Input.

Further resources

1. European Union. "Complete Guide to GDPR Compliance." General Data Protection Regulation (GDPR.EU).[17]

2. Mazzucato, Mariana. *The Entrepreneurial State: Debunking Public vs. Private Sector Myths.* New York: Public Affairs, 2015.

[17]A robust set of privacy and security laws, put into effect on 25 May 2018, that imposes obligations onto organizations anywhere, so long as they target or collect data related to people in the EU. The regulation includes significant penalties for breach, reaching into large sums of funds.

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3. Mazzucato, Mariana. *Mission-Oriented Research & Innovation in the European Union: A Problem-Solving Approach to Fuel Innovation-Led Growth*. European Commission Directorate-General for Research and Innovation Publications Office, 2018.

4. Shearman & Sterling. "A Deeper Look at the Global Framework Principles for Decarbonizing Heavy Industry." *Perspectives.* 28 June 2022.[18]

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[18] This article discusses framework principles that include funding models that tie public financing for heavy industry to key measures aligned with corporate greenhouse gas emission reduction commitments and plans calibrated to a 1.5°C trajectory.

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Issue: Metrics must provide evidence of compliance with standards, laws, and regulations

Background

The world is moving toward increased standards and regulatory requirements that include performance (such as maximum allowable levels of emissions), reporting and disclosure (such as reporting climate risk impacts and mitigation plans for investors), and assurance (such as standards for sustainability audits) requirements. To be enforceable, such standards need to rely on quality metrics.[19]

The development of robust standards is only meaningful if they are widely implemented, and this requires that the necessary metrics and underlying data for compliance be available and reliable. Currently, much of what gets reported are estimates, and reliable data is lacking. Considerable effort will be needed to ensure that metrics and measurement methods keep pace with the standards under development, with a goal of harmonizing terminology, definitions, and metrics used to enhance consistency and understandability of reported results. This will require significant multidisciplinary collaboration among standard setters, those responsible for disclosures, and those responsible for measuring the factors and reported elements as well as auditors, rating organizations, consultants, and other market players.

Technology assists these standards by:

- enabling more accurate capture of the underlying data (including data on emissions) with finer spatial and temporal granularity that are ultimately reported via the requirements contained in the standards;
- facilitating more rigorous controls over the data once captured to help ensure its integrity (this will assist both preparers and assurers in helping to validate the integrity and completeness of the data); and
- facilitating greater trust in the source of products and raw materials, as well as the source and veracity of reported metrics, via the use of distributed ledger technology offering efficient data access and management in addition to immutability.

Digital tools can also support a system of sustainability badges/kitemarks certified by trusted entities, which can further motivate and incentivize individuals and organizations to strive for progress in sustainability initiatives. For example, digital systems could support:

- A sustainability rating system for companies and organizations that is similar to—and possibly combined with—credit ratings, which could ultimately integrate to better align corporate/organizational and planetary interests.
- Government/jurisdictional ratings that reflect environmental, social, and governance commitments and verified progress against those commitments. Such ratings could also recognize and give credit for supporting developing countries, marginalized communities, and so forth.

[19] See also the "Economics and Regulations" chapter for information on sustainability-related standards.

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Recommendations

In order for standards and regulations to serve as a consistent means of assessing performance and facilitating accountability, compliance with such standards must be evidenced by quality metrics. To achieve this:

- Metrics required by regulators and standard setters should be well-defined (for example, in terms of allowable measurement approaches, expected level of granularity, etc.), consistent, and objectively measurable.

- Standards need to reflect appropriate expectations for using technology to improve accuracy, reliability, and objectivity when measuring, monitoring, and reporting on elements. These expectations should be scalable and consider geographic (e.g., country) differences to reflect the realities of varying levels of technological maturity in different jurisdictions.

- Those enforcing standards should consider targeted benchmarking to help determine whether results are accurately presented. If, for example, every company in a particular jurisdiction is scoring poorly in a certain area but one company stands out as vastly better, is it doing something innovative and effective or is it greenwashing? Transparent data and effective traceability of the reported results can help determine this.

Technological Insights and Recommendations

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Further Resources

- International Sustainability Standards Board
- Task Force on Climate-related Financial Disclosures (TCFD)
- Statement on Proposed Mandatory Climate Risk Disclosures(U.S. Securities and Exchange Commission / SEC)

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Issue: The need for consistent, mandatory, and enforced standards

Background

Standards, laws, and regulations for measuring, reporting, and independently verifying sustainability-related performance are numerous, not entirely aligned, and voluntary. Voluntary reporting can lead to de facto requirements through societal expectations and pressure, but it can also lead to inconsistency and greenwashing, either intentionally or through error and imprecise estimates.

Over the years, there has been an ever-growing number of organizations developing standards and methodologies for measuring and reporting sustainability-related metrics. The recent heightened spotlight on sustainability allows great opportunities for collaboration and progress but runs the risk of duplicating efforts, jockeying for position between organizations, and propagating inconsistencies between patchwork systems.

Seemingly with this risk in mind, many standard setters in this space are purposefully looking to converge, collaborate, and build on each other's work and, in some cases, are providing tables of concordance to show how systems align and connect. This helps users consider where standards align and where to promote different approaches so that the merits and interoperability of approaches can be assessed in a particular context.

In order for standards to be widely implemented, the necessary metrics and underlying data for compliance must be available and reliable. Broad implementation also requires coordinated action from regulators, lawmakers, the judiciary, and law enforcement. The complexity within and between these different stakeholder institutions leads to challenges such as inconsistent development and interpretation of environmental protection and regeneration mandates between jurisdictions and within any given jurisdiction (i.e., between different branches of government). There is a risk that political pressures will get in the way of progress, which has been suggested with respect to the 2022 US Supreme Court decision to limit the powers of the US Environmental Protection Agency. Similarly, major global challenges resulting from conflicts and wars threaten the will and ability of countries to take bold action toward progress and result in backsliding instead. For example, in May 2022, the G7 energy ministers had agreed to stop taxpayer-funded fossil fuel financing overseas by the end of the year, but this commitment was loosened in June of 2022, in response to the energy shortages resulting from Russia's invasion of Ukraine.

Consistent standards are also needed to require the independent verification (auditing) of reported results. The uncertainty that comes from reporting estimates and the lack of consistent globally recognized reporting standards adds to the challenge in setting high-quality assurance standards. Furthermore, there is a need to ensure that those applying the standards and providing assurance on the information reported are professionally competent to do so. As a result, there is a need to ensure high-quality standards not only in reporting but in the provision of assurance as well. Such standards will encompass assurance, quality management, and ethics and independence.

Notwithstanding the need for consistent regulations and reporting requirements to be met by organizations and institutions, there are caveats that must also be considered:

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- Requirements for hitting certain benchmarks should be sensitive to the context, such as whether the entity or organization is large or small, developed or developing, well-resourced or poorly resourced, etc.

- Incentivizing change needs to involve both the "carrot" of providing benefits and the "stick" of regulatory enforcement in order to shift the momentum.

- Requirements should allow for reasonable tolerances, to avoid tying the hands of organizations or institutions that are legitimately trying to improve and meet net-zero or net-positive results.

These challenges are inherently complex and further illustrate the need for global leaders to prioritize sustainable development goals over personal ambitions, short-term perceived gains, and jurisdictional differences.

Recommendations

- Globally recognized standards are needed to attain net-positive goals. These standards are likely to be developed and promulgated by recognized international standards organizations, led by first-world countries, and can then be leveraged by local jurisdictional standard setters.

    - Standards for stakeholder reporting should not only reflect the information on how climate change and other sustainability factors are impacting the entity and how those risks are being managed and mitigated but also the impact the entity is having on the environment and social systems and so forth. The even closer alignment and potential merger of ISSB and GRI should provide the multistakeholder sustainability reporting framework that is needed, leading to significantly improved connectivity with financial statements.

    - The International Auditing and Assurance Standards Board (IAASB) is well-placed with its standards on quality management and assurance to ensure that assurance engagements will be conducted in accordance with high-quality standards.

    - In addition to reporting and assurance standards, requirements for ethical decision-making are essential to guide behavior. To this end:

        - Standards developed (and under development) by the IEEE Standards Association provide guidance on ethical design and development of products and systems including the application of technology.

        - The International Ethics Standards Board for Accountants (IESBA) International Code of Ethics for Professional Accountants (including International Independence Standards) provides the basis for high-quality standards of professional ethics and independence, applying to both reporting activities and assurance engagements. Additionally, the IESBA's ongoing work in the technology space will also help ensure that the specific ethics implications of professional accountants utilizing technology will be appropriately considered.

- Standards need to be robust enough to reflect the breadth of relevant activities undertaken by organizations, stakeholders, communities, and individuals. These standards should reflect a holistic multi stakeholder approach, recognizing the interdependence of global systems and cultures.

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- All countries—and especially G7/G20 countries—must implement meaningful, robust legislation and regulations to achieve their stated commitments. Reporting requirements agreed to under the Paris Agreement should be closely monitored and enforced.

- Standards will be enacted to require organizations to provide adequate information to consumers for them to make purchasing decisions with sustainability criteria in mind. For example, product labels will reflect the product's environmental, social, and/or governance impact so that consumers can evaluate cost and value more holistically and trace potential impacts of their purchasing decisions.

- Complying with (or exceeding the requirements of) standards must be adequately incentivized:
  - Executive and senior leadership remuneration packages will adequately reflect expectations for meeting suitable sustainability metrics.
  - Regulators and legislators will provide clear requirements for organizations, stakeholders, communities, and individuals with respect to standards and will ensure they are enforced. At the same time, however, there is a need to respect the realities within individual jurisdictions and be mindful of the need for flexibility and support for less resourced or less mature entities.
  - Governments will incentivize innovation to meet and exceed standards through tax policy, grants, and similar means.
  - Governments will adequately price GHG emissions with carbon, methane, and nitrous oxide priced based on their vastly different global warming potential (GWP).
  - Investors need to engage with corporations and promote the need for sustainability to be embedded and take action against those companies and their boards that do not place sufficient importance on this.

- As standards are developed, there is a need for developers to seek out and embrace opportunities to harmonize standards and adopt the best ideas from the range of standard setters. Collaboration must take precedence over competition. Wherever possible, common terminology should be used to avoid confusion. Consideration should be given to making requirements scalable in order to apply to organizations, communities, countries, and individuals of different size, maturity, resources, level of technology, context of operation, and so forth.

- During the period of uncertainty that will exist until the most appropriate standards become widely adopted, to allow for consistent interpretation by readers it is essential that reporting include sufficient detail regarding the underlying methodologies used. Such transparency will also promote the ability to apply an additive and iterative approach to achieve progress, regardless of which standards become more globally accepted. It will also be important to ensure a clear transition from interim systems of measurement to the final accepted standards, including methods to determine and present comparative figures for interim results that reflect the final measurement methodologies chosen (i.e., so that an "apples-to-apples" comparison can be made between results of different periods).

- Standard setters should ensure that they leverage technology to enhance the processes of collaboration and outreach during development to ensure appropriate due process and to maximize diverse participation and acceptance and, ultimately, adoption and implementation.

- Similarly, the agencies and organizations responsible for verifying, auditing, and certifying compliance with standards should employ appropriate digital methods to support and add reliability to their work, thereby building trust.

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Technological Insights and Recommendations

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Further Resources:

Evolving Standards Guidelines

Global Reporting Initiative (GRI)
https://www.globalreporting.org/

GRI is the independent, international organization that helps businesses and other organizations take responsibility for their impacts by providing them with the global common language to communicate those impacts. The organization provides the world's most widely used standards for sustainability reporting: the GRI Standards. The GRI Secretariat is headquartered in Amsterdam, the Netherlands, and has a network of seven regional offices to help ensure it can support organizations and stakeholders worldwide.

Greenhouse Gas (GHG) Protocol
https://ghgprotocol.org/

GHG Protocol establishes comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains, and mitigation actions.

Building on a 20-year partnership between World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), GHG Protocol works with stakeholders, industry associations, NGOs, businesses, and other organizations.

International Auditing and Assurance Standards Board (IAASB)
https://www.iaasb.org/

The IAASB is an independent standard-setting body that serves the public interest by setting high-quality international standards for auditing, quality control, review, other assurance, and related services and by facilitating the convergence of international and national standards. In doing so, the IAASB enhances the quality and uniformity of practice throughout the world and strengthens public confidence in the global auditing and assurance profession.

IEEE Standards and Publications

- Adamson, G., J. C. Havens, and R. Chatila. "Designing a Value-Driven Future for Ethical Autonomous and Intelligent Systems." *Proceedings of the IEEE* 107, no. 3 (Mar. 2019): 518–525.DOI: 10.1109/JPROC.2018.2884923.

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- "IEEE Draft Model Process for Addressing Ethical Concerns During System Design." IEEE P7000/D7 (20 April 2021): 1–83.

- Peters, D., K. Vold, D. Robinson, and R. A. Calvo. "Responsible AI—Two Frameworks for Ethical Design Practice." *IEEE Transactions on Technology and Society* 1, no. 1 (Mar. 2020): 34–47. DOI: 10.1109/TTS.2020.2974991.

- Schiff, D., A. Ayesh, L. Musikanski, and J. C. Havens. "IEEE 7010: A New Standard for Assessing the Well-being Implications of Artificial Intelligence." *2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC)* (2020): 2746–2753. DOI: 10.1109/SMC42975.2020.9283454.

- Schuelke-Leech, B., and M. Janczarski. "Incorporating Societal (Social) and Ethical Implications into the Design, Development, and Deployment of Technologies." *2019 IEEE International Symposium on Technology and Society (ISTAS)* (2019): 1–6. DOI: 10.1109/ISTAS48451.2019.8937964.

- Shahriari, K., and M. Shahriari. "IEEE Standard Review—Ethically Aligned Design: A Vision for Prioritizing Human Wellbeing with Artificial Intelligence and Autonomous Systems." *2017 IEEE Canada International Humanitarian Technology Conference (IHTC)* (2017): 197–201. DOI: 10.1109/IHTC.2017.8058187.

- Spiekermann, S. "From Value-Lists to Value-Based Engineering with IEEE 7000™." *2021 IEEE International Symposium on Technology and Society (ISTAS)* (2021): 1–6. DOI: 10.1109/ISTAS52410.2021.9629134.

International Ethics Standards Board for Accountants (IESBA)
https://www.ethicsboard.org/

The IESBA is an independent standard-setting board that develops, in the public interest, high-quality ethics standards and other pronouncements for professional accountants worldwide. This includes the International Code of Ethics for Professional Accountants (including International Independence Standards), which establishes ethics requirements for professional accountants. The board also supports adoption and implementation, promotes good ethical practices globally, and fosters international debate on ethics issues faced by accountants.

International Sustainability Standards Board (ISSB)
https://www.ifrs.org/groups/international-sustainability-standards-board/

International investors with global investment portfolios are increasingly calling for high-quality, transparent, reliable, and comparable reporting by companies on climate and other environmental, social, and governance (ESG) matters.

On November 3, 2021, the IFRS Foundation Trustees announced the creation of a new standard-setting board—the International Sustainability Standards Board (ISSB)—to help meet this demand.

The intention is for the ISSB to deliver a comprehensive global baseline of sustainability-related disclosure standards that provide investors and other capital market participants with information about companies' sustainability-related risks and opportunities to help them make informed decisions.

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The ISSB standards include a series of metrics (industry-based disclosure requirements) that cover a range of industries. These are substantively based on those of the Sustainability Accounting Standards Board (SASB), which has merged into the ISSB.

The industries covered are:

1. Consumer goods
   a. Apparel, accessories, and footwear
      1) Percentage (by weight) of raw materials third-party certified to an environmental and/or
      2) Social sustainability standard, by standard
      3) Number of tier one suppliers and suppliers beyond
2. Appliance Manufacturing
   1) Percentage of eligible products by revenue certified to an energy efficiency
   2) Certification
   3) Percentage of eligible products certified to an Association of Home Appliance Manufacturers (AHAM) sustainability standard
   4) Description of efforts to manage products' end-of-life impacts
   5) Annual production (number of units)
3. Extractives and mineral processing
   1) Building Products and Furnishings
      1. Total energy consumed
      2. Percentage grid electricity
      3. Percentage renewable
      4. Description of efforts to manage product
4. Lifecycle impacts and meet demand for sustainable products
5. Financials
6. Food and beverage
7. Health care
8. Infrastructure
9. Renewable resources and alternative energy
10. Resource transformation

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11. Services

12. Technology and communications

13. Transportation

Likewise, the GRI standards also contain various metrics.

Additional Resources:

International Federation of Accountants (IFAC)

https://www.ifac.org

IFAC is the global organization for the accountancy profession, comprising 180 member and associate organizations in 135 countries and jurisdictions, representing more than 3 million professional accountants.

See, for example, Championing an Integrated Mindset: Driving Sustainability and Value Creation in which IFAC calls on businesses to integrate financial and sustainability information with an integrated mindset to make better-informed decisions that deliver long-term value creation—financial returns to investors—while taking account of value to customers, employees, suppliers, and societal interests.

The Paris Agreement

https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 parties at COP 21 in Paris, France, on December 12, 2015, and entered into force on November 4, 2016.

Its goal is to limit global warming to well below 2 °C, preferably to 1.5 °C, compared to preindustrial levels.

To achieve this long-term temperature goal, countries aim to reach global peaking of GHGs as soon as possible to achieve a climate neutral world by midcentury.

The Paris Agreement is a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.

A profile or dashboard of indicators (measuring innovation and change) should include the basics, for example:

- Ten committed outcomes
- Ten levers of change
- Aligned performance targets, indicators, and milestones

Ongoing contributions from expert teams should be undertaken to calibrate (or recalibrate) the proper sets of metrics and indicators that fit with the specific circumstances and the required outputs and outcomes. These teams must follow an interdisciplinary approach and be ready to dynamically rearrange their own

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composition in order to fit the concrete circumstances and the evolution of tasks in the various phases of transformation.

The Kunming-Montreal Global Biodiversity Framework" (GBF) agreement
https://www.unep.org/news-and-stories/story/cop15-ends-landmark-biodiversity-agreement

Many are calling this Biodiversity Framework the "Paris Agreement for Nature." The following is information from the COP15 site:

The United Nations Biodiversity Conference (COP15) ended in Montreal, Canada, on 19 December 2022 with a landmark agreement to guide global action on nature through to 2030. Representatives from 188 governments have been gathered in Montreal for the past two weeks for the important summit.

Chaired by China and hosted by Canada, COP 15 resulted in the adoption of the Kunming-Montreal Global Biodiversity Framework (GBF) on the last day of negotiations. The GBF aims to address biodiversity loss, restore ecosystems and protect indigenous rights. The plan includes concrete measures to halt and reverse nature loss, including putting 30 percent of the planet and 30 percent of degraded ecosystems under protection by 2030. It also contains proposals to increase finance for developing countries – a major sticking point during talks.

The stakes could not be higher: the planet is experiencing a dangerous decline in nature as a result of human activity. It is experiencing its largest loss of life since the dinosaurs. One million plant and animal species are now threatened with extinction, many within decades.

The GBF consists of four overarching global goals to protect nature, including: halting human-induced extinction of threatened species and reducing the rate of extinction of all species tenfold by 2050; sustainable use and management of biodiversity to ensure that nature's contributions to people are valued, maintained and enhanced; fair sharing of the benefits from the utilization of genetic resources, and digital sequence information on genetic resources; and that adequate means of implementing the GBF be accessible to all Parties, particularly Least Developed Countries and Small Island Developing States.

The GBF also features 23 targets to achieve by 2030, including:

- Effective conservation and management of at least 30 percent of the world's land, coastal areas and oceans. Currently, 17 percent of land and *8 percent of marine areas are under protection
- Restoration of 30 percent of terrestrial and marine ecosystems
- Reduce to near zero the loss of areas of high biodiversity importance and high ecological integrity
- Halving global food waste
- Phasing out or reforming subsidies that harm biodiversity by at least $500 billion per year, while scaling up positive incentives for biodiversity conservation and sustainable use
- Mobilizing at least $200 billion per year from public and private sources for biodiversity-related funding

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- Raising international financial flows from developed to developing countries to at least US$ 30 billion per year

Requiring transnational companies and financial institutions to monitor, assess, and transparently disclose risks and impacts on biodiversity through their operations, portfolios, supply and value chains.

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