STRONG SUSTAINABILITY BY DESIGN, V.2
(PLANET POSITIVE 2030)

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Planet Positive 2030 Workshop at The Hague
September 19-20, 2022

Introduction

The following document is the second draft (called "Version Two") of a compendium called, ***Strong Sustainability by Design: Prioritizing ecosystem and human flourishing with technology-based solutions.*** The first draft of *Strong Sustainability by Design*, released as part of our Stanford University workshop, can be found here.

This compendium is the first deliverable from the committees that are part of Planet Positive 2030, an Initiative supported by The IEEE Standards Association (IEEE SA).

Draft Status / Evolution

The process for creating *Strong Sustainability by Design* (SSbD) follows the consensus-driven processes supported and championed by IEEE SA. Drafts of the following chapters were written by volunteers giving their time to provide content for participants at The Hague to consider and reflect on as a means to iterate the overall compendium/work.

It is with deep appreciation that we wish to thank these volunteers who began this process earlier this year, continued the process at our Workshop at Stanford and who will continue with this process leading to a public Request for Input (RFI) released with a Creative Commons license available by January, 2023. When Version Two is updated with feedback from the general public, *Strong Sustainability by Design* will be released back in a final version, 2023, to the general public in Q3 or Q4 of 2023.

Feedback / Technical Expertise

As a way to honor volunteers and to most effectively drive this work forward, we are asking for *actionable* feedback to these chapters. Actionable feedback will help evolve drafts of our chapters with clarity and expertise. As an example, when reading language in a certain "Issue," beyond saying, "that language is unclear to me" actionable feedback would include how to update the language, eg, "that language is unclear to me - I believe you're speaking about ESG metrics here in which case I would add something like, 'regarding the ESG metrics utilized for sustainability.'"

In terms of technical expertise, our first (prepared for the Stanfore workshop) and second (draft incorporating comments and contributions from the Stanford workshop prepared for the workshop at

The hague) drafts were designed to identify socio-technical and societal issues as well as technological ones in regards to sustainability including climate change challenges. It is our hope, that by identifying the more specific cultural, regional, societal and other contexts of the Issues and Recommendations included here, those with technical expertise will be able to more explicitly provide insights leading to more expedited and pragmatic approaches, solutions and recommendations to achieve"Planet Positive 2030".

Special Thanks

We wish to thank the many participants, contributors and supporters of the Planet Positive 2030 Initiative - Your commitment and contributions are amazing and deeply appreciated:

For making this event possible, deep gratitude to our partners and Sponsors:

- The IEEE Standards Association
- The IEEE Industry Engagement Committee
- TU Delft
- TU Delft Digital Ethics Centre
- The Stanford Institute for Human-Centered Artificial Intelligence *(Workshop One)*
- The Stanford Woods Institute for the Environment *(Workshop One)*

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We wish to extend a special thank you to our colleagues at Stanford University who helped organize our first event: Kaci Danae Peel, Vanessa Parli, Lea Rosenbohm. We also wish to thank the video crew, students, staff and other volunteers from The Stanford University community helping during our event.

Thank you to the IEEE volunteer and staff leadership and all the organizations and companies who are supporting their associates in their engagement with and contributions to Planet Positive 2030.

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Finally, in addition to Planet Positive 2030, which is a program supported by IEEE SA, there are various other large scale programs and initiatives within IEEE (both at IEEE Board and at organizational unit levels) with the goal to mobilize IEEE against climate change and its impacts, and in support of Sustainable Development. Thank you to all the volunteers and their contributions to Planet Positive 2030.

A great big 'Thank You' to you All!

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IEEE Past VP of Member and Geographic Activities
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Guiding Principles

It is 2030.

Greenhouse gas (GHG) emissions, as recorded in 2005, have been reduced by 50%, and the earth's lands and ecosystems are on the road to recovery – a recovery that will enable planetary-scale environmental regeneration and resilience.

The first step in reaching these goals came from a profound sense of urgency to avoid the looming climate catastrophe - acknowledging the *climate emergency* related to Earth moving closer to the climate tipping point - *the point of no return* - along with a reformed sense of leadership and planetary-scale governance informed by the notion of *deep care*—for the environment, for the earth's biospheres and for human dignity (ascribed to all people, including historically marginalized populations, equally). While addressing the urgent issues of greenhouse gas emissions reductions and dealing with adaptation to the impact of more intense severe weather patterns as well as other pressing issues, the need for caregiving and sustainability have become new guiding principles for decision-making, as the majority of global political and business leaders, many of whom represent groups marginalized in the past, have embraced the notions of justice, diversity, equity, and inclusion in shaping new policies, new economic and business models, new tools for measuring growth, and new standards of practice[1]. Sustainable behavior is now integral to cultures around the globe - for the individual as well as for organizations.

The shift in governance strategies has led to further infrastructure developments that enable humans to live sustainably and coexist with other species, accommodating human groups overlooked by past large-scale urban planning efforts, and balancing today's needs with the needs of future generations.

[1] (UN Business and Human Rights Guiding Principles contain three chapters, or pillars: protect, respect and remedy. Each defines concrete, actionable steps for governments and companies to meet their respective duties and responsibilities to prevent human rights abuses in company operations and provide remedies if such abuses occur. These Principles are valid for all kinds (and sizes) of businesses. https://www.ohchr.org/documents/publications/guidingprinciplesbusinesshr_en.pdf

Emerging technologies, in general, along with responsibly developed artificial intelligence (AI) systems allow humans to better negotiate between the needs of various stakeholders, which include the environment, and fully embrace the complexity of the issues at stake. Change is driven by an increased awareness of interconnectedness and interdependence among different types of entities, each of which forms a part of Earth's ecosystems.

Decisions are made considering the balance of both ethics to the environment and ethics to the dominant species. We, as humans, are sharing the planet's resources with a vast variety of other living creatures. As the dominant species, we have recognized that our actions affect other species to a degree exponentially greater than their impact upon us. Just as our technological acumen had disproportionately affected the planet's ability to sustain all species, that same technological prowess has now been utilized to undo our earlier ill-informed efforts. We have developed sustainable and regenerative replacement practices and recognized that we are caretakers of the planet in a way that other species cannot be. We have learned to operate under an ethic of caretaking.

Introduction

Recognizing that the goal of a long-term flourishing planet Earth may only be attained if the current warming trend of the Earth's atmosphere is first halted and then reversed, at least partially, to preindustrial levels, reduction of greenhouse gas emissions is paramount. While changing from fossil fuel-based economies to largely greenhouse gas emissions-free economies is the urgent agenda to address the looming climate crisis, it is important to observe a balance between the urgency of today's needs - hunger, lack of potable water, effects of severe weather, lack of equity, pollution, destruction of ecosystems to name a few - and the urgency of tomorrow's looming climate catastrophe. To this end, this chapter builds on United Nations declarations and values and defines principles to guide the decisions and the implementation of these decisions as individuals, companies, governments and organizations embark on the road to a flourishing planet.

Embracing complexity throughout the pursuit of this goal is vital. The increasing complexity of society and the environment means that the transition to a sustainable future is a complex or "wicked problem" (Rittel and Weber, 1973)[2]. Indeed, combating climate change may be the

[2] Rittel, H.W.J., Webber, M.M. Dilemmas in a general theory of planning. *Policy Sci* 4, 155–169 (1973). https://doi.org/10.1007/BF01405730

most wicked and complex problem humanity has ever faced. Honoring the large diversity in culture, in local, regional and global conditions and needs - the varying contexts around the globe - requires flexibility and a diversity of approaches to creating a planet positive society.

The very succinct definition of planetary sustainability by an unknown participant from Africa to the UN meeting in Johannesburg (Rio + 10) states "Enough for All - Forever" serves as a key guidepost.

The Foundation: Human Rights, Values and the Need for a Flourishing Planet

\The foundation for the Guiding Principles are the need for a flourishing planet to sustain all life. This foundation is built upon the 'United Nations (UN) Universal Declaration of Human Rights'[3], the 'UN Declaration on the Rights of Indigenous Peoples'[4], the UN 'Declaration on the Rights of Disabled Persons'[5], the UN 'Declaration on the Right to Development' [6], the UN 'Rio Declaration on Environment and Development'[7], the 'human right to a clean, healthy and sustainable environment'[8], regional Human Rights Declarations, and the IEEE Code of Ethics[9].

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

Alignment with UN values embraces a powerful declaration for universal human values that guide human societies. Having those values form the basis for Strong Sustainability by Design's

[3] United Nations Universal Declaration of Human Rights, December 1948, https://www.un.org/en/about-us/universal-declaration-of-human-rights - Aug 15, 2022
[4] United Nations Declaration on the Rights of Indigenous Peoples, Sept 2007, https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP - Aug 15, 2022
[5] United Nations Declaration on the Rights of Disabled Persons, Dec 1975, https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf - September 05, 2022
[6] United Nations Declaration on the Right to Development, 1986, https://www.ohchr.org/sites/default/files/Documents/Issues/Development/RTD_booklet_en.pdf - Sept 5, 2022
[7] United Nations Rio Declaration on Environment and Development, June, 1992. A/CONF.151/26/Vol.I: Rio Declaration on Environment and Development (un.org) - Sept 5, 2022
[8] United Nations, July 2022, UN General Assembly declares access to clean and healthy environment a universal human right | | UN News - Sept 5, 2022
[9] IEEE Code of Ethics, adopted by the IEEE Board of Directors, 2020, https://www.ieee.org/content/dam/ieee-org/ieee/web/org/about/corporate/ieee-code-of-ethics.pdf

Planet Positive 2030 Guiding Principles provides a powerful, cultures-wide foundation for guiding the efforts of humans as caretakers of a flourishing planet.

Essential to impactful follow-through on the guiding principles are accountability, transparency, freedom of expression and protection of whistleblowers. The goal is a flourishing planet. All nations. All peoples. All life.

Guiding Principles

1. *Responsible and ethical leadership from individuals and organizations.* The responsibilities of individual professionals and of organizations should be broadened to include an increased role in addressing the challenges of climate change, sustainability, and socio-economic and environmental stewardship. Knowledge demands action and brings responsibility. Leadership requires collaboration and cooperation with scientists, public policymakers, businesses, economists, researchers, educators, and all community stakeholders.
2. *Justice, diversity, equity, and inclusion.* Championing justice, diversity, equity, and inclusion must be addressed in climate change strategies in recognition that human impacts on climate are felt most by those with the least resources. It is the responsibility of those with the most resources to support those with the least resources in an equitable manner. Addressing climate change should reduce conflict, violence, and inequity.
3. *Energy transformation.* The transition from a fossil fuel-based energy system to a system that is based on clean and sustainable sources of energy must ensure that energy accessibility, affordability, sustainability, and reliability are maintained through all phases of the transition. The goal for this transition should be to achieve ubiquitous access to energy. A successful energy transition will enable greenhouse gas emissions reductions not only in the energy/power sectors but in all sectors using energy, thereby supporting the decarbonization and electrification of these sectors.
4. *Mitigation and adaptation.* In responding to the challenge of climate change, and to prevent a climate catastrophe, society needs to mitigate (i.e., reduce) greenhouse gas emissions primarily by moving away from fossil fuel-based energy systems. To reduce risks to people, the planet's ecosystems, and the built environment, adaptation to the changing climate must also be addressed, until the climate returns to the 'safe zone.' Sometimes the goals of mitigation and adaptation may come into conflict, and society will have to balance the conflicting goals.

5. *The regenerative imperative and a circular economy.*Thinking and action must broaden beyond current economic, business, societal and resource utilization models to achieve sustainability and for people and the planet to flourish for many generations to come. Future economic, societal and business models should take resource limitations into account and emphasize new public imperatives such as circularity, ecological regeneration, zero-waste, human flourishing, and well-being.
6. *Balance between today's needs and the needs of the future.* In the course of transitioning societies and the global economy towards a sustainable future, today's short-term societal needs must balance with the long-term, global aspirations for a flourishing planet. This balanced approach should address all societal needs, including access to food and clean water, health care, and other essential goods necessary for a healthy standard of living.
7. *Alignment of global goals with local goals and actions.* The transition to a more sustainable future will be driven by local actions that should also produce positive global benefits. Local actions and global goals should strive for harmonization.
8. *Culture of sustainability.* Strategies and actions should move society toward building a culture of sustainability and doing good that is based on respect for all living beings and for the Earth. Sustainability efforts must move beyond minimizing harm to restoring and regenerating human and environmental systems.
9. *Responsible technology.* The design, development, and use of technology should be a dynamic ongoing process for evolving an appropriate, timely response to both negative impacts (the unforeseen consequences of technology on people and planet) and positive impacts (the opportunities to relieve suffering, increase flourishing and equity, and better steward the planet).
10. *Knowledge-based decisions and accountability*. Informed decisions are based on sound data, relevant information, context, experience and perspective; these factors all constitute knowledge. Knowledge-based decisions possess a higher degree of certainty over other less informed decisions. Knowledge-based decisions are thus made on the basis of good evidence and sound reasoning; this, in turn, can make hard decisions more fitting and true. Application of appropriate metrics and re-evaluation of decisions at appropriate time intervals can enable corrective action.

Guiding Principle 1 – Responsible and Ethical Leadership from Individuals and Organizations

The responsibilities of individual professionals and of organizations should be broadened to include an increased role in addressing the challenges of climate change, sustainability, and socio-economic and environmental stewardship. Knowledge demands action and brings responsibility. Leadership requires collaboration and cooperation with scientists, public policymakers, businesses, economists, researchers, educators, and all community stakeholders.

Background

Our professional community includes technical and nontechnical professionals and technologists who are committed to a sustainable future. There is an imperative for leadership from this community to inspire global cooperation and collaboration at all levels of society.

This leadership imperative applies to both individuals and organizations. Whereas individual responsibility is restricted to the choices and actions of the individual, organizations play a significant role in achieving long-term sustainability due to the way in which their decisions and activities impact the planet on a macro or global scale. Individuals at all levels within organizations must recognise that one of the most effective ways to tackle global warming and climate change is by improving the way their organizations operate. Similar to how individuals are responsible for their actions and behaviors, large organizations should see themselves as being " collective individuals" who understand the imperative to implement the necessary organizational changes for combating climate change and in doing so, lead the way towards achieving a sustainable planet.

There are two key elements to this leadership imperative (see Case Studies, the Engineering Change Lab). They are as follows:

- Stepping up to leadership roles:
    - Communicating, connecting, convening, and caregiving
    - Challenging the status quo and catalyzing change
    - When necessary, taking the heat and holding steady
- Building bridges:
    - Collaborating across disciplines and with all other stakeholders

- Proactively reaching out across divides and between factions
- Managing polarities and resolving conflicts
- Committing to an open-source ideology that also recognizes sources
- Maintaining cultural awareness and empathy

Increased engagement in public policy that is focused on creating a more sustainable world will be necessary to achieve the goals of Planet Positive 2030. Our professional community will need to utilize our technical knowledge and leadership skills to guide public investment decisions and promote needed regulatory shifts.

Recommendations

1. Work with professional organizations to broaden their definitions of professional responsibility to place greater emphasis on sustainability, climate change, environmental stewardship, and responsible technology.
2. Engage in activities focused on educating the public about the science behind climate change and the value that the natural world provides to society.
3. Support efforts to incorporate leadership in sustainability and a comprehensive understanding of technical skills related to sustainability, climate change action, and environmental stewardship in the curriculum for engineering education and other fields of study.
4. Support efforts and highlight best practices related to the inclusion of sustainability and ESG metrics for all types of organizations.
5. Support the sustainability leadership initiatives of other organizations and collaborate with these organizations for increased impact.
6. Engage in public policy advocacy at all levels of government that supports the goals of Planet Positive 2030.

Case Studies and Further Resources

1. Annas, G.J., C. L. Beisel, K. Clement, A. Crisanti, S. Francis, M. Galardini, R. Galizi, J. Grünewald, G. Immobile, A. S. Khalil, R. Müller, V. Pattanayak, K. Petri, L. Paul, L. Pinello,

A. Simoni, C. Taxiarchi, and J. K. Joung, "A Code of Ethics for Gene Drive Research," *The CRISPR Journal*, vol. 4, no. 1, Feb. 19, 2021.

2. Engineering Change Lab – USA, "Climate Change Noble Purpose for Engineering Statement," https://ecl-usa.org/climate-change/.
3. Engineering for One Planet, "A Global Effort to Accelerate Sustainable Engineering," https://engineeringforoneplanet.org/.
4. Sustainable Development Technology Canada, "Advancing Clean Tech Innovation at Home and Abroad," https://www.sdtc.ca/en/.

Guiding Principle 2 – Justice, Diversity, Equity, and Inclusion

Championing justice, diversity, equity, and inclusion must be addressed in climate change strategies in recognition that human impacts on climate are felt most by those with the least resources. It is the responsibility of those with the most resources to support those with the least resources in an equitable manner. Addressing climate change should reduce conflict, violence, and inequity.

Background

Let us start by understanding that minority groups in society must understand and take part in the governmental decision-making process, especially when we are talking about sustainability.

Every group in society has its own values; therefore, diversity means including all the ways in which people differ. This includes not only race, gender, ethnicity, and multiculturalism but also age, national origin, religion, ability, sexual orientation, socioeconomic status, education, marital status, language, and physical appearance. Diversity should also emphasize accessibility needs by considering age, disability, pregnancy, and so forth. The goal of diversity should be to increase visibility and representation for *all*.

By having this perspective, we will see the need to apply equity that focuses on just treatment, access, opportunity, and advancement for all people, while at the same time identifying and eliminating barriers that prevent the full participation of some groups. Equity involves questioning advantages and barriers within the procedures and processes of institutions as well as in their distribution of resources.

First, it is essential to distinguish between *equality* and *equity*, which can cause confusion. Equality is, essentially, sameness. In fairness to its noble purpose, equality presumes that treating people the same offers the "same" opportunity or starting point for ensuring the same outcomes or endpoint. Equity is about justice. It provides *access* to the same opportunity and measures it in terms of outcomes achieved.

Our goal is to reduce the barriers to providing the opportunity to feel equal, so inclusion involves cultivating cultures and environments in which any individual or group can be and feel welcomed, respected, valued, and supported to fully participate. An inclusive culture fosters a shared understanding or commitment to appreciating differences in words and actions.

The impacts of climate change—the earth will warm by the end of the twenty-first century—will bring more hurricanes and other extreme weather, reduced air quality, and more infectious diseases spread by ticks and mosquitoes, among other impacts.

We can see that marginalized populations are disproportionately impacted yet rarely included at the table when policies are being negotiated. Marginalized populations are those who have the smallest carbon footprint, but due to their socioeconomic status, geographic location, gender, or age, they are the ones who experience the worst effects of climate change.

Intersectionality is a key conceptual lens to understand how multiple forms of social inequalities and vulnerability interconnect and overlap with each other. Intersectionality addresses more than the categories of identities; it also includes the intricacies necessary to understand persistent social, political, and structural inequalities that, in turn, translate into various types of vulnerabilities and the unequal caring of needs and responsibilities.

Currently, millions of people living in the northern region of Africa are on the brink of famine, struggling to have one meal a day. Drought, in addition to ongoing conflicts, has devastated their living conditions. Climate change causes droughts to be more frequent and severe, which will continue to negatively impact the lives of the African people.

Indigenous populations, who are especially reliant on their land for day-to-day survival, are leading the way with initiatives aimed at quelling the environmental disasters they suffer as a result of global warming and extreme weather conditions.

And yet, despite the discrepancy in how different groups and countries are affected by climate change, previous negotiations and policy decisions have excluded nongovernmental organizations (NGOs), activists, civil society, and those most vulnerable to the effects of climate change. These groups, while present, are not allowed an equal opportunity to contribute to policy decisions. Human rights must always be respected in the implementation of decarbonization strategies. Advanced, wealthier countries have a responsibility to protect the human rights of all people.

The common rhetoric surrounding climate change implies that the effects of climate change exclusively impact developing nations, when in reality developed nations are far from exempt. It is often the marginalized communities in developed nations who also suffer from its uneven impacts. Notably, in 2005, Hurricane Katrina completely devastated and changed the lives of many Americans, but the people who were hurt the most were people of color, women, children, the poor, and people with disabilities.

Recommendations

1. Utilize resources and disseminate climate information in formats that are accessible to communities for increased engagement[10].

2. Develop climate change ambassadors from different communities as messengers, ensuring they are prepared with leadership support, tools, training, and resources to communicate with and engage the public and community partners on local climate change issues[11]

3. Integrate intersectional thinking into climate solutions, collaboration between communities, policymakers, and other key stakeholders through:
   a. Bridging traditional knowledge and climate science[12]
   b. Active participation at each stage—from engagement in creating policy and developing technology to implementing solutions and strategies for climate change—and working in collaborative ways with all levels of community and government[13]

Case Studies

[10] Farzaneh Shaikh Khatibi, Aysin Dedekorkut-Howes, Michael Howes, Elnaz Torabi, "Can Public Awareness, Knowledge and Engagement Improve Climate Change Adaptation Policies?," Discover Sustainability 2, no. 1 (March 23, 2021): 1-24, https://doi.org/10.1007/s43621-021-00024-z.

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Further Resources

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2. Tony Zampella, "True Diversity and Inclusion Requires Equity," Medium. March 10, 2021, https://medium.com/@tonyvzampella/true-diversity-and-inclusion-requires-equity-9f258fcec8f7.

3. "Climate Change on the Front Line: Why Marginalized Voices Matter in Climate Change Negotiations," Global Witness. August 9, 2017, https://www.globalwitness.org/en/blog/climate-change-front-line-why-marginalized-voices-matter-climate-change-negotiations/.

4. Wändi Bruine de Bruin, M. Granger Morgan, "Reflections on an Interdisciplinary Collaboration to Inform Public Understanding of Climate Change, Mitigation, and Impacts," *Proceedings of the National Academy of Sciences* 116, no. 16 (January 14, 2019): 7676-7683, https://doi.org/10.1073/pnas.1803726115.

5. Ana T. Amorim-Maia, Isabelle Anguelovski, Eric Chu, James Connolly, "Intersectional Climate Justice: A Conceptual Pathway for Bridging Adaptation Planning, Transformative Action, and Social Equity," Urban Climate 41 (January 2022): 101053, https://doi.org/10.1016/j.uclim.2021.101053.

6. *Analytical Study on the Promotion and Protection of the Rights of Persons with Disabilities in the Context of Climate Change.* (April 2020), https://documents-dds-ny.un.org/doc/UNDOC/GEN/G20/097/56/PDF/G2009756.pdf.

Guiding Principle 3 – Energy Transformation

The transition from a fossil fuel-based energy system to a system that is based on clean and sustainable sources of energy must ensure that energy accessibility, affordability, sustainability, and reliability are maintained through all phases of the transition. The goal for this transition should be to achieve ubiquitous access to energy. A successful energy transition will enable greenhouse gas emissions reductions not only in the energy/power sectors but in all sectors using energy, thereby supporting the decarbonization and electrification of these sectors.

Background

In 2021, the International Energy Agency published a roadmap to building a global energy sector with net zero emissions. It was the world's first, and the target date was 2050. In it the agency called for a "complete transformation of how we produce, transport and consume energy," and that this process hinged "on an unprecedented clean technology push to 2030"[14]. Covering a broad and interconnected range of human activities—power generation, transportation, heating and cooling, industry, agriculture and more, all producing greenhouse gas emissions[15]—such a complete transformation of the world's energy infrastructure is a complex and difficult undertaking.

This energy transformation is critically necessary—and - it is feasible as reported by researchers at LUT University and the Energy Watch Group in their report: Global Energy System based on 100% Renewable Energy[16] and by Christian Breyer et. al.[17]. Other authors comment: wind and solar may not be enough, as "the only way in which wind/solar could meet all (or nearly all) global energy needs is if energy use is drastically curtailed"[18]. Many degrowth and limits-to-growth experts agree[19]. Nuclear power generation offers a fossil fuel alternative that can make up renewable energy deficits, but it

[14] IEA, "Net Zero by 2050," International Energy Agency, May 2021, https://www.iea.org/reports/net-zero-by-2050.

[15] Hannah Ritchie, 2020. Sector by sector: where do global greenhouse gas emissions come from? - Our World in Data. https://ourworldindata.org/ghg-emissions-by-sector - Sept 5, 2022

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remains controversial[20]. Other technologies, including future developments, such as geothermal, biofuels etc. will additionally factor into production deficits. Most scenarios and projections predict it will take a blend of a variety of local and global technologies to transition to a fossil fuel-free—or greatly reduced—global energy system.

The energy transformation is not limited to switching from fossil-fuel based energy sources, it also requires energy efficiency measures and energy conservation. Energy conservation - e.g. turning a device off, when not in use - and energy efficiency measures - e.g. replacing HID 'light bulbs' (high intensity discharge technology) with LED lighting for street lighting - are the low-hanging fruit;

This transition must address the disposition of the elements of our old energy system(s) through integration into the new system, reuse, and waste minimization. Depending on local and regional contexts, this may or may not be extraordinarily difficult for both technical and human or social reasons. It will be technically complex due to the interconnectedness of competing needs, often expressed as the Food/Land-Water-Energy nexus, for example for biofuels[21]. Agriculture and solar panels may compete for land use. Energy production may have significant water requirements[22].

Perhaps more difficult will be the human and social challenges—the social, political, and economic wills arising from human nature: threats to established ways of life[23]; political constraints[24]; and economic challenges[25]. Steering this transition through so many conflicting challenges will not be an easy task. But the cost of maintaining the existing energy infrastructure is far higher—the future of our planet. And Bogdanov et.al.[26] claim that renewables based energy generation will be more cost-effective than current systems.

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This difficult transition roadmap must balance above human and technology needs—an *equitable* balance. A *just transition* as described by the Stockholm Environment Institute is "a transition that minimizes disruption for workers and communities reliant on unsustainable industries and energy sources"[27]. This transition ensures accessibility, ubiquitous access, affordability, sustainability, and reliability for the differing cultural and economic needs of diverse multitudes, as it develops and implements clean and sustainable energy sources for all.

Ultimately, despite these challenges and complexities, this energy system transition is a ***doable task.*** According to Julia Steinberger, an ecological economist at the University of Lausanne, the process "is entirely doable, and it is doable fast, but it will come with a price tag which will then be repaid forever after in a prosperous and healthy society"[28]. There will be innumerable benefits. They will result in economic opportunities, particularly for less developed countries, as economies are built upon access to(abundant) energy resources. Societies will experience a tremendous positive health impact in response to clean air and water[29], for example, preventing premature deaths and reducing healthcare costs. And there will be many others.

Models exist, such as leveraging innovations from the space industry and other environments where sustainability principles are critical[30]. There are other roadmaps and resources to help guide the way.

Most importantly, decarbonization of the energy sector is achievable - it is a *doable* task. A necessary task. A worthy task. And the reality is that there is no choice if humans and our biosphere are to survive and flourish.

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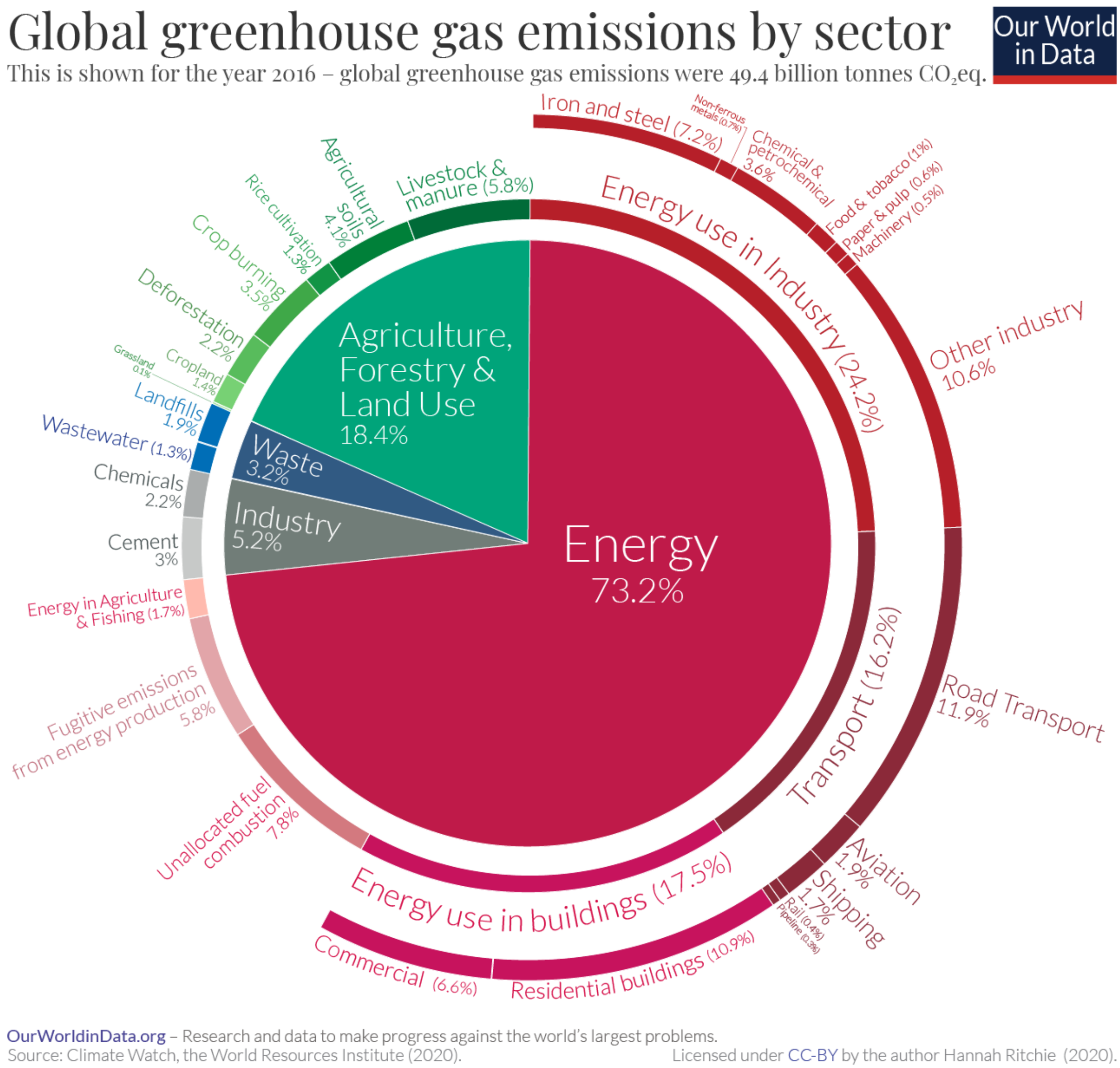

Recommendations

Address the energy transition as an early priority and in a contextualized, sustainable way, as it is an energy enabler for other sector transitions. Associated water, food, and communications (i.e., connections to the internet and services) challenges will be easier to resolve as the new energy distribution system spreads across geographies and cultures.

1. Involve all nations as being part of the energy transition process, especially the poorest nations who themselves don't have the wealth or resources available to acquire renewable energy systems. All nations should feel confident that the international community will provide the support services and technological mechanisms necessary for transitioning their economies over to renewable energy systems. No nation should feel excluded or unable to participate in this transition, nor should they feel that the transition poses too great an economic burden such that they decline to actively participate with the rest of the global community in making this crucial transformation to renewable energy systems. This transformation must therefore be economically affordable, technologically sustainable, reliable in terms of supplying energy needs and requirements, and available to all nations regardless of their economic status.
2. Implement the United Nations recommendations to jump-start the renewable energy transition: [32]
    a. Make renewable energy technology a global public good via radically increased actions in policy, education, media, and other venues[33],[34].
    b. Improve global access to components and raw materials via financial incentives, public-private partnerships, governmental and private sector support[35].
    c. Level the playing field for renewable energy technologies versus fossil-fuel based energy.[36]
    d. Shift energy subsidies from fossil fuels to renewable energy[37].

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   e. Triple investments in renewables.

3. Decentralize and diversify energy production as much as practical and feasible. Distributed generation increases resilience, reliability, and reduces transport[38].
4. Encourage energy conservation - energy not used, need not be produced - energy not used, need not be paid for - through widespread educational campaigns and possibly sharing metering devices for individuals to test power consumption of devices.
5. Incentivize energy efficient devices of all kinds - from light bulbs to vehicles.
6. Give ownership 'of energy consumption' to the user through data sharing and choices; e.g. the London Hydro Green Button program[39].
7. Strongly enable participation by small and medium-sized enterprises in the energy sector. This will help decentralization and diversification of energy production as well as development of energy efficient devices and services, and, at the same time, support economic development.
8. Increase technical literacy in general and technical knowledge/know-how through workforce retraining and development[40] to support appropriate procurement and use of technology as well as safe, knowledgeable operation and maintenance of deployed technologies. Please, refer also to the Sustainable Workforce Opportunities chapter.
9. Educate for a futures literacy mindset[41].
10. Share best practices and know-how widely for communities and business around the globe to implement[42]. Please, refer also to the Sustainability Commons chapter.
11. Design and implement new energy systems - including production, transport, storage and use - from the out-set such that the components enable a circular economy (as much as possible)[43].
12. Ensure ubiquitous reliable access to clean affordable sustainable energy, access to water, clean air, food and services, around the globe, as the transition completes.

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Case Studies

1. Renewable energy cooperatives: Facilitating the energy transition at the Port of Rotterdam https://www.sciencedirect.com/science/article/abs/pii/S0301421518304026
2. Driving factors for the regional implementation of renewable energy - A multiple case study on the German energy transition https://www.sciencedirect.com/science/article/abs/pii/S0301421517300940
3. Japan's resilient, renewable cities: how socioeconomics and local policy drive Japan's renewable energy transition https://www.tandfonline.com/doi/10.1080/09644016.2019.1589037
4. Reimagining energy futures: Contributions from community sustainable energy transitions in Thailand and the Philippines https://www.sciencedirect.com/science/article/abs/pii/S221462961830570X
5. Blind spots in energy transition policy: Case studies from Germany and USA https://www.sciencedirect.com/science/article/pii/S2352484718301847
6. Geographies of renewable energy transition in the Caribbean: Reshaping the island energy metabolism https://www.sciencedirect.com/science/article/abs/pii/S2214629617303973
7. Renewable energy and transition-periphery dynamics in Scotland https://www.sciencedirect.com/science/article/abs/pii/S2210422418301102
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9. Energy Poverty and Low Carbon Just Energy Transition: Comparative Study in Lithuania and Greece https://link.springer.com/article/10.1007/s11205-021-02685-9
10. The clean energy transition of heating and cooling in touristic infrastructures using shallow geothermal energy in the Canary Islands https://www.sciencedirect.com/science/article/abs/pii/S0960148121002846

Further Resources

1. Towards global sustainability: Education on environmentally clean energy technologies https://www.sciencedirect.com/science/article/abs/pii/S1364032117309929
2. Towards sustainable production of clean energy carriers from biomass resources https://www.sciencedirect.com/science/article/abs/pii/S0306261912003601

3. Transforming Access to Clean Energy Technologies in the Global South: Learning from Lighting Africa in Kenya https://www.mdpi.com/1996-1073/14/14/4362
4. An energy vision: the transformation towards sustainability — interconnected challenges and solutions https://www.sciencedirect.com/science/article/abs/pii/S187734351200005X
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6. Renewable and sustainable clean energy development and impact on social, economic, and environmental health https://www.sciencedirect.com/science/article/pii/S2772427122000687
7. A step to clean energy - Sustainability in energy system management in an emerging economy context https://www.sciencedirect.com/science/article/abs/pii/S0959652619333323
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Guiding Principle 4 – Mitigation and Adaptation

In responding to the challenge of climate change, and to prevent a climate catastrophe, society needs to mitigate (i.e., reduce) greenhouse gas emissions primarily by moving away from fossil fuel-based energy systems. To reduce risks to people, the planet's ecosystems, and the built environment, adaptation to the changing climate must also be addressed, until the climate returns to the 'safe zone.' Sometimes the goals of mitigation and adaptation may come into conflict, and society will have to balance the conflicting goals.

- *Time is of the essence.* According to a U.N. Intergovernmental Panel on Climate Change (IPCC) report finalized on April 4, 2022 (UN, IPCC, "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change," ed. P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, and J. Malley, Cambridge, UK and New York, NY: Cambridge University Press, https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/), to limit warming to 1.5 °C, global GHG emissions should peak before 2025 and be reduced by 43% by 2030. Methane must be reduced by 34% by 2030. Even if we are willing to tolerate warming of 2 °C, global GHG emissions must peak before 2025 and be reduced by 27% by 2030.[44]
- *All sectors of the economy will have to contribute.* Key sources of emissions are illustrated in figure TS.6 of the IPCC mitigation report; direct plus indirect emissions by end-user sector for 2019 are as follows: industry 34%, agriculture/forestry/land use 22%, buildings 16%, transportation 15%, and other 12%.
- *It is not just about electricity production:* If we look at electricity and heating production, it contributes to 23% of total carbon dioxide (CO_2) emissions (and is distributed across the sectors above). While ground transportation may be able to transition to electricity, innovations will be needed to transition food production, protect nature, and produce steel, cement, and other industrial processes.
- *Greenhouse gasses linger in the atmosphere for hundreds of years***.** While reforestation, biomass, and other natural systems can sequester some carbon, innovative breakthroughs are

[44] UN, IPCC, "Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change," ed. P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, and J. Malley, Cambridge, UK and New York, NY: Cambridge University Press, https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/.

needed to scale up carbon capture and storage—even if the mitigation goals are met. Because carbon capture and storage requires energy (endergonic systems), it is necessary to power carbon sequestration and storage with non-GHG "green" energy sources such as solar energy.

- *Preparing for extreme weather.* Climate change is making extreme weather more intense and more frequent. Reducing the risks caused by extreme weather requires planning, building resilient infrastructure, and strengthening natural systems like dunes and lagoons.
- *Preparing for extreme climate.* Adaptive actions are needed to reduce vulnerability of natural and human systems. For example, changes in farming and land management practices will be needed, including the identification and development of new species of crops and livestock with increased resilience.
- *Our generation's responsibility to future generations.* We must expeditiously solve the climate crisis so that we leave future generations a world that is supportive and nurturing.

Background

Upon releasing a new IPCC report in February 2022 (UN IPCC, "Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change," ed. H.-O.Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, and B. Rama, United Nations, Intergovernmental Panel on Climate Change, 2022 (in press), https://www.ipcc.ch/report/ar6/wg2/), the IPCC noted in a press release :

> The report clearly states Climate Resilient Development is already challenging at current warming levels. It will become more limited if global warming exceeds 1.5 °C (2.7 °F). In some regions it will be impossible if global warming exceeds 2 °C (3.6 °F). This key finding underlines the urgency for climate action, focusing on equity and justice. Adequate funding, technology transfer, political commitment and partnership lead to more effective climate change adaptation and emissions reductions.[45]

There are two main goals:

[45] UN IPCC , "Climate change: a threat to human wellbeing and health of the planet. Taking action now can secure our future," press release, February 28, 2022.

1. *As soon as feasible, mitigate human-caused GHG emissions*. GHGs include carbon dioxide, which form the bulk of the problem, as well as methane and nitrous oxide, which also hold heat in the atmosphere. It isn't possible to instantly stop all processes that create GHGs because they are intertwined with the daily lives of citizens. It is necessary to very quickly find and implement sustainable solutions that generate energy, products, and services without generating GHGs. In some cases, this will require research, development, and innovation.
2. *Adapt to the climate changes that people are and will be facing.* In this document, adaptation is a method—or methods—for being resilient; that is, it is the ability of society to maintain essential functions and structures as well as to generate the capacity for its transformation. This adaptation will also require dealing with extreme weather events that climate change is making more frequent and more intense.

Recommendations for Mitigation of GHG

1. Electrify all land-based transportation (which constitutes 10% of emissions). Passenger cars, trucks, and buses are the low-hanging fruit of the transportation sector for quick electrification. There are few technology problems to be solved. Government policy action could begin to mandate this as well as establish a recharging infrastructure.
2. Reduce emissions from planes (1.8%) and ships (1.6%) and invest in research and development (R&D) for biomass fuels, improved fuel efficiency, and electrification. Technology challenges around the latter include the weight and energy density of batteries. Other R&D ideas include using hydrogen either as a fuel or for fuel cells, assuming hydrogen can be produced with green electricity.
3. Switch the grid (23%) to renewables (e.g., solar and wind) and nuclear. There is little reason to delay this transition and stop the development of new carbon-emitting power plants. Further R&D is needed for energy storage and for building the necessary infrastructure to handle distributed generation (e.g., solar panels on houses and buildings).
4. Electrify heating (5%) and cooking (1%). There are no technological barriers to decarbonizing building and house heating and cooking.
5. Reduce emissions from agriculture, livestock, and food supply (11%). This requires cultural shifts—like reducing the amount of meat in our diet and cutting food waste—as

well as technological changes to reduce fuel consumption when making fertilizer and to grow rice without producing methane.

6. Reverse deforestation and protect the ocean (11%). Trees and the ocean store a tremendous amount of carbon.
7. Reduce carbon coming from industry, including cement, steel, plastic, and other manufacturing (24%).
8. Achieve carbon capture and storage. While all the above recommendations will reduce the amount of new carbon in the atmosphere, it is necessary to still eliminate the carbon people have been generating since the industrial revolution. This requires new innovations to capture and sequester atmospheric carbon.

Recommendations for Adaptation to Climate Change

1. Society must prepare for extreme events caused by climate change such as floods, heat waves, drought, hurricanes, tornadoes, wildfires, insect and disease outbreaks.
2. Parts of the earth will be inhabitable. Societies must reduce the impacts of relocating vulnerable populations and infrastructure due to sea level rise, wildfires, and drought.
3. Develop employee disaster risk management strategies.
4. Support social safety nets.
5. Implement blue (water) and green (plants) urban infrastructure.
6. Integrate climate change into all planning (e.g., federal, state, city, company plans) and implementation of conservation and environmental management.
7. Support R&D related to cultivating agricultural and livestock species with increased resilience to temperature, water, and other climate stressors. Develop new practices to conserve water and live with weather extremes.
8. Develop integrated and systems-oriented solutions to reduce trade-offs between mitigation and adaptation and to support long-term resilience.
9. Invest in health systems to support adaptation to climate change and higher temperatures (e.g., early-warning monitoring systems, increased vaccine development, improved heat resistance of the built environment, and advanced water and sanitation systems).

10. Support research into solar radiation modification (SRM), which seeks to reflect more sunlight back into space, reducing the heating of Earth. Further study is needed to understand its benefits and risks.
11. New buildings should be built to be resilient and withstand extreme weather conditions. Older buildings should be similarly renovated. Depending on building codes and location consider energy backup systems, emergency water tanks, raising buildings above the flood protection elevation level, reinforcing the roof, and building in wildfire resistance.

Case Studies

- TBD

Further Resources

1. UN IPCC, "Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change," ed. H.-O.Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, and B. Rama, Cambridge, UK and New York, NY: Cambridge University Press, 2022 (in press), https://www.ipcc.ch/report/ar6/wg2/.
2. Engineering for One Planet, "A Global Effort to Accelerate Sustainable Engineering," https://engineeringforoneplanet.org/.
3. Project Drawdown, https://drawdown.org/.
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Guiding Principle 5 – The Regenerative Imperative and a Circular Economy

Thinking and action must broaden beyond current economic, business, societal and resource utilization models to achieve sustainability and for people and the planet to flourish for many generations to come. Future economic, societal and business models should take resource limitations into account and emphasize new public imperatives such as circularity, ecological regeneration, zero-waste, human flourishing, and well-being.

Background

Waste characterizes our linear economy. Single-use items from finite resources are discarded into landfills and float in vast ocean patches, wash onto beaches, spill across forests, and soil lakes and streams. Material waste produced by a throwaway economy is destroying entire ecosystems. Coupled with energy waste fueled by fossil fuels pumped from finite reserves, the damage is further compounded by duplicate waste in many areas—even as other areas struggle with not having even basic energy needs met. The greenhouse gasses from these efforts, in turn, are warming a finite atmosphere and fueling a climate crisis that threatens the future of the planet—and life itself.

Humanity faces an imperative: the need to transition from this wasteful linear economy to a system both sustainable and regenerative. A circular economic system is needed, a system in which finite resources are turned into items that not only have a history but a future.

This means taking a resources stewardship approach, which maintains resources indefinitely for future generations. As popularized in William McDonough's seminal book, *Cradle to Cradle: Remaking the Way We Make Things*, this necessitates moving from linear *cradle-to-grave* resource usage to *cradle-to-cradle* circular utilization in which nothing goes to waste[46]. Resources are extracted once from the planet, and after extraction, they enter a circular, ongoing usage cycle. The end-of-life cycle for one item sees its components rebirthed in others. The planet does this naturally, as in nature, there is no waste. The by-product of one process is the feedstock for another process.

The only resource on this planet that gets renewed every day is the energy Earth receives from the sun. A fantastic source of renewable energy. Earth reradiates this energy back into space, but no longer the same amount, hence, Global Warming. At this time, the Earth receives more energy from the Sun than is radiated into space by Earth.

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[46] William McDonough, *Cradle to Cradle: Remaking the Way We Make Things*, 2022. (http://www.mcdonough.com/writings/cradle-cradle-remaking-way-make-things/).

Governments must create circular economies that manage waste to zero, maximize resources, and incorporate “de-manufacturability.”

Common steps and targets in such transitions are available and known. They are detailed in the following figure.

Figure 1.

Smarter product use and manufacture	**R0**	**Refuse**	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1	**Rethink**	Make product use more intensive (e.g. through sharing products or by putting multi-functional products on market).
	R2	**Reduce**	Increase efficiency in product manufacture or use by consuming fewer natural resources
Extend lifespan of product and its parts	**R3**	**Reuse**	Re-use by another consumer of discarded product which is still in good condition and fulfils its original function
	R4	**Repair**	Repair and maintenance of defective product so it can be used with its original function
	R5	**Refurbish**	Restore an old product and bring it up to date
	R6	**Remanufacture**	Use parts of discarded product in a new product with the same function
	R7	**Repurpose**	Use discarded products or its part in a new product with a different function
Useful application of materials	**R8**	**Recycle**	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9	**Recovery**	Incineration of material with energy recovery

Figure 2. https://www.sciencedirect.com/science/article/pii/S0921344919304598

Implementing these targets will not be an easy task. Technologies must be expedited to capture and reuse the many types of linear waste. Social structures will have to be developed to foster the transition from linear economics to a circular counterpart. This is a complex and challenging undertaking.

Waste management is just one goal of an emerging circular economy. “The ultimate goal of promoting a circular economy is the decoupling of environmental pressure from economic growth." Indeed. "Circular Economy has the potential to understand and implement radically new patterns and help society reach increased sustainability and wellbeing at low or no material, energy and environmental costs"[47].

Resource management is the second critical challenge. This requires the reuse of components of manufactured items either directly or as recovered materials as feedstock for new products. It also requires regeneration of the earth's ecosystems and biospheres that sustain life on Earth. This includes regenerative farming practices, restoring ecosystems like mangrove forests and coral reefs (to name a few), and reversing desertification in many places around the world.

Finally, the regenerative imperative and circular economy also require changes in the way products and services are designed. Design requirements for strong sustainability must include "design for de-manufacturability".

Recommendations

1. Governments must develop policies that encourage and support development and implementation of new innovations. Support must also be given to businesses and organizations who are applying these innovations and are building circularity and regenerative practices into their business and organizational models.

    Given the challenges and risks associated with these new features, businesses should be rewarded for their ambition and leadership whenever they succeed in proving that new economic and business models are both viable and profitable.

    The philosophy behind a circular economy is one that sees multiple, collaborative social segments as forces for good. Business, government, academia and society-at-large all become domains in which innovative solutions can be created for tackling global problems and achieving planetary sustainability.

2. Expedite development of technologies promoting ten common circular economy strategies.
    a. Recovery[48]
    b. Recycling[49]

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[47] https://www.sciencedirect.com/science/article/abs/pii/S0959652615012287
[48] Resource Recovery from Waste (RRfW) Represents a Transition Stage Toward a Sustainable Circular Economy (Editorial: Resource Recovery From Waste)
[49] Circular economy, recycling and end-of-waste (Circular economy, recycling and end-of-waste - Arne M Ragossnig, Daniel R Schneider, 2019).

   c. Repurposing[50]
   d. Remanufacturing[51]
   e. Refurbishing[52]
   f. Repairing[53]
   g. Reusing[54]
   h. Reducing[55]
   i. Rethinking[56]
   j. Refuse[57]
3. Design for circularity
   a. Design, implement, and operate installations and/or devices to include end-of-life plans for circularity.
   b. Design systems for zero waste (minimizing waste) and maximizing efficiencies.
   c. Design for modularity, repairability, high efficiency, and long service.
4. Move away from gross domestic product (GDP) accounting toward ESG accounting.

[50] An Extended Circular Supply Chain Model Including Repurposing Activities (An Extended Circular Supply Chain Model Including Repurposing Activities | IEEE Conference Publication).
[51] Remanufacturing in the Circular Economy: Operations, Engineering and Logistics (Remanufacturing in the Circular Economy: Operations, Engineering and Logistics | Wiley).
[52] Towards a circular supply chain for PV modules that addresses today's challenges in PV recycling, refurbishment and re-certification (Towards a circular supply chain for PV modules: Review of today's challenges in PV recycling, refurbishment and re-certification - Tsanakas - 2020 - Progress in Photovoltaics: Research and Applications - Wiley Online Library).
[53] Reconfiguring repair: Contested politics and values of repair challenge instrumental discourses found in circular economies literature (Reconfiguring repair: Contested politics and values of repair challenge instrumental discourses found in circular economies literature - ScienceDirect).
[54] Exploring environmental benefits of reuse and recycle practices: A circular economy case study of a modular building (Exploring environmental benefits of reuse and recycle practices: A circular economy case study of a modular building - ScienceDirect).
[55] Food loss and Waste Reduction as an Integral Part of a Circular Economy (Food loss and Waste Reduction as an Integral Part of a Circular Economy).
[56] Recent trends in green and sustainable chemistry: rethinking textile waste in a circular economy (Recent trends in green and sustainable chemistry: rethinking textile waste in a circular economy - ScienceDirect).
[57] Role of refuse-derived fuel in circular economy and sustainable development goals (Role of refuse-derived fuel in circular economy and sustainable development goals - ScienceDirect).

GDP does not capture: the unpaid work of caregivers and other aspects of the caring economy; volunteer efforts that contribute to the economy; leisure time; and other aspects that are important to human well-being.

Public health and education can contribute to building a sharing economy.

5. Set targets and develop policies and resources to address:
    a) Necessary social infrastructure around waste reclamation and reuse.

        Paradoxically, waste reclamation often "ironically increases the risk of creating a demand for these waste streams, which thereby may become commodified" and increase linear economy path dependencies[58].

    b) Creation of future economic and business models expanding upon, and emphasizing, regeneration, human flourishing, and well-being[59],[60].

6. Set targets, develop policies and provide resources for the implementation of natural ecosystem regeneration, for example:
    a) Reversal of desertification
    b) Restoration of wetlands

7. Set policy for and practice contextualized regenerative farming and food production.

Case Studies

1. Singapore Turns Sewage into Clean, Drinkable Water, Meeting 40% of Demand (Singapore Turns Sewage into Clean, Drinkable Water, Meeting 40% of Demand)
2. Zero-Waste Communities across the Globe (Zero Waste Communities around the World | zerowaste.com)

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58 The Waste-Resource Paradox: Practical dilemmas and societal implications in the transition to a circular economy - ScienceDirect

59 A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems - ScienceDirect).

60 Wellbeing-oriented organizations: Connecting human flourishing with ecological regeneration (Wellbeing-oriented organizations: Connecting human flourishing with ecological regeneration - Shrivastava & Zsolnai- 2022 - Business Ethics, Responsibility, the Environment).

3. Nine Examples That the Transition to a Regenerative Economy is Underway (https://www.southface.org/nine-examples-that-the-transition-to-a-regenerative-economy-is-un)
4. 9 Ways to Create a Local Regenerative Economy (9 Ways to Create a Local Regenerative Economy - Shareablederway/)
5. Achieving one-planet living through transitions in social practice: a case study of Dancing Rabbit Ecovillage (Achieving one-planet living through transitions in social practice: a case study of Dancing Rabbit Ecovillage)

Further Resources

1. Make the SDGS a Reality https://sdgs.un.org/
2. Conceptualizing the circular economy: An analysis of 114 definitions https://www.sciencedirect.com/science/article/pii/S0921344917302835
3. Principles for a sustainable circular economy https://www.sciencedirect.com/science/article/pii/S2352550921000567
4. The Circular Economy in Detail https://archive.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail
5. Targets for a circular economy https://www.sciencedirect.com/science/article/pii/S0921344919304598
6. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems https://www.sciencedirect.com/science/article/abs/pii/S0959652615012287
7. Critiques of the circular economy https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.13187
8. Circular economy indicators: What do they measure? https://www.sciencedirect.com/science/article/pii/S092134491930151X
9. Measuring regenerative economics: 10 principles and measures undergirding systemic economic health https://www.sciencedirect.com/science/article/pii/S2589791819300040
10. The Regenerative Economy: Exploring regenerative principles for business and innovation: Net Impact's Virtual Event Series https://netimpact.org/regenerative-economy-resources
11. How circular is the circular economy? Analysing the implementation of circular economy in organisations https://onlinelibrary.wiley.com/doi/full/10.1002/bse.2590

12. Developing and implementing circular economy business models in service-oriented technology companies https://www.sciencedirect.com/journal/journal-of-cleaner-production
13. A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective https://www.tandfonline.com/doi/abs/10.1080/00207543.2017.1402141
14. Do dynamic capabilities matter? A study on environmental performance and the circular economy in European certified organisations https://onlinelibrary.wiley.com/doi/abs/10.1002/bse.2997
15. Regional development of Circular Economy in the European Union: A multidimensional analysis https://www.sciencedirect.com/science/article/abs/pii/S0959652620302651
16. Towards a new taxonomy of circular economy business models https://www.sciencedirect.com/science/article/abs/pii/S0959652617320346
17. Waste hierarchy index for circular economy in waste management https://www.sciencedirect.com/science/article/abs/pii/S0956053X19303927
18. Solid Waste and the Circular Economy: A Global Analysis of Waste Treatment and Waste Footprints https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12562
19. When challenges impede the process: For circular economy-driven sustainability practices in food supply chain https://www.emerald.com/insight/content/doi/10.1108/MD-09-2018-1056/full/html
20. Investigation of circular economy practices in the context of emerging economies: a CoCoSo approach https://www.tandfonline.com/doi/full/10.1080/19397038.2020.1871442
21. Towards a Circular Economy: Exploring Routes to Reuse for Discarded Electrical and Electronic Equipment https://www.sciencedirect.com/science/article/pii/S2212827116314032
22. Circular economy and electronic waste Circular economy and electronic waste | Nature Electronics
23. Can Re-distributed Manufacturing and Digital Intelligence Enable a Regenerative Economy? An Integrative Literature Review https://link.springer.com/chapter/10.1007/978-3-319-32098-4_48
24. A Finer Future: Creating an Economy in Service to Life, L. Hunter Lovins, Stewart Wallis, Anders Wijkman, John Fullerton https://newsociety.com/

25. Regenerative Economies: A New Approach Towards Sustainability https://www.researchgate.net/publication/347691425_Regenerative_Economies_A_New_Approach_Towards_Sustainability
26. How to globalize the circular economy https://www.nature.com/articles/d41586-019-00017-z
27. World Economic Forum Center for the New Economy and Society https://www.weforum.org/platforms/centre-for-the-new-economy-and-society
28. Capital Institute https://capitalinstitute.org/
29. Climate Justice Alliance https://climatejusticealliance.org/
30. Just Transformations to Sustainability https://www.mdpi.com/2071-1050/11/14/3881
31. A concept to support the transformation from a linear to circular carbon economy: net zero emissions, resource efficiency and conservation through a coupling of the energy, chemical and waste management sectors concept to support the transformation from a linear to circular carbon economy: net zero emissions, resource efficiency and conservation through a coupling of the energy, chemical and waste management sectors | Clean Energy | Oxford Academic
32. Encyclopedia of Consumption and Waste: The Social Science of Garbage, Volumes 1 and 2, edited by Carl A. Zimring, William L. Rathje, https://us.sagepub.com/en-us/nam/home
33. Seeking common ground for people: Livelihoods, governance and waste https://www.sciencedirect.com/science/article/abs/pii/S0197397505000445
34. The regenerative supply chain: a framework for developing circular economy indicators https://www.tandfonline.com/doi/full/10.1080/00207543.2018.1524166
35. Indigenous Sustainable Wisdom: First-Nation Know-How for Global Flourishing https://philpapers.org/rec/NARISW

Guiding Principle 6 – Balance Between Today's Needs and the Needs of the Future

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

Background

At the heart of sustainability is the understanding that our resource utilization cannot surpass the rate of resource availability and reuse. With this in mind, we aim to reduce resource waste through an understanding of current needs and needs of the future to avoid Earth Overshoot Day (the point at which our consumption outstrips the planet's biocapacity in each annual cycle). Therefore, we require an understanding of our present socioeconomic capacity contextualized among individuals and communities—locally to globally—while integrating the multifactorial conditions that determine resource utilization, availability, and rate and the effects of these on our environment.

Another way of expressing this imperative is that our decisions should follow the "Seventh Generation Principle" that "decisions we make today should result in a sustainable world seven generations into the future."[61] This inter-generational mindset should see us concerned for the health and well-being of future generations, i.e., our children's children and the generations beyond, just as much as we are concerned for our own health and well-being today.

Healthy humanity depends upon a healthy planet, both directly through the ecological services that it offers and indirectly through the positive impacts of the living environment on stress and mental health. It also requires an understanding of how needs differ across demographics and how climate change may influence these needs, while accounting for future adaptations and changes. For example, if our consumption outstrips production, we impoverish our children. Overconsumption is not the only issue; for example, a lack of recycling of wastes that contaminate our environment will also have direct and indirect population effects. There is no return from extinction!

[61] Indigineous corporate training, August 16, 2022 https://www.ictinc.ca/blog/seventh-generation-principle#:~:text=The%20Seventh%20Generation%20Principle%20is,seven%20generations%20into%20the%20future.

We need to develop adjustment mechanisms that allow us to constantly improve our social, political, and economic systems such that we can provide for our short-term needs with one hand, while working on the long-term transformation process with the other hand .

Recommendations

1. Calculate, quantify, and organize socioeconomic needs, contextualized to location and demographics—past, present, and future—and the role of climate with these factors.
2. Determine actionable steps to address these needs based on the first recommendation above, with preference given to actions that increase and support biodiversity. Diverse ecosystems are more resilient and stable. Biodiversity mitigates against climate change and its effects. In turn, this includes developing actionable steps that are positive toward our environment (e.g., utilizing resources and developing programs that support our environment).
3. Design for maintainability, sustainability, repair, reuse, and recycling. As much as possible, avoid creating single-use products.
4. Develop collaborations between programs, organizations, and institutions (e.g., government, academic, and nonprofits) that have an understanding of and data available for individual and community needs.

Case Studies

1. Li, Qirui, Hua Ma, Zhuqing Xu, Hao Feng, and Sonoko D. Bellingrath-Kimura, “Balancing socioeconomic development with ecological conservation towards rural sustainability: a case study in semiarid rural China,” *International Journal of Sustainable Development & World Ecology*, vol. 29, no. 3, pp. 246–262, 2022, https://doi.org/10.1080/13504509.2021.1990157.
2. Wu, Shuyao, and Binbin V. Li, “Sustainable linear infrastructure route planning model to balance conservation and socioeconomic development,” *Biological Conservation,* vol. 266, pp. 109449, 2022, https://doi.org/10.1016/j.biocon.2022.109449.
3. Li, Y., and Z. F. Yang, “Quantifying the sustainability of water use systems: Calculating the balance between network efficiency and resilience,” *Ecological Modelling,* vol. 222, no. 10, pp. 1771-1780, 2011, https://doi.org/10.1016/j.ecolmodel.2011.03.001.

Further Resources

1. US Department of Defense, “Designing and developing maintainable products and systems,” Philadelphia, PA: Navy Publishing and Printing Office, 1997.
2. Rastelli, E., B. Petani, C. Corinaldesi, A. Dell’Anno, M. Lo Martire, C. Cerrano, and R. Danovaro, “A high biodiversity mitigates the impact of ocean acidification on hard-bottom ecosystems,” *Scientific Reports*, vol. 10, no. 1, pp. 1–13, 2020, https://doi.org/10.1038/s41598-020-59886-4.
3. Hisano, M., E. B. Searle, and H. Y. Chen, “Biodiversity as a solution to mitigate climate change impacts on the functioning of forest ecosystems,” *Biological Reviews*, vol. 93, no. 1, pp.439–456, 2018, https://doi.org/10.1111/brv.12351.

Guiding Principle 7 – Alignment of Global Goals with Local Goals and Actions

The transition to a more sustainable future will be driven by local actions that should also produce positive global benefits. Local actions and global goals should strive for harmonization.

Background

The more that localized societies align their own goals and actions with global goals and objectives, the greater our chance will be at achieving a fundamentally sustainable planet. Local communities across our globe will be impacted directly and indirectly by climate change. Moreover, there are local differences across communities: at the individual level, at the family level, at the housing level, at the neighbor and community level, at the village, town, and city level, and at the county, state, and national level. At *all* levels, we require objective integration, contextualization, weighting, data acquisition, and consideration to produce positive global benefits. In doing this, local actions will not contradict global goals, but rather, be understood and weighted appropriately in a manner that is diverse, equitable, inclusive, and accessible.

This is significant, as the effects of climate change are also diverse. The people of communities most impacted by climate change are poor, disadvantaged, and underserved and, therefore, are the least able to respond appropriately and effectively. These also include agricultural and environmental goods communities, where climate events directly and indirectly lead to socioeconomic impacts.

These climate change effects will, in time, lead to increased competition, increased conflict, lower quality of life and health, increased inequities, and so forth. Through balancing our socioeconomic factors globally and in a manner that is also beneficial for distributed local communities, not only will we successfully address climate change, we also will address socioeconomic issues—such as poverty, lack of education, and lack of socioeconomic mobility and support—faced by communities across the world, while also addressing potential conflicts, inequities, and so forth. In turn, this will lead to improved human rights, well-being, competence, and accountability, and, if applied appropriately, data-driven technologies will deliver increased data agency, transparency, and awareness of misuse contextualized from local to global circumstances. This strategy will make the best use of our resources (on Earth or otherwise) and our collective capacity for human progress now and for future generations, and it will promote a shared and heightened understanding of human cultures and experiences in a technology-supported world.

Recommendations

1. Organize and/or research local to global differences in a multifactorial approach of human (e.g., demographic, health, occupation, and education) and environmental factors (e.g., temperature, humidity, flora, and fauna), independently and dependently, regionally, and across time (past, present, and future).
2. Connect low-income, high-risk, and high-need communities with programs, organizations, and so forth that can provide immediate, short-term, and/or long-term support.
3. Organize, develop, guide (from preexisting initiatives, new initiatives, and also, ideally, integrated collaborations), and engage relevant technologies and communities—for example, government, organizations, academia, and industry—that address and support recommendations 1 and 2, with emphasis and priority given to technologies and programs that apply sustainable practices and knowledge that are inexpensive, simple, approachable (i.e., require minimal training), and long-lasting and that minimize resource utilization and waste.
4. Organize details and share diversity, equity, inclusion, and accessibility information that is adapted for and empathetic towards individual, cultural, and socioeconomic differences and circumstances in support of sustainable programs.
5. Develop timelines and objectives that are adaptive in real time and in the short and long term and are based on priorities and factors related to local and global contexts from the above recommendations and that balance, align, and integrate local and global goals and initiatives.
6. Develop knowledge sharing and communication mechanisms that teach—both technical and nontechnical—actions and outcomes across backgrounds and professions.

Case Studies

1. Balvanera, Patricia, Rafael Calderón-Contreras, Antonio J. Castro, María R. Felipe-Lucia, Ilse R. Geijzendorffer, Sander Jacobs, Berta Martín-López, Ugo Arbieu, Chinwe Ifejika Speranza, Bruno Locatelli, Natalia Pérez Harguindeguy, Ilse Ruiz Mercado, Marja J Spierenburg, Améline Vallet, Laura Lynes, and Lindsey Gillson, "Interconnected place-

based social–ecological research can inform global sustainability," *Current Opinion in Environmental Sustainability*, vol. 29, pp. 1–7, 2017, https://doi.org/10.1016/j.cosust.2017.09.005.

2. Reid, Walter V., Davidson Chen, Leah Goldfarb, Heide Hackmann, Yuan-Tseh Lee, Khotso Mokhele, Elinor Ostrom, K. Raivio, J. Rockström, H. J. Schellnhuber, and A. Whyte, "Earth system science for global sustainability: grand challenges," *Science,* vol. 330, no. 6006, pp. 916–917, 2010, https://www.science.org/doi/abs/10.1126/science.1196263.
3. Holmstedt, Louise, Nils Brandt, and Karl-Henrik Robèrt, "Can Stockholm Royal Seaport be part of the puzzle towards global sustainability?–From local to global sustainability using the same set of criteria," *Journal of Cleaner Production,* vol. 140, pp. 72–80, 2017, https://doi.org/10.1016/j.jclepro.2016.07.019.
4. Liu, Jianguo, Harold Mooney, Vanessa Hull, Steven J. Davis, Joanne Gaskell, Thomas Hertel, Jane Lubchenco, Karen C. Seto, Peter Gleick, Claire Kreme, and Shuxin Li et al. "Systems integration for global sustainability," *Science,* vol. 347, no. 6225, p. 1258832, 2015, https://www.science.org/doi/10.1126/science.1258832.

Further Resources

Guiding Principle 8 – Culture of Sustainability

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

Background

Actions are most powerful and effective when we have a clear understanding of what we are doing, how we can do it, and perhaps most importantly, why our actions are necessary and important. The more we understand how our human civilization is impacting and changing the world around us, the more capable and confident we, as a global community, will be to make the necessary changes not only in our own personal lives but also within the technological systems that underpin our societies and the global economy in general. Indeed, the more we understand the significance of our individual choices and the immense power of our collective, international actions, the global problems and challenges that we are facing today should become less threatening and more manageable, if not even resolvable. We must therefore understand that every action we take should be leading us one step closer to achieving a sustainable future.

Many great sustainability initiatives and purpose-driven organizations have been launched in recent years, with the United Nations Sustainable Development Goals (or UN SDGs) one of the most well known. Recent research (see the *Nature* article in Further Resources) has shown, however, that while the UN SDGs have had positive effects in terms of generating global discussion, as well as shaping some isolated policy reforms, "there is little evidence that goal-setting at the global level leads directly to political impacts in national or local politics." This suggests that goal setting is largely ineffective unless it is also accompanied by a *commitment and willingness to act* at the local level in accordance with the stated goals such as the SDGs.

Acting sustainably, therefore, starts with individuals, communities, organizations, and nations making an explicit commitment to live and to work, grow, and prosper in accordance with the necessary courses of action that guarantee the long-term health and well-being of all living beings and ecological systems on our planet. This commitment needs to be made not just at the level of individuals but also within the political systems at local, national, and international levels. This commitment then needs to be written into political policies to guarantee political action. Culture also plays a key role in embedding this commitment to act sustainably within the social psychology of organizations and other large collectives.

This is a global problem, and we are all interconnected; therefore, we cannot rely on each nation or region to cease unsustainable actions or implement sustainable ones in isolation. Although poorer countries are impacted more severely by the impacts of climate change, they did not contribute the most to the current crisis. Similarly, they are the least able in terms of resources, technology, and time to take significant actions. We need urgent global climate cooperation and investment similar to the urgent action and investment we have seen among nations in response to the war in Ukraine.

Recommendations

1. We must recognize and acknowledge that talking about sustainability is futile unless we also seriously commit to taking the necessary actions for ensuring that we achieve long-term planetary health and well-being—actions speak louder than words.
2. Acting sustainably requires collective entities—such as businesses, industries, governments, and international organizations—at the most basic level to inscribe and/or embed this commitment into their policies, codes of conduct, mission statements, and other governing doctrines.
3. Businesses and industries need to recognize that they play a central role in how natural resources are either used and/or impacted by their business activities. Businesses and industry need to establish an ecological consciousness, whereby they take a proactive role in overseeing how their business is impacting the environment, combined with methods and procedures that aim to minimize environmental impact and ensure that best practices and optimal use of resources is achieved in the course of doing business. These actions must be consistently invested in and applied to every aspect of their businesses—not just in building design or supply chains but also in the AI they build or implement, in their work from anywhere vs. forced commute policies, and in their building site plans and employee travel requirements and event planning practices.
4. Businesses must hold the advocacy groups that lobby governments on their behalf to the same standards that they claim to apply to themselves publicly. Advocacy groups

cannot lobby for weaker policies or longer implementation periods or greater subsidies on behalf of any organization that is making sustainability claims.

5. Encourage businesses to become ethically certified, for example, B-Corp, Fair Trade International, Climate Neutral, and People for the Ethical Treatment of Animals (PETA).
6. Governments need to make national commitments to climate treaties such as the Paris Agreement and Kyoto Protocol and to global climate summits such as the Conference of the Parties (COP). Such commitments can be further accomplished by passing climate targets into law; Finland is considered one of the most ambitious nations on the planet in terms of achieving net zero by 2035

- *Industry*:
  - Invest in sustainable buildings and renewable energy.
  - Do not force employees to commute if their jobs do not absolutely require them to be in a specific location. For those that must commute to a specific location, invest in regional public transportation rather than offering private buses.
  - Restrict travel, particularly international travel unless it is essential.
  - Do not rely on carbon offsets or planting trees to negate the carbon you are adding or resources you are extracting.
  - Conduct human rights impact assessments by neutral evaluators, publish the results, and hold yourself accountable to them.
  - Cash that big companies keep in banks could be inadvertently bankrolling oil and gas companies —being more informed about how a company's investments are used could have an outsized impact on the oil and gas industry.
- *Agriculture*:
  - Invest in regenerative agriculture.
  - Do not farm in areas where massive amounts of water must be piped in.
  - Do not strip trees or other highly efficient carbon capturing plants in order to farm.
  - Do not use pesticides.
  - Do not use hormones on livestock; change their feed to reduce methane emissions.
- *Construction*:
  - Carbon-sucking concrete.

- *Government*:
  - Subsidize renewable energy and tax fossil fuels.
  - Major economies need to donate sustainable materials for renewable energy and regenerative agriculture to economies that cannot afford them.
  - Stop companies from using tax havens to avoid contributing to the tax base needed to fund these initiatives.
  - Heavily invest in water recycling and reuse.
  - Plant more trees, especially in low-income neighborhoods where pollution is higher and where residents are also less likely to have air-conditioning for the summer (temperatures rise significantly higher in areas with no trees); residents also are more likely to have underlying health conditions.
  - Restore the oceans and waterways.
- *Manufacturing:*
  - Invest in packaging that quickly breaks down rather than relying on plastics to be recycled; Less than 10% of plastics are recycled.
  - In emerging markets, create water-free or very low water products (e.g., shampoo and detergent) to reduce the amount of water needed.
- *Technology:*
  - Use AI to identify ways to increase the efficiency of your data centers.
  - When using AI, ensure it is energy-efficient.
  - Use proof-of-stake not proof-of-work chains. If you provide a platform for user-generated content, do not allow climate denial or false science claims on your platform.

Case Studies

1. Patagonia Activism and Mission Statement - "We're in business to save our home planet." Patagonia is famous for its commitment to tackling climate change through the way it does business.
2. Finland aims to be net zero by 2035 and net negative by 2040
3. Former Unilever CEO Paul Polman Says Aiming for Sustainability Isn't Good Enough—The Goal Is Much Higher - [Companies must] "take responsibility of that total impact in the world. I call it the total handprint, all consequences intended or not. Where we see some companies going wrong nowadays is that they celebrate and herald the positive

sides of their business model. But when it gets to undermining democracy or hate speech or child addiction, they don't want to take that responsibility."

4. How Salesforce wants to make its supply chain more sustainable - "With these new contract terms, Salesforce is taking a swing at one of the more intractable sources of a company's carbon footprint, Scope 3 emissions, which include everything outside of direct operations, such as travel, waste, and supplies."
5. Could Google's carbon emissions have effectively doubled overnight?
6. Salesforce teams up with AT&T to cut IoT emissions
7. Neste is the world's third most sustainable company

Further Resources

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Guiding Principle 9 – Responsible Technology

The design, development, and use of technology should be a dynamic ongoing process for evolving an appropriate, timely response to both negative impacts (the unforeseen consequences of technology on people and planet) and positive impacts (the opportunities to relieve suffering, increase flourishing and equity, and better steward the planet).

Background

Each wave of technology has brought its unforeseen consequences: fire, language, writing, printing, electricity, computing, transistors, AI, and more. We can learn from earlier waves and recognize that the responsible design, development, and use of technology is a dynamic cyclical process, not a two-step binary dance of *backlash* followed by *bring in the laws and regulations*. We can learn from drug and nutrition labeling, which recognized the need to alert customers about how they would be affected by what they consume. Today, we consume technology 24/7, and it affects our health and lives.

Advanced technologies such as AI and machine learning present great opportunities for enhancing our own human capabilities for tackling climate change and other global problems. These same technologies also pose serious risks and dangers to the health, well-being, and dignity of human life and the broader fabric of our societies and the environment. Advanced technologies will not lead to nor generate beneficial outcomes automatically - for technology is only as good as we are. It is therefore up to us, technologists in the first instance, to decide how technology is designed and developed, and whether we believe that our technologies are being built to work and serve in the best interests of humanity. In the same way that a parent is responsible for the actions of their children, we each bear some degree of responsibility in the production process of the technologies that we are working to create. Should we see instances of irresponsible or unethical uses of technology, we must be able to raise our concerns in a way that can help prevent any risks or dangers from occurring downstream, in the real world. The technology industry and the community within must be receptive to these concerns and be brave enough to call out instances where technology is not being developed in a responsible way. Responsible use of technology also applies to the way in which organizations and businesses use technology for their own strategic purposes; we must ensure that industrial use of technology does not perpetuate activities that are inherently unsustainable and which work against our ultimate objective of creating long-term sustainability. Responsibility requires firstly an awareness of what constitutes good and bad actions and behaviors, and secondly, the willingness to encourage and promote good actions and behaviors while also preventing or calling out bad actions and behaviors when they are noticed. Failing to use technology responsibly will likely see many of the risks and dangers occurring in the world which, in consequence, will see instances of harm and suffering which could have otherwise been prevented had someone acted responsibly beforehand.

Recommendations

1. Future development of technology should be accompanied by a responsible technology checklist, attesting if it is:
    a. Centered on the person or people
    b. Sustainable by design
    c. Preserves desired privacy and security by design
    d. Protects personal information with timely, specific informed consent on the private or public use of data
    e. Accountable to the people who use it and to the planet—in addition to the people who fund and manage it
    f. Ethical by the cultural guardrails and mileposts of the developers and the people who deploy it
    g. Respectful of the natural environment
    h. Deployed in solutions that are appropriate to the context of the problem (not all problems need technology)
    i. Deployed where a human is *in the loop* with respect to overseeing and managing technological systems
    j. Showing due respect for justice, fairness, the law, and public interest

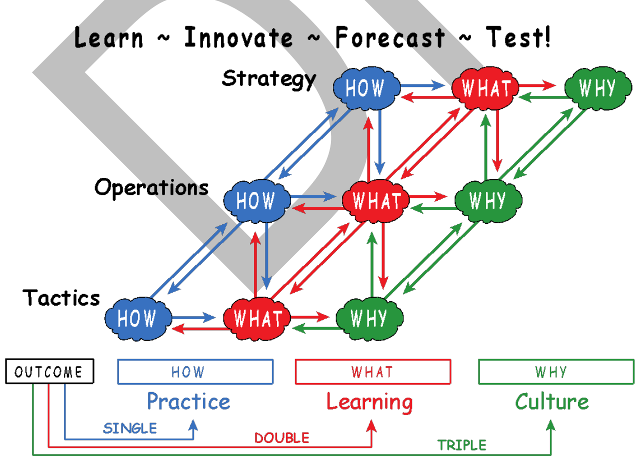


Figure from Douglas Engelbart Memorial 2013. Federal Health Futures, a multi-year initiative funded by the US Defense Health Authority. OODA (Observe Orient Decide Act) loop inspired feedback diagram for organizing Strategy, Operations , Tactics across sectors, silos, hierarchies and disciplines now possible in a networked digitally enabled world.

2. Take into account feedback. Track and measure deployment of technology at the innovation and experimentation stage, filtering out technology that triggers undue backlash. Implement a standardized feedback process for technology innovation with checkpoints to catch dangerous or irreconcilable issues.
3. Assign *responsible technology* labels for robustly tested technology. Caveat emptor (i.e., buyer beware) should be in force for consumers and businesses who decide to buy technology that has received lax or inadequate testing and does not qualify for the label.

Case Studies

Food and Drug Act of 1906. The United States was very slow to recognize the need for a national food and drug law. Frederick Accum's "Treatise on Adulterations of Food and Methods of Detecting Them" had been published in London and Philadelphia in 1820, and Great Britain's first national food law was passed in 1860. A variety of US state laws dated from colonial times. Conditions in the US food and drug industries a century ago included uncontrolled use of chemical preservatives and toxic colors. Changes from an agricultural to an industrial economy had made it necessary to provide the rapidly increasing city population with food from distant areas. But sanitation was primitive compared to modern standards. The great pioneers of bacteriology were just starting their victories over infectious diseases. Milk was unpasteurized. Cows were not tested for tuberculosis.

What information the public received came frequently from bitter experience. Thousands of so-called patent medicines such as Kick-a-poo Indian Sagwa and Warner's Safe Cure for Diabetes reflected public acceptance of the doctrine that buyers could and should look out for themselves. Medicines containing such drugs as opium, morphine, heroin, and cocaine were sold without restriction. Otherwise, harmless preparations were labeled for the cure of every disease and symptom. Labels did not list ingredients, and there were no warnings against misuse.

A drug tragedy, the births of thousands of deformed infants whose mothers had taken the new sedative thalidomide, focused public attention on legislation to strengthen the U.S. Federal Food, Drug, and Cosmetic Act.

The 1962 drug amendments tightened control over prescription drugs, new drugs, and investigational drugs. It was recognized that no drug is truly safe unless it is also effective, and effectiveness was required to be established prior to marketing—a milestone in modern medical history. Drug firms were required to send adverse reaction reports to the U.S. Food and Drug Administration (FDA), and drug advertising in medical journals was required to provide complete information to the doctor—the risks as well as the benefits.

Vehicle information labels in the US include the 17-digit vehicle identification number (VIN) and also some or all of these: the vehicle emissions label, the certification (safety) label, tire information label, service parts identification label, air conditioning label, coolant label, and belt routing diagram.

Drug labels did not come into widespread use until the 1800s. They came into common use because of the need to label pills. Early pharmacy labels included the same information they do today: how often to take the medication, how much to take, and essential information for those taking the medication.

Nutrition labels. The Nutrition Labeling and Education Act of 1991 (NLEA) marked the culmination of a groundbreaking effort to provide information on food labels to help consumers make better choices and encourage food companies to produce healthier food. The NLEA required food packages to contain a detailed, standardized nutrition facts label with information such as: serving size; the number of calories; grams of fat and saturated fat; total carbohydrate, fiber, sugars, and protein; milligrams of cholesterol and sodium; and certain vitamins and minerals. The 2020 Nutrition Facts label required the largest food manufacturers (those with over $10 million in annual food sales) to use the revised label after the US FDA announced an extension to its May 27, 2016, final rule.

The trend toward prevention. If there is one dominating theme in the FDA's history, it is the change from a law that was primarily a criminal statute, protecting consumers through the deterrent effect of court proceedings, to a law that is now primarily *preventive*, due to informative regulations and controls before marketing can begin. The laws requiring approval before marketing formed important changes in the FDA's methods regulating food and drugs in the US (www.fda.gov). They specifically required the agency to issue regulations explaining the requirements and procedures. The 1962 Drug Amendments called for current good manufacturing practice (GMP) regulations to set standards for plant facilities, maintenance, laboratory controls, and so forth, to prevent errors or accidents that could harm consumers. The idea was too good to be restricted to drugs, and in 1969, the first GMPs for food establishments were issued. All such regulations are based on actual industry practices.

Further Resources

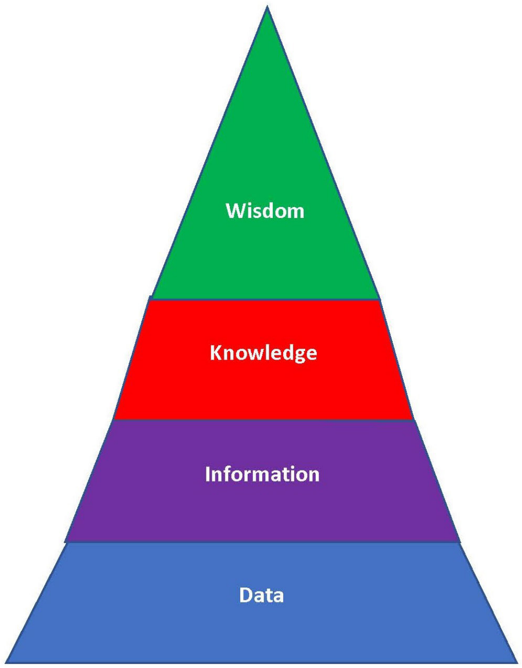
1. The story of the laws behind labels (Link)
2. History of Drug Labels (Link)
3. History of Nutrition Labels (Link)
4. Vehicle Information labels (Link)
5. Privacy by Design: The 7 Foundational Principles (Link)
6. Standards for Personal Data Protection for Ibero-American States (Link).
7. General Data Protection Regulation (2016)

Guiding Principle 10 - Knowledge-Based Decisions and Accountability

Informed decisions are based on sound data, relevant information, context, experience and perspective; these factors all constitute knowledge. Knowledge-based decisions possess a higher degree of certainty over other less informed decisions. Knowledge-based decisions are thus made on the basis of good evidence and sound reasoning; this, in turn, can make hard decisions more fitting and true. Application of appropriate metrics and re-evaluation of decisions at appropriate time intervals can enable corrective action.

Background

To head towards global sustainable and equitable outcomes, our decision-making processes require refinement and precision, being based on knowledge and data from empirical methods as in relevant, objective technical disciplines (e.g. science, technology, engineering, and mathematics, etc.), complemented by non-technical disciplines (e.g. culture, history, education, communication, policy, etc.) . We also have the opportunity to utilize and apply new technologies (e.g. AI, Machine Learning, and big data) to aid with making progress towards our goals, providing guidance with our decision making, as well as objective feedback, for these technologies can enable us to deepen our understanding of the complexities around global problems such as climate change. Knowledge-based decision-making is the most effective and objective way of ensuring that our collective decisions and actions are the best we can make in light of the evidence we obtain. Decisions which are not based on empirical, comprehensive, and contextualized knowledge must be evaluated and scrutinized, and those who act contrary to such circumstances should be held accountable as these actions may have negative consequences towards obtaining our long-term planetary sustainability goals.



The opportunity of technology, data acquisition systems, big data, and computational processing techniques (e.g. AI, and machine learning) is tied with their ability to communicate knowledge and information with humans in a way that is practical, objective, and comprehensible to allow individuals to make more informed decisions, as well as prioritize and maximize our decisions, resources, and time in other areas that improve our human condition. However, there are risks and potential negative outcomes with relying on data (e.g. skewed, biased, variable, not comprehensive, etc.) and advanced technologies (e.g. minimal testing and application, algorithm reliability, comprehensiveness and reliability of the data types and sources, etc.) without feedback, updates, evaluation, and control as needed. These negative outcomes provide creative pressures for development of new technologies to minimize the negative effects of current technologies and lead to innovations to benefit humanity and our environment. To-date, benefits to humanity have largely outweighed benefits to our environment , which with current environmental pressures, require us to re-evaluate and reconsider, another area that technology could potentially help us with. Indeed, the knowledge and information that technology offers us can significantly enhance our socioeconomic, human decision-making processes in an objective and progressive way that considers our environmental impacts, as well as improving humanity's capability to tackle large-scale problems with a great degree of confidence (e.g. see human space exploration programs).

Related to this is the expectation that we can rely on the information and conclusions calculated for us from technology, to empower us to make significant decisions such that we can align our localized goals and actions with our long-term, global aims and ambitions for achieving a sustainable future. This ties with aligning our global goals with local needs, and requires an inter, multi-, and trans-disciplinary approach bringing together all sectors (e.g. academia in terms of knowledge, industry in terms of application, and government in terms of guidance and support, generally speaking). In turn, we should also be cognizant and evaluate how our knowledge gathered and decisions align with our global collective objectives to minimize harm to both our societies and the environment to achieve a sustainable future. In turn, negative actions or behaviors affecting our environment is also relevant data to determine how these factors influence our environment, how to minimize their effects, as well as consequences from said actions and behaviors. Critical to addressing our climate science goals is holding negative actions and behaviors and their source accountable, given the social and environmental crises that we are facing in these critical times. Related to this is how academics and an education can teach or re-teach to change these negative actions and behaviors at the individual to societal level. Failing to hold bad actors to account will only work against the positive aims and ambitions we have for promoting human flourishing and improving the health and well-being of our planet for future generations to come.

Recommendations

1. Objective data and knowledge-based decision-making must be recognized as the primary method and first step for determining organizational actions, behaviors, and public policy to address the necessary steps towards lessening and improving upon the effects of on-going global climate change actions.
    a. Multi- and interdisciplinary STEM must be involved in contributing roles to determine the necessary steps and actions towards determining roles in the process of developing climate change policies at the business, academic, governmental, and political levels. The increasing complexity, nonlinearity, and rapid pace of our society and our environment means that the transition to a sustainable future is a “wicked problem”. We are approaching several societal and environmental tipping points. To move towards a positive direction in light and consideration of these tipping points requires knowledge-based decision and accountability, understanding competing goals and problem sets, and in turn, we

require diversity, flexibility, inclusive, accessible, collaboration, and consideration of our intertwined and interconnected global socio-economics that are sustainable, yet adaptive, towards our planet positive goals.

2. All organisations must be able to show and describe how data collection has minimized inaccuracies and error (e.g. bias, discrimination, race/gender skews, etc), or at least account for variation, which can produce false or inaccurate outputs. These may be from poor methodology, lack of contextualizing, poor leadership, unethical behavior, and inaccurate representation. Careful oversight and consideration must also be practiced and applied with regards to the technological systems used for generating data-driven knowledge and outputs.

3. Whenever decision-making processes which are not based on the principles described above, these processes must be scrutinized by an appropriate independent party for verification and validation with respect to the guiding principles. In turn, there should be actions (e.g. education, new policy, etc.) that hold these negative responses accountable.
4. Technology should be held accountable, in the context of the above recommendations, as well as its utilization and effect on humanity, nature, and environment (e.g. resources, material state and distribution, etc.). Therefore, mechanisms (guided by an objective diverse, equitable, and inclusive range of human perspectives from a varied and representative socioeconomic demographic) should be in-place to routinely and consistently evaluate, review, and consider technologies' role in how we utilize our current knowledge and grow it, so technology is also held accountable.

Case Studies

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Metrics/Indicators

It's 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 requires informed decision making and clear commitments (e.g., targets, action steps, and transparent relevant information sharing) These changes have brought about globally converging regulatory changes, and by interlocking mission-driven (Mazzucato,2015, 2018) innovation-enabling programs, have incentivized regenerative socio-economic transformations at both the company and global supply chain levels. Nation states also can implement both regulatory and innovation decisions.

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. For example, it is now well understood that the climate crisis is the result of rising temperatures primarily which in turn fuels environmental degradation, natural disasters, weather extremes, food and water insecurity, economic disruption and war. Since mankind needs to maintain progress and improve quality of life, companies have stepped in to make sure consumption is responsible and environmentally and socially responsible.

Moreover, although developed countries and large corporations have been (and continue to be) the largest emitters of greenhouse gasses, through globally synchronized, targeted regulatory steps similar to a carbon tax, they have recognized that their money, power, and influence provide them the opportunity to make the biggest difference in the world's future, and have taken it as a challenge to become leaders in sustainability. Leaders in industry include various companies, programs, and organizations that are empowered to prioritize climate and overall environmental protections. 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) that reflect how the products and services they design and develop increase long-term environmental and human flourishing. Therefore, countries, companies, and the various primary contributing communities toward climate have changed their organizational structure and socioeconomic means of contributing in a manner that is now results-driven, positive, and appreciative of our global sustainability goals that improve life on Earth for current populations and for future generations to come.

Indeed, from our half-way point of 2030, the universal commitment to 2050 net zero and long-term sustainable development is now driving individuals, corporations (large *and* small), organizations (e.g., academic, governmental, and nonprofit), and communities with transformation to a new digital economic Industrial 5.0 Revolution model. Noncompliance and "greenwashing" have been replaced by full environmental, social, governance (ESG)-based open reporting (relating to relevant standards and industry benchmarks), KPIs, and consumer labeling that measures capacity and capability to meet sustainability commitments and goals across the system, measuring the impact on individuals, corporations, and communities. The ESG metrics measure progress toward the goals, and the KPIs measure new innovations and scenario-based initiatives to continue to discover the better use of all resources and greater sustainability for all stakeholders. The ability to access data of critical infrastructure that defines and correlates with accountability is a requirement. In turn, balanced scoring and/or dashboards are used to help build and maintain trust, reliability, and consistency in new systems and methodologies. This has led to advancements in society to make it more equitable and sustainable, as well as improve quality of life and business returns on investment.

Better data and information is spurred on by the exponential growth in funding options to pursue and apply new technologies and enable the creative thinkers harnessing these technologies to find innovative new ways to meet the world's need for food, water, housing, energy, travel, and recreation—without generating any further harm to the earth's ecosystem or to the society (through often "double-edged" externalities). Nations prioritize those goals and additionally foster global citizenship to collectively meet the needs of a flourishing earth environment.

In the context of educational development, the introduction of the global "My Planet, Our Worlds" and "Global Citizenship" elementary school curriculum has ensured that younger generations are receiving consistent education on the threats to the planet and why their actions matter. This installation of planetary values at an early age has helped the world not just in terms of the problems it faces but in having the world act as one and not as a world of competing entities (companies, nation states, etc.). This is coupled with and tied to our human space exploration efforts and the "Overview Effect[62]." As a result, academic institutions train and educate a new generation of students with inter-, multi-, and transdisciplinary studies of social, climate, and overall planetary ecosystem responsibility as core intrinsic elements of every course and discipline.

Media sources and mechanisms collaborate with academics and relevant organizations to describe climate science updates and related informational detail in an unbiased, objective, informational manner that empowers climate-positive altruistic and long-term driven behavioral considerations. Corporations, policy makers, and individuals alike understand their direct and indirect impact on the Earth and are committed to making sure their impact is a positive one.

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. This support benefits these developing countries by allowing them to respond to climate change, and includes the long-term savings of these investments (e.g., better irrigation, improved agricultural practices, strengthened health systems, greater access to finance and telecommunication systems, etc.) and job creation with new and unique experiences (e.g., cultural immersion, educational training, unique problem-solving and skills development and training in limited resource environments, etc.) as well as non-traditional ways of value co-creation for developed countries in supporting developing nations. The growing awareness and capacity of deploying technology to facilitate - and, as needed, recover - natural mechanisms and processes with regenerative impact turned out to be a game changer. Rather than focusing on replacing natural processes by using technology, scientists and engineers first aim to harness the Earth's natural regenerative powers, then seek to augment these natural processes when they are insufficient to reverse harm quickly enough. This radically reduced technological inefficiencies and helped stem global resource

[62] The Overview Effect is the cognitive shift that astronauts go through when seeing the Earth from space and realizing how fragile it is and how thin the atmosphere is that protects our planet.

consumption. The consequent elaboration and implementation of enabling social technologies facilitate turning the technology enactment / implementation regenerative "by definition".

Ultimately, a better planet has been achieved by the harmonization of talent across the globe from different countries and backgrounds. It was facilitated with the latest technological developments serving the augmentation of human talents in an equitable manner. The elaboration and thorough implementation of high standards of corporate and public governance ensured that the planet has become more enjoyable for the many and not just for the few. The acceptance that moderation and embracing a more frugal lifestyle can contribute to quality-of-life improvements has facilitated new perceptions of abundant life that contributes to the recognition that a self-serving focus on exponential economic growth brings general population level destruction rather than improved life and happiness in an equitable manner.

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. These metrics and indicators enable progress towards goals and can be objectively and quantitatively assessed and sufficiently validated to support confidence in decision-making based on a set of common metrics (see UN Climate Change Common Metrics). As an example, governments and organizational promises and commitments have been replaced by action and by plans to ensure that greenhouse gas (GHG) targets are met ahead of schedule. This quicker and more accurate reporting of emissions has led to the development of the GGHGED (Global Greenhous Gas Emissions Tracker). This near real-time electronic display of GHG emissions provides a reasonable approximation of the current global level of emissions. The integrated multiprofessional approach that has been adopted across organizations has led to better preinvestment assessment of the true cost of capital expenditure. It enabled going beyond predicting, measuring, and monitoring the reduction of GHG emissions and allowed gauging and visualizing the impact on the biodiversity and of the flourishing, or lack thereof, of local communities.

Countries have taken on board the principles as set out in the 2015 Paris agreement and by the subsequent follow-up events and mechanisms serving its implementation. There is now far greater coordination and collaboration and sharing of new ideas than was the case only five years ago. For example, more countries and companies are reporting on achievement of 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. The review procedures to assess the accuracy and fairness of the submitted reports have also become far more rigorous and transparent, driven by citizen, community, and collective input, and are more frequently shared in more specific, direct, and clear updates. This has further driven governments, 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 towards long-term climate goals.

At the corporate level, the building blocks approach where the baseline standards of the International Sustainability Standards Board (ISSB)—primarily targeted at the providers of capital, whether debt or equity—have been complemented by the standards of other bodies which are focused on a wider group of stakeholders such as those of the Global Sustainability Standards Board, which operates under the auspices of the Global Reporting Initiative. The 2022 collaboration agreement between both bodies has proved pivotal in ensuring that the respective standards dovetail appropriately and do not add an unnecessary regulatory burden in terms of reporting.

Unification of environmental standards (e.g., with https://www.ipcc.ch/) has enabled integration into the quality assurance systems embracing production and services and has driven significant changes taking place in any economic activity. For example, corporations are now taxed not just based on their financial profits but also on other measures that assess their true impact on the planet. This is also built into the investment and lending decisions of financial institutions, including rating agencies. Any company not deploying enhanced quality assurance is confronted with robust extra costs connected with financing their operations, skyrocketing insurance costs, funding constraints, and challenges in cooperating with global supply and technology chains, all of which undermine the ability to remain competitive as a market player.

With this vision of 2030 in mind, the following issues and recommendations are presented with respect to metrics and measurement systems.

Chapter Issues Summary Overview:

Metrics and indicators are essential for data-driven decision making in response to our climate change concerns. Here we summarize our research, issues, and recommendations, in response to these societal needs:

1. A balance of metrics and indicators are needed versus current capitalistic, resource-driven models that do not equitably consider environmental and societal circumstances and side-effects.
2. Metrics provide targets, act as feedback, and highlight the need for further change in behavior (individual and entity, physiological, psychological, environmental, and local to global), as well as allow us to learn gaps in knowledge that can be addressed through innovation.
3. Change will require new mindsets capable of deploying systemic views and deep education and engagement of all levels of society, industry, and communities in a systematic way.
4. 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.
5. We need to build broader accountability for strong sustainability by design and develop a clear understanding of the true impacts of phenomena similar to ESG.
6. Achieving meaningful change will require moving beyond mere compliance to a higher level of planetary progress and innovation.
7. Standards, laws and regulations for measuring, reporting, and independently verifying sustainability-related performance are numerous, which should be better aligned. / not entirely aligned.
8. Paradigm alterations in technology development and usage/enactment must be considered to best synchronize nature's "technology" with human-based design.

In short, these suggestions aim to provide guidance towards achieving our Planet Positive 2030 Metrics and Indicator objectives and goals.

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 effective monitoring and management capacity (building), 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, as outlined here:

Issue 1

A balance of metrics and indicators are needed to shift away from the current win/lose focus of developing a “business case” driven by 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 accession and enactment that supports the full vision of prosperity that is of positive impact and benefit to all stakeholders and the planet.

Background

The necessary paradigmatic change 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. If sustainability is a core value rather than just a compliance exercise, the focus on quality metrics will be to help organizations assess if their actions are achieving what they value

?and imagine?, 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. Instead, it can facilitate social innovation, business models and pursuit of technologies that aim and show long-term potential and altruistic benefits.

To shift behavior and enhance compliance, proper incentivization is needed to ensure that fuller measures of prosperity are adequately factored into resource accession, allocation and enactment decisions. This requires the “stick” of standards, laws and regulations, but also the “carrot” of incentivizing individual decision-makers partly with improved access to (collective) resources to act on their values and the values demanded by broader stakeholder groups in an equitable fashion.

Given the complexity of the types of metrics and systems needed to measure full environmental impacts and support the pursuit of sustainability goals, there is a distinct need for technological tools to support the measurement, monitoring, reporting, and visualization of the aggregation of transformational processes. The proper sets and implementation dynamics of metrics and measurements enable us to elaborate on and implement effective methodologies aiming to lower emissions and increase the regeneration, restoration, and resilience of Earth’s ecosystems.

Recommendation

There is a need for a set of interplaying metrics that cross domains and reflect stakeholder values described as standards and the principles outlined in this document that provide an innovative way to measure, monitor, and visualize progress towards net-positive products and services, by going beyond carbon neutrality and facilitating the protection and regeneration of ecosystems. It allows combining financial and nonfinancial indicators of life-quality-focused “prosperity” in terms of long-term net-positive success. Metrics need to recognize the interdependence of global societies and ecosystems and the need for greater fairness in resource sharing within and among societies in order to achieve more equitable outcomes to the benefit of all.

New, genuinely net-positive business models are required that promote and implement regenerative approaches. These are aiming and capable of generating profit by restoring also previously triggered (environmental and social) damages, i.e. by going beyond non-generating further damages. These models facilitate personal and collective life quality improvements through tailor-made fulfillment of genuine needs instead of facilitating mass-consumption and self-serving growths. These business models have to rely on dynamic sets of metrics and indicators capable to provide feedbacks simultaneously on

- the altering, becoming more life quality focus needs,
- the proper changes on the technology enactment enabling these personal needs' tailormade fulfillment
    - with decreasing environmental footprint
    - and by restoring previously caused (environmental and social) damages.

Consequently, such non-traditional business models have to follow a perception of prosperity that focuses on the quality of life and environment. These strategies promote multiple wins in practice through extended cooperation overcoming the organizational boundaries and feed backing with altered competition in providing better collective solutions.

The civil society can and has to play an active role in the elaboration and implementation of such business models by generating favorable demand patterns, legislative (including taxation) environment 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 cooperative and sharing social dynamism (Toffler, 1980, 1995; Perlas, 2000; Benkler, 2006, 2011; Rifkin, 2004, 2011; Reichel, 2012; Chase, 2012). These mutually catalytic changes interplay with robust institutional (Giddens, 1984) alterations that can aggregate into a societal culture characterized by a new associational societal kinetics. Such cultural transformation can take place 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). The 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)

Consider introducing Basic Sustainability Assessment Tool (BSAT) here (as an example of measurement systems with balanced metrics?) with screen shots of balanced indicators (#77/79) and introduce the identification of this tool as a Technology Resource for balanced Metrics/Indicators identified by Planet Positive, and available for participation in the Planet Positive "Champions" network being organized through IEEE. (Workshop - Tuesday, 9/21)

Further Resources

- Rifkin, J. (2011) *The Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World*. Palgrave Macmillan.
- Perez, C. (2002) *Technological Revolutions and Financial Capital The Dynamics of Bubbles and Golden Ages*. Edward Elgar.
- Toffler, A.(1980) …
- Crawford, K. (2021). *The atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University Press.

Issue 2

Metrics provide targets, act as feedback, and highlight the need for further change in behavior (individual and entity, physiological, psychological, environmental, and local to global) as well as the need for further innovation. To do so, metrics and indicators need to be reliable, practical, and measure what makes a difference.

Background

To be useful, metrics must reliably and accurately measure what is intended, using the best-proven methods available at the time. As an example, there are a myriad of carbon dioxide calculators available for use but not all provide accurate estimates, nor is carbon dioxide the only cause for climate change. Systems being measured are complex, so it is important that metrics be flexible and adaptable to changes as new information becomes available regarding the indicators most relevant to progress and the underlying relationships being modeled. For example, measurement of greenhouse gasses (GHGs) should be measured using an enhanced Greenhouse Gas Protocol that disaggregates measurement of relevant gasses such as methane, nitrous oxide, and carbon dioxide and considers their dynamic interplay through the inclusion of feedback loops.

Measuring what matters

In terms of measuring what matters, it is important that metrics (or sets of metrics) work together to support holistic decision-making. For example:

- metrics need to reflect the fact that it is not just carbon dioxide that we need to be concerned about, but that all of the planet's ecosystems are out of balance;
- measurement needs to be bio-centric rather than human-centric, reflecting the fragile tensions between human development and biodiversity;
- metrics need to 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 need to be robust enough to support multidisciplinary decision-making by reflecting the elements of importance from a wide range of perspectives;
- metrics have to enable decision-makers to interact with and manage the wicked problems emerging from complex systems whose interplay is driving the emergent Anthropocene era (Shrivastava et al., 2022);
- data collection and measurement needs to enable efficiency by supporting interoperability, i.e., enabling companies to collect data once and use it in multiple ways or formats to meet reporting requirements;
- consideration needs to be given to the "S" and "G" elements of ESG, to better assess the holistic impact of actions. Failure to consider the full scope might lead to short-sighted decisions without due consideration of the big picture.

Metrics need to reflect the context

With metrics, one size does not fit all. Each organization, community/government, and individual needs to adopt a set of metrics that reflects their unique situation with respect to risks, priorities, resources, and core values. Of course, there are commonalities within industries, geographies, and so forth, but even these similarities are tempered by factors such as the level of sophistication and experience of the person or group and the tools and resources available in the circumstances. As such, it is important for metrics to be meaningful in the specific context, and be able to be consistently measured, visualized, and interpreted by the user in order to support progress and guide behaviors. Consistency between organizations, countries etc. (typically achieved through conformance with standards) is also a core requirement for objective reporting over time, such that reported progress can be verified and relied on.

An example of an innovative metric for a particular context, when measuring circularity of a project, consider the "radius of the circle". Nature evolves using small circles in tight ranges of jurisdiction. In contrast, humans might find a "circular" solution, but if that means building products on one side of the globe, shipping it 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 much more wasteful than a smaller radius project.

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 pivot as society learns more about what the real drivers of progress are. Unforeseen and unintended consequences will need to be identified and addressed. For example, in order to provide scope 3 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.

Avoiding technological solutionism

The choice of metrics is important, of course, but their implementation and interpretation is arguably even more important. Special attention should be paid to the proper interpretation of metrics and indicators as tools for effective change, rather than as proponents of *techno-fix* propositions. This requires using metrics in a way that distinguishes what *can* be done from what *should* be done in order to drive meaningful change. By providing a misguided optimism of technology's potential that reinforces existing sociotechnical falsehoods and shifts the focus away from the true issues, the techno-fix approach worsens issues instead of mitigating them (Levidow and Raman, 2020; Sovacool et al , 2020).

In order to illustrate this point, consider the following two examples related to the reduction of GHG-equivalent emissions:

1. *Emissions produced from the use of fossil fuels in ground transportation.*

Today's norms, with respect to social and economic activities, require patterns of mobility that have led to the present use of vehicles for ground transportation. Given that most vehicles still use fossil fuels, one sensible approach is to find technological solutions for vehicles to emit less carbon dioxide, either by being more energy efficient or by replacing fossil fuels with alternatives such as green hydrogen. This approach, however, risks similar problems but in new contexts, such as harmful emissions from other sorts of fuels or the lack of an incentive to decrease vehicle use. Alternatively, we can get to the root of the issue and question whether the level of mobility is really needed. Finding ways to reduce the need for mobility (by, for example, changing perceptions to encourage a "stay at home" mentality as desirable, and/or by incorporating the use of immersive technology such as VR/XR and holograms to augment experiences and create adventure and human connection through virtual means without physical mobility) could lead to lower emissions immediately without negative side-effects. Moreover, it can bring about potential increases in quality of life for people if the time spent in unnecessary transit can be used for other activities.

2. *Emissions produced by raising cattle.*

Human consumption of meat as a primary source of protein demands extensive cattle raising, which as a side effect generates methane, nitrous oxide, and carbon dioxide. Additional environmental consequences of widespread cattle-raising relate to the significant use of energy, water, and land for meat production. Given the observable patterns of diet worldwide, it seems reasonable to look for alternative means to produce meat, such as sustainable farming, synthetic meat, and the consumption of meat from local, more naturally raised sources. This approach, however, bears the same risks as observed in the previous example, as there are limitations for sustainability in cattle raising, and industrial production of synthetic meat might lead to unforeseen environmental and health-related consequences. Alternatively, we can—as suggested in the previous example—get to the root of the issue and question whether the observed nutritional patterns must be taken for granted. Lowering consumption of meat through adopting diets higher in plant-based proteins could lead to lower emissions with the added benefit of a potential increase in people's quality of diet (https://ourworldindata.org/less-meat-or-sustainable-meat).

These examples reflect institutional shifts that facilitate alternative value-creation and business models and support socio-economic activities that fulfill genuine needs without adopting an "infinite growth" mentality. To evaluate these examples fully, however, consideration should also be given to other social consequences, such as:

- job losses in sectors being reduced and retraining that will be needed to shift jobs to new types;
- inequity in access to resources that support the desired changes (such as public transit or plant-based food alternatives); and
- unintended impacts on land development or biodiversity.

Metrics must be measurable

In order for metrics to be practical, it is also 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. The necessary measurement data 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)];
- projects such as DSCOVR and HyspIRI and collaboration with human research programs [(e.g., the National Institutes of Health's "All of Us" Research program, https://allofus.nih.gov/; and Verily Life Sciences, precisionFDA, https://precision.fda.gov/)];
- consideration of how to leverage knowledge derived from traditional and indigenous perceptions and measurements and their interplay with altered patterns of need fulfillment;
- public health programs [e.g., the World Health Organization (WHO), WHO Collaborating Centers, the Centers for Disease Control and Prevention (CDC), and TEPHINET, https://www.tephinet.org/];

- machine-learning and artificial intelligence technologies for big data interpretation and governance frameworks;
- computing power centers and programs (e.g., cloud computing platforms and API providers);
- new training technologies—virtual reality (VR) and augmented reality (AR)—that are immersive and scalable and can immure different environments and experiences locally to globally;
- blockchain and decentralized systems for de-identified data sharing; and
- new energy solutions (e.g., solar, wind, new nuclear technologies, hydroelectric, etc.) that shift us away from fossil-fuel use.

The need for more accessible, open-source data

Open-source data at a census block level is needed to enable well-informed and collaborative decision-making. This can be done while protecting privacy and respecting "trade secrets", through appropriate anonymizing of data. More transparency is needed in the data that is collected so that, for example, start-ups can be evaluated for current impacts (i.e, their current digital footprint) and potential, so that smarter decisions can be made about where to concentrate efforts. Maintaining data repositories does come with a caveat: when storing data, it is important to recognize that data gets outdated quickly in some contexts, and that it often doesn't transfer from one context to another (this is especially important when training AI). This is in addition to the general awareness of the impact of data bias.

Alternatives such as value co-creation in open source communities can provide viable alternatives for knowledge co-production and sharing what probably will require other types of metrics as well as approaches to and ways of measuring.

Use of technology

Technology supports quality metrics by enabling the evaluation of data to determine which factors are actually meaningful in driving progress toward net-positive results. Technological advancements can improve measurement efficiency and effectiveness, and can help gather and analyze broad-scale data to determine where the problems are and where progress is being made. For example, satellite-based measurement of carbon emissions can track data on a global level that can provide comparisons and trends around the world, across the full political and socio-economic spectrums. By pooling comparative data from different jurisdictions (cities, countries, etc.) global progress can be monitored, and evaluations can be made if gains in one region are being achieved by facilitating improvements of global benefit, or by making gains at the detriment of another region. When technological enhancements facilitate more accurate and effective data capture, this leads to more effective measurement and timely reporting.

When applying technology, it is important to understand that today's complex problems don't lend themselves to linear optimization approaches. Technology needs to be applied in ways that are creative and that allow us to further build information and knowledge to manage the complexity and uncertainty in new ways. There is not a straight line solution; multi-route pathways are needed to innovate and solve problems, and there is a need to get beyond the human tendency to think linearly in 2 dimensions. But at the same time - somewhat paradoxically - there is also a need to look for simple approaches, given that rapid progress is essential.

The development of technology solutions also requires consideration that some technologies also tend to come with a huge carbon footprint, at least initially, so the decision is one of trade-offs that focus on where technological solutions have the most potential to result in net-positive outcomes in the shortest time. The application of artificial intelligence to measurement and predictive analytics also provides significant opportunities in measuring and modeling progress toward the UN SDGs. But the incredible potential of big data and predictive analytics must also recognize the inherent trade-off between progress and accuracy and privacy and autonomy. Accurate metrics depend on the ability to get access to large data sets on a continuous basis, but this access comes with several potential downsides:

- Risks to privacy
- Potential for misuse
- Potential for power to be consolidated among a few players
- Risks of misinformation from cherry-picking data, misrepresenting results, and so forth
- Risks of elevated resource consumption due to inappropriate patterns of machine learning using large volumes of data.

These risks point to a need for the judicious and selective collection and use of quality data—rather than mass collection and processing of data—and highlight the need to include robust control and feedback processes. Such controls might entail the rigorous tracking of who is using the data and how it is being used, for example through the appropriate implementation of blockchain technology to make information about data usage “immutable”. At the same time, however, the environmental footprint of collecting and processing data during the measuring efforts must be also considered and measured.

Recommendations:

Metrics need to be chosen that fit the relevant context and that:

- are science-based, objectively measurable, reproducible and reliable;
- consider the challenges and limitations of data collection issues and the tradeoffs of the limitations of the technologies used to monitor and assess indicators
- are practical to use and easy to interpret, in order to drive meaningful change through consistent and timely measurement and monitoring;
- reflect priorities and clearly align with the outcomes being sought;
- challenge assumptions and help support investigation of root causes and beneficial actions that both can and should be undertaken;
- are 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;
- support consistent application (within and between organizations and over time) in order to more objectively gauge changes and facilitate progress;
- are flexible and adaptable to new information, recognizing that we are dealing with complex, adaptive, interdependent systems with significant uncertainty and the potential for unintended consequences (both negative and positive);
- propose trustworthy indications by considering possible differences in various contexts;
- are comprehensive enough to measure direct and indirect impacts across the entire life-span of the product or project; and
- are, ultimately, able to be adequately documented and assured (i.e., be objective such that they can be independently verified).

For a specific organization, entity, or individual, a set of metrics and indicators needs to be carefully selected and reflected in their organizational values and outlined in their Theory of Change (if any). The set of metrics should provide sufficient appropriate information to facilitate decision-making that brings about the necessary socioeconomic transformation(s). The metrics and indicators should reflect—and be adaptive to—ongoing change and should support efforts to not only prevent environmental or social harms but also reverse harms and provide regeneration. The key is prioritizing areas of measurement focus and ensuring adequate feedback processes to test and validate assumptions while measuring actual outcomes.

Maintaining effective Metrics

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

Possible introduction of diagram (Targets PP)

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

The technology requirements include metrics that measure individual to societal factors across trends, inter- and multidisciplinary and integratable, variation comparable, de-identified, democratic, and transparent and tied with specific objectives and outcomes.

Further Resources:

1. Levidow, L., and S. Raman, “Sociotechnical imaginaries of low-carbon waste-energy futures: UK techno-market fixes displacing public accountability,” *Social Studies of Science*, vol. 50, no. 4, 2020, https://doi.org/10.1177/0306312720905084.
2. Sovacool, B. K., N. Bergman, D. Hopkins, K. E. H. Jenkins, S. Hielscher, A. Goldthau, and B. Brossmann, “Imagining sustainable energy and mobility transitions: valence, temporality, and radicalism in 38 visions of a low-carbon future,” *Social Studies of Science*, vol. 50, no. 4, 2020, https://doi.org/10.1177/0306312720915283.

3. Global Partnership for Artificial Intelligence (GPAI). 2021. Climate Change & AI: Recommendations for Government Action. https://gpai.ai/projects/responsible-ai/environment/climate-change-and-ai.pdf
4. Coalition for Digital Environmental Sustainability (CODES). 2022. Action Plan for a Sustainable Planet in the Digital Age. https://wedocs.unep.org/bitstream/handle/20.500.11822/38482/CODES_ActionPlan.pdf?sequence=3&isAllowed=y

Issue 3

Change will require new mindsets and deep engagement of all levels of society, industry, and communities in a systemic 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-word aspirations for achieving net-positive results.

Background

A shift in mindset is needed to one with a more holistic, non-linear 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…

Recommendations:

A fundamental change in mindset is required in order to let nature work, to reestablish and unleash 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 should perceive 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 being part of nature, and we must relearn living in harmony in order to improve our quality of life. Such a fundamental shift in human perception and praxis is intertwined, fed back with profound alterations in types and compositions of the various metrics and indicators to be used. Embedding such new perspectives in education, from preschool to universities, will play a crucial role in achieving the desired mindset change and building awareness and lifelong learning opportunities (UN SDG 4).

There is merit in evaluating new technologies and exploring alternate methods such as the use of metaverse concepts through extended reality simulations of various alternative future scenarios (both augmented and virtual reality or even through neurotechnology methods delivered directly to the brain). Ultrapersonalized immersive scenarios at various levels of society, might enable individuals and collectives to review and assess their own and others' contributions to the ecosystem of the planet, as well as enabling the understanding of how they can contribute to the future wellness of the Earth. These simulation methods can also help test and validate theoretical models and test the appropriateness of specific metrics that have been chosen in a given context, to see if the metrics are providing the necessary information also about the dynamism of changes and if the models are performing as anticipated. Care will be needed, of course, to avoid unintended consequences by carefully assessing the psychological and physiological impacts of these immersive technologies.

Whether using immersive technology or simply focusing on the physical reality that is relevant to communities, there is a need to be able to measure the effectiveness of various tools to motivate and change behavior. These evaluations should be performed in local contexts, in order to harness 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. i.e., measure and monitor what is resonating with people to support different methods of using tech and education (high and low tech) to change behaviours by improving self-image, self awareness etc. At the same time, however, we need to recognize that measuring and 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.

Through transition design methods and tools for simulating various realistic scenarios with leveraging factors that can be used to change future economies, geographic, political, ecology, biodiversity and human impact on each of these, 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. Personalization (such as a visualization of the green and sustainable transformation of an individual's own neighborhood) will create meaningful internalization of the urgency and necessity as well as 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.

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 based, for example, on 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 change of mindsets and worldviews, particularly among those with significant power to make fundamental changes in society.

Similarly, at a corporate/organizational and governmental 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 (e.g., government, industry, and academia) levels and are integrable, comparable, and adaptable based on environmental contexts and circumstances as well as educational (empathetic) contexts across cultures, circumstances, and ecosystems. (t)

Issue 4

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, enabling us to once again be proud to be human.

Background:

The recognition and acceptance of our global interdependence ensures that humans will approach nature 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 to dominate the planet and control its destiny. The responsibilities that result 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 recently, 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.

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 where a plane is hit by a bird strike. No thought is ever given to the poor 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 of crucial importance to recognize also the intrinsic value of every—and any—living being. Quantifying this intrinsic value is challenging, especially given the "ranking" that occurs naturally within the food chain. 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.

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 their 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 general AI, 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?

While these debates must be held, in the interim, technology will assist us in becoming proud to be human by:

1. Helping ensure that we appropriately mitigate the risks of global warming as described in other sections of 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 instantaneous 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

1. Resolve the hierarchy of "rights" of species on planet Earth.

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 human-centred desire for exponential growth. This is a key matter to be resolved, as if we don't 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 other lifeforms 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.

2. 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 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.

3. 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.

The technology requirements include tools that quantify and define individual to societal effects on our global environment (human and nonhuman) across behavioral factors. (t

Further Resources

1. https://www.bbc.co.uk/news/world-32854504
2. https://en.wikipedia.org/wiki/Animal_rights - Animal rights
3. https://www.theguardian.com/environment/2021/jul/25/rivers-around-the-world-rivers-are-gaining-the-same-legal-rights-as-people
4. https://www.icas.com/__data/assets/pdf_file/0006/597300/GAA-Joint-Statement-3-March-2022.pdf

Issue 5

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

Background

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 robust 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. (https://climateaccountability.org/carbonmajors.html).

The probability of genuinely transformational alterations can be significantly enhanced by building on business models that enable reach and improve profitability through truly sustainable, and even regenerative activities. t. Such business models must enable the owners' and operators to remobilize even the stranded assets of trillion USD in market value through truly regenerative activities. Mutually catalytic changes carried out by the core players of global supply chains and ecosystems can provide significant multiplicative effects and can facilitate their aggregation into transformations that ultimately impact the socioeconomic level.

Such overarching transformation requires awareness creation promoting broad cultural shifts. These require using multiple tools, ranging from education to new reporting formats. The latter must combine robust indicator sets with underlying complex models and dynamic simulations, and the findings must be communicated through easy-to-understand visual formats, including dashboards.

Changes must unfold simultaneously in multiple contexts, including corporate sector governance, legislation, policy making and implementation; public agencies and civil society players must capitalize on well-selected and dynamic indicator sets. The concrete setup of such rolling indicators must feed back with actual composition of the constitutive (systemic) factors by facilitating due changes and their aggregation into proper patterns of the emerging transformations. The awareness creation among key players capable of initiating and managing due changes that can embrace from corporate to societal fields all and every constituents of the current global (techno-cultural-) socio-economic constellation can capitalize on a consciously facilitated convergence efforts among various measurements and standards. The proper selection and communication of metrics can help the endeavors of the champions who are ready to take a defining role in initiating and catalyzing necessary organizational changes intertwined with business model innovations.

There is a growing awareness and popularity of ESG-related financial activities, products, funds (including 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 fund ratings 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.,), These are paying 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."[63] 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.

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.

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[63] See https://www.msci.com/our-solutions/esg-investing/esg-ratings

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 US, 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 Chief Executive Officer and Chief Sustainability Officer 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 in 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 robust path dependence and destructive greenwashing.

To effectively encourage innovation and net-positive performance, 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 gauge the firms' GHG emission, carbon footprint while measuring the effect of the transformational business models and such innovative financial tools such as ESG.

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 by using locally available natural resources and sharing knowledge in networks of green communities, smart cities, and other initiatives building and capitalizing on regenerative efforts.

The 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, validated consumer labeling.

The 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 reflects the genuinely regenerative paradigm enabling the ability to manage the multi-faceted challenges of the climate crisis.

A broadly accepted set of relevant metrics and standards can facilitate elaborative models, carrying out simulations and making broadly accessible their findings 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 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. (t)

Further Resources:

1. Carbon Majors Project https://climateaccountability.org/carbonmajors.html
2. Raworth, Kate (2018) Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist. Business books

Issue 6

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

Background

A previous Issue described 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.

In western nations, corporations are a significant part of GDP, while in other jurisdictions, the government takes that role. It is therefore important that incentives that are implemented be designed based on the context and the entity driving economic activity.

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 $925M 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, machine learning (ML), and big data. Similar 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 monitoring. For example, the dashboard developed with regard to the 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 ability to trace the potential impacts of demand-side changes on decreasing environmental footprints and improving life quality. The mass uptake up of demand patterns' alterations can capitalize on target oriented enhancement of awareness and engagement providing genuine empowerment and readiness to contribute to solutions. Similar catalyzation 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 (https://www.climateinteractive.org) with methods similar to backcasting (pathfinding to non-trivial solutions by "walking back" from normative long term positive visions) and role playing (for example 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. Guidance should be sought through standards and governance bodies such as those offered by the IEEE Standards Association.

Recommendations

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

1. Maintaining and expanding regulations that prevent further environmental (and social) 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. Catalyzing large-scale multidimensional changes and their aggregation into overarching transformation requires a systemic approach similar to mission-driven innovation (Mazzucato,2015, 2018 …) combining robust, multidimensional financial incentives, demand facilitation and management catalyzing

the take up of unknown, innovative, expensive and therefore perceived as risky solutions with consistent implementation of regulatory requirements.

2. 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 affect required changes.
3. Visualization tools, similar to dashboards from the International Monetary Fund (IMF), the Massachusetts Institute of Technology (MIT), and so forth, should be used to broaden awareness and facilitate alterations in consumer demand. As an example, the dashboard for IEEE Std 7010™-2020 could be modified to indicate impact on GHG emission.
4. Real-time data collection and analysis, where appropriate, should be integrated with low-technology and qualitative methods to provide a holistic picture of planetary health in both technology-heavy and non-technology environments, in a manner that is quantifiable and reproducible.
5. Appropriate and sufficient governance around the use of data collection should 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 EU's General Data Protection Regulation, and so forth and the conscious convergence of their approaches.
6. The technology requirements include 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.
7. Regulatory decisions that reward and penalize market players by matching access to and costs of financing and resources with efforts and results in providing genuine contributions to prevent and address climate crisis related issues.

TOOLKITS

C-ROADS and En-ROADS simulation tools https://www.climateinteractive.org
https://en-roads.climateinteractive.org/scenario.html?v=22.8.0

IMF Climate Change Indicators Dashboard - https://climatedata.imf.org/

Further Resources

1. Mazzucato, Mariana (2015) The Entrepreneurial State. Public Affairs, New York;
2. Mission-Oriented Research & Innovation in the European Union MISSIONS A problem-solving approach to fuel innovation-led growth. https://ec.europa.eu/info/sites/default/files/mazzucato_report_2018.pdf
3. A Deeper Look at the Global Framework Principles for Decarbonizing Heavy Industry https://www.jdsupra.com/legalnews/a-deeper-look-at-the-global-framework-2642526/?origin=CEG&utm_source=CEG&utm_medium=email&utm_campaign=CustomEmailDigest&utm_term=jds-article&utm_content=article-link
   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.
4. EU's General Data Protection Regulation (GDPR)
   https://gdpr.eu
   A robust set of privacy and security laws, put into effect on May 25, 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 the tens of millions of euros.

Issue 7

Standards, laws and regulations for measuring, reporting, and independently verifying sustainability-related performance are numerous, not entirely aligned, and voluntary rather than mandatory.

Background

Voluntary reporting can become 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 (see Further Resources for information). 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.

The development of robust standards, however, 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, in order 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.

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 recent 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 on reporting but on 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:

- requirements for hitting certain benchmarks need to 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;
- regulators and governments need to also allow for certain 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.

Technology will assist 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 the integrity of the data (this will assist both preparers and assurers in helping to validate the integrity and completeness of the data)
- Facilitating more integrated reporting systems that better allow entities to track their progress on their 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.)
- Facilitating more comprehensive and complex modeling of scenarios by means of predicative analysis to more accurately forecast the impact of entities of different levels of global warming (up to the concept of a "digital twin")
- Facilitating improved accessibility, which enables easier extraction and comparison of information via digital consumption of information provided in accordance with globally recognized taxonomies
- 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 immutable data access and management
- Facilitating greater outreach with stakeholders during the standard setting phase, with the end result being enhanced due process

Digital tools can also support a system of sustainability certification badges/kitemarks, 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 that is similar to - and possibly combined with - a credit rating that could ultimately integrate to better align personal and planetary interests.

This could be provided for organizations, governments and communities, or even individuals;

- A jurisdictional rating that reflects commitments and verified progress against those commitments. This could also factor in as a positive where support is given to developing countries, marginalized communities, and so forth by helping to strengthen positive change tendencies.

Recommendations

1. Globally-recognized standards are needed to attain net-positive goals. These standards are likely to be developed and promulgated by recognized international standards organizations, and can then be leveraged by local jurisdictional standard-setters.
    a. Standards for corporate or organization and government entity reporting should reflect not only 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, etc. 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 the financial statements.
    b. 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.
    c. In addition to reporting and assurance standards, requirements for ethical decision-making are essential to guide behavior. To this end:
        i. 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.
        ii. The International Ethics Standards Board for Accountants (IESBA's) *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.

2. Standards need to be robust enough to reflect the breadth of relevant activities undertaken by organizations, governments and communities, and individuals. These standards should reflect a holistic multi-stakeholder approach, recognizing the interdependence of global systems and cultures.
3. All countries—*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.
4. Standards should 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 should 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.
5. Complying with (or exceeding the requirements of) standards must be adequately incentivized:
    a. Executive and senior leadership remuneration packages should adequately reflect expectations for meeting suitable sustainability metrics.
    b. Regulators and legislators should provide clear requirements for organizations, governments/communities, and individuals with respect to standards, and should 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.
    c. Governments should incentivize innovation to meet and exceed standards, through tax policy, grants, and similar means.
    d. Governments should adequately price GHG emissions, with carbon, methane and nitrous oxide having externality prices based on their vastly different global warming potential (GWPs) and thorough monitoring of changes in their emission by particular firms.
    e. Investors need to engage with corporations and promote the need for sustainability to be embedded in organizations, and take action against those boards that do not place sufficient importance on this. This will include voting on remuneration schemes for executives.

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 to reflect the realities of varying levels of technological maturity in different jurisdictions.

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. In addition, to the extent that standards use metrics to represent properties of the system being assessed, it would be beneficial to settle on a measurement framework to define a hierarchy of factors of different granularity early on. This will support the availability of comparable and combinable data in the future to the largest extent possible, minimizing the risk of double counting and apples-to-oranges comparisons.

During the period of uncertainty that will exist until the most appropriate standards rise to the top and become widely adopted, it is essential that reporting includes sufficient details regarding the underlying methodologies used to allow for consistent interpretation by readers. This 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).

Sufficient transparency can also support the assessment of data validity, by allowing for benchmarking to occur in local contexts 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.

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 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.

The technology requirements include tools that quantify and measure emissions, communication and distribution, progress reporting, and modeling and prediction. (t)

Further Resources

Current Standards and Standard Setters

European Financial Reporting Advisory Group (EFRAG)
https://www.efrag.org/

EFRAG is a private association established in 2001 with the encouragement of the European Commission to serve the public interest. EFRAG extended its mission in 2022 following the new role assigned to EFRAG in the proposal for a CSRD of April 21, 2021, providing technical advice to the European Commission in the form of fully prepared draft EU Sustainability Reporting Standards and/or draft amendments to these standards. Its member organizations are European stakeholders and national organizations and civil society organizations. EFRAG's activities are organized in two pillars:

- A financial reporting pillar, which influences the development of IFRS Standards from a European perspective and how they contribute to the efficiency of capital markets and provides endorsement advice on (amendments to) IFRS Standards to the European Commission.
- A sustainability reporting pillar, which develops draft EU Sustainability Reporting Standards and related amendments for the European Commission.

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 governments, 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

"IEEE Draft Model Process for Addressing Ethical Concerns During System Design," in IEEE P7000/D7, April 2021 , vol., no., pp.1-83, 20 April 2021.

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, pp. 1-6, doi: 10.1109/ISTAS48451.2019.8937964.

Adamson, G., J. C. Havens, and R. Chatila, "Designing a Value-Driven Future for Ethical Autonomous and Intelligent Systems," in Proceedings of the IEEE, vol. 107, no. 3, pp. 518-525, March 2019, doi: 10.1109/JPROC.2018.2884923.

Spiekermann, S., “From value-lists to value-based engineering with IEEE 7000™,” 2021 IEEE International Symposium on Technology and Society (ISTAS), 2021, pp. 1-6, doi: 10.1109/ISTAS52410.2021.9629134.

K. Shahriari 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, pp. 197-201, doi: 10.1109/IHTC.2017.8058187.

Peters, D., K. Vold, D. Robinson, and R. A. Calvo, “Responsible AI—Two Frameworks for Ethical Design Practice,” in *IEEE Transactions on Technology and Society*, vol. 1, no. 1, pp. 34-47, March 2020, 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, pp. 2746-2753, doi: 10.1109/SMC42975.2020.9283454.

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 3 November 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.

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
        i. Percentage (by weight) of raw materials third-party certified to an environmental and/or
        ii. Social sustainability standard, by standard
        iii. Number of tier one suppliers and suppliers beyond
    b. Appliance Manufacturing
        i. Percentage of eligible products by revenue certified to an energy efficiency
        ii. Certification
        iii. Percentage of eligible products certified to an Association of Home Appliance Manufacturers (AHAM) sustainability standard
        iv. Description of efforts to manage products' end-of-life impacts
        v. Annual production (number of units)
    c. Extractives and mineral processing
        i. Building Products and Furnishings
            1. Total energy consumed
            2. Percentage grid electricity
            3. Percentage renewable
        ii. Description of efforts to manage product
        iii. Lifecycle impacts and meet demand for sustainable products
2. Financials
3. Food and beverage
4. Health care
5. Infrastructure

6. Renewable resources and alternative energy
7. Resource transformation
8. Services
9. Technology and communications
10. Transportation

Likewise, the GRI standards also contain various metrics.

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

Issue 8

The role of technology is an essential capability for measurement (metrics), monitoring and control (advanced technology), and modeling scenarios to enable multi-disciplinary domains to DESIGN, plan, and act with a new paradigm and unified focus on the metrics and indicators, as addressed above.

Introduction:

Paradigm alterations in (engineering /technical) technology development and usage/enactment must aim to improve life quality by fulfilling genuine human needs through best and relevant synchronization with ocietal and natural “technology”. The successful utilization and implementation of new technologies frequently may require alterations in socioeconomic models (“technologies”). These simultaneous transformations contributing to a new reality are fundamental in achieving strong sustainability goals by design. An important institutional and industrial consideration to enable this transformations is the recognition that the value production is growingly shifting from physical assets to intellectual solutions through knowledge co-creation and sharing and have gone from stovepipes to complex and interwoven systems of systems where small changes can cause big effects and vice versa.[1] Therefore, technology needs to be recognized as an “essential” and empowering capability. It enlarges the capacity of any organization or community to manage physical resources more effectively and to replace them with soft resources and optimization techniques (e.g. machine learning, artificial intelligence, communication platforms, etc.) (key point here: is data/information/knowledge/co-creativity). Such altered value co-creation potential is emerging partly through the design of systemic level automation which includes the collection, processing and use of data on operational processes and outcomes. Such new technologies with impactful new designs and strategies enable strong sustainability and can augment human creative capacities by mobilizing human insights and systems knowledge and building new capabilities through collaborative intelligence, allowing individuals to focus in these areas versus conducting laborious tasks [2]. Our Recommendations suggest tools and applied technologies that enable truly data driven decision-making and enabling adaptabilons through support of effective measurement, monitoring, and controlling at systemic level. Such “green digitalization” capitalizing on new edge computing and ethical algorithms, computational processing power, and data acquisition and computation (e.g. artificial intelligence, machine learning, biomedical informatics, environmental observation, big data, etc.) has to facilitate transformations simultaneously in technical /engineering, as well as in social and in business technologies. These outcomes and actions should provide the capacity to build and analyze interplaying new scenarios and models that facilitate improved decision making for our global society by capitalizing on continuously provided information (i.e., contextualized indicators). Consequently, such green digitalization presupposes and catalyzes the capability of growingly automatic monitoring and controlling by measuring results, i.e., metrics that reflect both outputs and outcomes at systemic level.

Background

"Technology is the result of accumulated knowledge and application of skills, methods, and processes used in industrial production and scientific research. Technology is embedded in the operation of all machines and electronic devices, with or without detailed knowledge of their function, for the intended purpose of an organization. The technologies of society consist of what is known as systems. Systems operate by obtaining an input, altering this input through what is known as a process, and then producing an outcome that achieves the intended purpose of the system. The earliest and simplest form of technology is the development of knowledge that leads to the application of basic tool" (https://en.wikipedia.org/wiki/Technology).

The current patterns of technological utilization enable organizing the production cycles in truly global scale by generating large energy, information, communication, and material flows. The resulting global information, communication, material and energy flows became the primary drivers of the emergence of Anthropocene and its major constituents, including the climate crisis. The Anthropocene is perceived as a "…geological epoch dating from the commencement of significant human impact on Earth's geology and ecosystems, including, but not limited to, anthropogenic climate change" (https://en.wikipedia.org/wiki/ Anthropocene) The destructive dynamics characteristic for the age of Anthropocene, menaces with the collapse of the terrestrial ecosystem[1]. The issue is that the current patterns of globalization bring about as unintended side effect waves of mass extinction that may also trigger the self-destruction of the human species.

The technology advancements enable to extend life expectancy and improve the health and social care systems' effectiveness. However, instead of improving the life quality the human population's resulting rapid increase undermines the Earth's capacity of systemic self-reproduction. I.e. the technology (development) remains part of the problem instead of becoming genuine driver of the solution. By deploying technologies without transforming the characteristic patterns of their enactment (Orlikowski 1992, 2000) the human societies seem to push themselves forward into the dead-end of Anthropocene. Additionally, there is data to suggest how our technological advancements have approached diminishing returns and can also be detrimental to human health, with life expectancy in developed countries actually lowering.

To alter the characteristic patterns of technology enactment requires deploying both cooperative social technologies and business models that follow new paradigm applications, as well as are considerate of nature. These transformations are inseparable from robust institutional changes (Giddens, 1984) including the acceptance of the dual primacy of interdependence and non-zero-sum approach what feeds back also with profound alterations in the characteristic / dominant patterns of the technology *enactment* (Orlikowski 1992, 2000). Such institutional transformation can bring about a shift toward a new quality and level of cooperation and simultaneous re-incorporation of the Ethics into the Economics and into the daily economic praxis. Such a robust attitude shift is intertwined with the recognition that every form of life and nature have an intrinsic value that is independent from any market, financial or other econometric approach to value. This setup facilitates focusing on chasing improved harmony with nature by overcoming the destructive attempts of “dominating and ruling” it.

A conscious switch to a “green digitalization” requires overcoming the institutional dominance of zero-sum-game paradigm intertwined with the (growingly artificial) resource scarcity view, bringing about dominance seeking in social context as well as in relation to nature and the terrestrial ecosystem as a whole. To put it in another way: without such robust, ethically oriented shift in technology enactment the (mass-) digitalization can continue bringing about unexpected destructive aggregate side effects despite the emergence of the newest, potentially most promising technologies.

Currently there is a challenge with a mindset focused on implementing the “technologization of nature” by taking over its “operation” as in the case of attempts of global geoengineering. Alternatively, there is an opportunity to focus on the “naturalization of technology enactment,” that is, let nature work, including healing the previously caused damages. It is of paramount importance to stop and prevent generating further harms and destructions while assessing the current damage of the planet. Artificial Intelligence has created already positive environmental impacts around the world, and to ensure an effective “technologization of nature”, businesses and organizations can utilize machine learning systems to monitor and evaluate their usage of environmental resources and make an assessment how to ensure “profitable” positive planet resources utilization. Alongside the positive implications of AI the future enhanced learning AI based systems will need to take into account the negative environmental impact (i.e. energy usage for deep learning processes), which is crucial moving forward towards new designs to enhance nature and prescribe effective systems and processes that will preserve and enlarge the benefits of nature. Such Strong Sustainability by Design (SSbD) can and has to be regenerative, i.e. can facilitate to recover previously triggered environmental and social damages. By following such an approach, the engineering (technical) technologies can serve as auxiliary, complementary, and supplementary catalysts of the natural processes, providing robust multiplicative effects.

Living in harmony with nature, knowing and using natural processes enables us to naturalize our available engineering technologies. We can re-focus on using technologies as catalysts by simultaneously multiplying the effects while reducing the required resourcing. Moreover, we can further advance technology as a foundational platform to enable the goals to be met and to develop new technology platforms that are designed to optimize Sustainability. For a harmonization between the needs of society and the needs for a sustainable planet positive we need to enable a “digital needs planet framework” to provide a planet-positive-centric lens to businesses and society that can focus their technology strategy into putting the planet’s needs at the heart of what they do and safeguard the planet and innovation for future generations. Using innovative “human technologies” including enabling business models can facilitate the accelerated take up and mass enactment of the technologies designed for strong sustainability by harmonizing with, relying on and re-enacting the mechanisms of nature while improving life quality through fulfilling genuine human needs.

Consequently, the strong sustainability by design (SSBD) as a paradigm[4] is to be intertwined with a systemic approach and can take place through interplaying feedback loops among major transformations affecting at least three major fields, namely (i) the standards, metrics and indicators, (ii) the technologies with "Ethically Aligned Design for Sustainability", and (iii) the models of business models facilitating / enabling these technologies rapid mass-deployment and regenerative enactment in the daily praxis. Therefore, besides a Roadmap Compendium and an Impact Accountability Assessment Tool which are planned to elaborate an "Ethically Aligned Design for Sustainability" approach probably has to be amended also with an explanation of the fundamental principles and mechanisms of the related **business models**.

Recommendations

Consider this section as continuation of the Background and group Recommendations below?

- A *simultaneous work* on the necessary standards, metrics and indicators measuring and facilitating the alterations on the business side constitute a growingly urgent task that must be in the core of the SSbD related efforts. (As a related case SEE "Time to Blow Up Electricity Markets -100-10—10789.DOCX".) It is required to enable the rapid enough technology take up / mass-deployment by radically transforming the human socio-economic praxis in order to achieve the two "impossible" Planet Positive goals[5]. These efforts have to consider also the various attempts aiming to develop more effective macro-indicators in order to overcome GDP related limitations that had taken place for example in the frame of the Stieglitz committee (?2009) and in the context of other indexes similar to the National Gross Happiness, etc.…)

- Upon the SSbD approach, increasingly digital *technologies* can serve *as* a *platform* that enables to carry out mass-measurements by deploying dynamic sets of standards, metrics and indicators. Such digital technology platforms can carry out growingly sophisticated data collection, processing, enabling systemic level modelling and simulations. The rapid global spread of sensors and automated data transfer (using 5 /soon 6/ G systems) facilitates accelerated temps of emergence of large global data bases to be used to improve the monitoring and controlling of the technologies and their deployment in human praxis.

- The effectiveness of SSBD requires and catalyzes
    - a turn to system thinking
    - to focus on life quality improvements through growingly tailor-made fulfilment of genuine needs instead of catalyzing growth becoming growingly self-serving and generating increasingly destructive global material and energy flows
    - a green digitalization

  - § intertwined with robust institutional and socio-cultural changes unfolding through ethically-weighted transformations affecting both the Economics and the economic praxis and that

- o facilitates to reach and improve harmony between the human praxis and the nature, its constitutive processes

- o by deploying technological solutions through emerging Web3.0 it will offer the capability to personally control data and provides the collective capacity to realign ethics into a data-driven regenerative economy

- o enables – for example by using Digital Twin technologies - to monitor in real time large-scale environmental changes to the Earth's ecosystem on a geographic and planetary basis.

- The standards, the metrics and the indicators should serve human activities, socio-economic praxis, which is based upon and facilitate "robust harmony-seeking" (instead of dominance seeking). It presupposes and requires the understanding and deeply rooted acceptance that the human practice have to consider (and also support) complex patterns of multiple feedback loops (rather than trying to perceive /and simplify/ them as mechanical relations between unidirectional cause-consequence dyads. Such an approach requires the deep understanding of the interplaying processes constitutive of the nature's operation and to perceive their complex dynamics as enabling context for the increasingly cooperative human activities.

  - o 1. Security and Privacy must be foundational by design.

  - o 2. There will be multiple technologies intersecting with Digital Twins like blockchain; Non-Fungible Token [NFTs] ; cloud computing; AI as examples.

  - o 3. These technologies together with Digital Twin technologies will have implications to our climate Example is Biodiversity:

    - § https://pubs.acs.org/doi/full/10.1021/acs.est.2c01562

- 4. There will be example of new disciplines given the intersectionality between computer science and law, for example, a crime that is committed within a Digital Twin world say the Metaverse, would they be prosecutable? One could imagine a new discipline like Metaverse Law or more discreet, Digital Twin Law:
  - See: https://www.beyondgames.biz/21556/murder-in-the-metaverse-could-be-a-real-crime/
  - https://link.springer.com/article/10.1365/s43439-022-00056-9
  - https://www.kingsleynapley.co.uk/insights/blogs/criminal-law-blog/the-metaverse-virtual-offences-real-world-penalties
- 5. "In short, our online lives are evolving..."
  - https://asia.techdata.com/the-role-of-the-metaverse-in-2022-and-beyond/
- (Reference - Matthew Ball, The Metaverse and How It Will Revolutionize Everything, Liveright Publishing Corp, 2022.)

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[1] KM World (July/August 2022), Art Murray

[2] Jozsef's Article on Collective Intelligence – cited here

[3]

[4]"Noise", Olivier Sibony (professor of strategy/business policy at HEC Paris, and Daniel Kahneman, Nobel Prize winning psychologist

[5]KM World (July/August), Art Murray

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[1] The Limits to Growth (1972), …

[2] Efforts to see and explain the systemic processes through mechanistic cause-effect pairs, without trying to understand the interplay among the various feedback loops generate the "systemic incapability" to explore and map the (dynamics of / among the) interfering processes. The practical acceptance and capacity to systemic thinking is crucial to enable overcoming simplifications that the current – often hidden – dominance of a mechanistic (in negative sense "Newtonian") approach in the social science continue to follow..

[3] https://hbr.org/2012/10/big-data-the-management-revolution

[4] "The Strong Sustainability by Design (SSbD), aimed to be used as a pragmatic tool for businesses and policymakers alike for the deployment of existing technical solutions and the creation of new technology that prioritizes people, planet and purpose-driven progress."

[5] "Our two "Impossible" Goals:

1. Transform society and infrastructure to achieve Planet Positive 2030. ("Planet Positive 2030" - Reduce greenhouse gas emissions to net 50% of 2005 emissions by 2030 and significantly increase regeneration and resilience of earth's ecosystems).

2. Identify the technological solutions we need to design, innovate and deploy to reach Planet Positive 2030."

[6] https://www.strategy-business.com/article/Digital-Technology-and-Sustainability-Positive-Mutual-Reinforcement

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Economics and Regulation

Wall Street Journal – January 1, 2030

A Caring, Inclusive, Circular, Sustainable (CICS) Economy is establishing itself globally/ The Value overhaul of the Global Economy: Drivers and Distribution of Wealth

The last few centuries of economic theories and practices took a long time to change. Until now, 4 billion people were not exactly a part of the global economy. Women. Now in 2030, less than a decade since the Glasgow Climate Pact, the global thinking around what constitutes success for a nation, for business, for society, and for individuals has completely changed. We have moved from a growth-driven, competitive, extractive, and unsustainable economy to a caring, inclusive, circular, and sustainable economy where "value" comes from very different sources compared to the economic thought of just a decade ago.

Scientists, engineers, economists, policymakers, and of course, the public have made this happen in less than eight years. Growth and margins are not the only mantras of the businesses anymore; non-extractive value drivers, caring and well-being metrics are the new norm for businesses. Nations don't pride themselves just on their growth in Gross Domestic Product (GDP) any longer but boast their march towards the Global Goals (Sustainable Development Goals) and beyond. The year 2028 saw the achievement of over 75% of the targets set out by the United Nations. We don't talk about an extractive economy depleting the resources of the planet, but a regenerative economy focused on the diversity of the planet and well-being of all life forms, and all of humanity.

This revolution was possible because it was rooted in every single nation and the indigenous peoples across the world, and not just the advanced markets. Businesses are focused not just on the financial profit & loss and cash flow statements but consider the carbon-based P&L and carbon flow statements as equally important. Individuals across the globe are tracking their carbon footprint and well-being scores to help each other further reduce waste, enhance air quality, and reduce carbon footprint. Governments are leading the charge by establishing the right legal infrastructure and incentives to change the behaviors of businesses and their citizens. Technology is enabling this transition rather than fuelling the extractive economy. Open-source data, code, and models are enabling individuals, businesses, and national governments to learn from each other and build on the successes of others.

The sovereign wealth funds, private equity, and venture capital funds of the previous decade have transformed into green funds contributing to the phenomenal investments in technologies and businesses that are building the CICS economy. We have shown as a global community that we can take action, and swift action to course correct and create a better future and a better planet for the generations to come.

Issue 1

There is a key conundrum between economic growth and the exacerbation of the climate crisis that needs to be addressed in the statistical and other models for how wealth, value, and sustainability are measured, shifting from a competition framework to a mutually beneficial framework.

Background

How much of the climate crisis is attributable to economic growth? Is the real issue about pricing in (or not pricing in) all relevant externalities (e.g. pollution, environmental degradation, etc) and how can the economic system resolve the imbalances?

The main metric in our current economic system revolves around pricing, as it lends itself as a universal tool to translate the valuation of scarce goods and services across an entire society. Within this system, legislative and regulatory frameworks ideally provide balancing impetus in order to shape economic activity according to societal demands. This is common, for example, through most modern tax systems, corresponding tariffs, and governmental regulatory measures. As industrialization has progressed over the past century, frameworks to manage environmental effects, though present, has failed to keep up with the level of degradation that has led to the climate crisis. With relevant externalities not being priced in sufficiently, the environment has suffered and is still suffering, without corresponding costs being captured in economic transactions.

However, while pricing in externalities may resolve to capture environmental degradation costs, and thus ideally steering economic activities towards sustainable paths, it would also lead to an economically disadvantaged position for lower-income countries (LICs). Industrial development has historically already taken place in higher-income countries, whereas it may then no longer be attainable by LICs, as required investment scales would multiply to prohibitive levels. Furthermore, responsibility for the bulk of CO_2 emissions in the past century sits disproportionally with higher-income countries, raising questions around equity. Some of these topics have been analyzed already and are part of the United Nations Framework Convention on Climate Change (aka COP agreements).

Recommendations

Reserve incentives for companies that don't just NOT harm future environmental growth or human harm, but only give incentives to organizations/companies whose process/products actively contribute to better futures

Technology Transfer to LICs that can mitigate the impacts of pricing in externalities within current economic and regulatory frameworks.

Issue 2

Growth as the sole indicator of progress for economics has accelerated harms to the planet when rapid economic development is prioritised over sustainable human and environmental flourishing.

Background

On the path to sustainability, cutting down growth/limiting consumption often raises questions of equity. No one wants to be left wanting, for example, countries still on the road to development, and debate why they should have less claims than other countries who have gone before. In this context, sacrifice is not appreciated nor does it scale. We should explore solutions to move from the era of mass consumption to the era of smart consumption.

Recommendations

AI and many emerging technologies could be used to identify and increase human wellbeing while prioritizing environmental sustainability. As satisfaction is a key attribute that guides humans, is it possible to use technology to provide the user with an optimal level of satisfaction while conserving resources?

As an example, consider a house left fully lit while only one room is occupied. The room's occupant is satisfied because it is illuminated but has no need to leave all the other rooms lighted. He overconsumes the resource without any real additional satisfaction.
Intelligent consumption would be to have the ability to keep the room in use as it is so that its user remains satisfied while automatically switching off the others, thus combining end-user satisfaction and resource usage optimization.

This is only an example, but several such optimization scenarios can be identified.

Also, growth has been defined in terms of human capital growth. It could be re-defined to also include environmental growth and benefits, as well as a system that is equitable versus competitive

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Further Resources

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MOBIUS team, combining the INSEEC Business School (for the economic model) and the ECE, engineering school (for the technical designs).

Issue 3

The realization of technological standards regarding environmental rights and regulatory measures calls for transparency and stricter laws that reflect ecological norms and ethics.

Background

Humans have environmental rights. But humans are also the only part of the environment that actively uses natural resources and therefore have duties. Human environmental right is balanced by obligation in respect to nature and society. This obligation may be voluntary; encouraged by law or prescribed by law. Duties include not only the obligation of active regeneration but also the obligation of enhancement of nature.

Also, technology can help us learn more about our environment and in turn guide regulatory policy and ethics.

Recommendation

The development of innovative green technologies should be supported by appropriate law. The present national regulatory systems are isolated from each other. It is necessary to build a unified global legal system, which shall include ex-ante and ex-post policy measures. Social-ecological norms and ethics should be reflected in Environmental Social Governance and law.

The EU Green Deal has a framework of regulations and policies formulated by the EU Commission that in turn become laws for EU countries. It helps us understand how (and what initiatives) they plan to finance the transition to a greener planet and the regulation required in different areas. (see appendix for a detailed description).

Environmental policy should be focused not just on the well-being of humans but also on the welfare of the natural environment (taking into account human and environmental limits) because only then the most favorable conditions for the flourishing of humans, nature, and the planet are created.

Policy measures include:

- **Environmental rights:** The environmental rights and duties should be recognized by the international community. If environmental rights are detailed in national constitutions, they guarantee access to justice. Regulation should be broadly construed so that the public's interest is the priority and constructs like "trade secrets" are the extreme exception?

- **Legal Restrictions:** It is necessary to develop the restrictions of ecologically harmful acts at the appropriate level (e.g., penalties, ban of activities, non-monetary sanctions).
- **Legal Stimulus:** It is necessary to develop monetary measures (tax, loans) and non-monetary initiatives (training, awards).
- **International cooperation:** It is necessary to elaborate international measures:
    - International Cooperative Treaties
    - International Standards
    - International Sanctions

Further Resources

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Issue 4

Adverse fallouts from climate change are an existential crisis that blocks growth and has serious consequences on the public's mental health well-being and but are not being given enough attention.

Background

Human well-being is tied with basic resources for a good life, health, good social relations, security, and freedom of choice and action. These are intertwined with direct and indirect drivers of change, that can affect the individual, family, community, and environment, with direct drivers of change including local land use and cover, technology adaptations and use, harvest and resource consumption, climate change, and indirect changes of change which include demographic, economic, socio-political, science and technology, and cultural and religious. These are tied with the ecosystem, which evidence is showing has been affected due climate change. This change in environment will, directly and indirectly, affect all the aforementioned factors, and in particular, will affect human well-being, in the context of physiological, psychological, and behavioral mechanisms. At the individual level, health is tied with income and employment, food and water availability; income and employment are tied with production, and some trades (e.g. agriculture) can be directly affected by climate change (e.g. changing weather patterns, increased temperatures, land degradation, etc.) that will in turn affect production, food, and water availability, etc.

Human physiology is directly related to environmental conditions (e.g., temperature, humidity, air quality) and diet (e.g., caloric intake, macro-, and micronutrient availability, water quality, and availability, etc.), and limitations in care, in particular in developing countries, disadvantaged, rural, low-resource communities, etc., that already face limited/lack of resources compared with developed countries, will only be exacerbated by the effects of climate change. For example, in 2000, worldwide undernutrition accounts for nearly 10% of the global disease burden, which with decreased agricultural production and sharing resulting from extreme weather events, will only be exacerbated. As another example, the burden of disease from inadequate water, sanitation, and hygiene totalled 1.7 million deaths and resulted in the loss of at least 54 million healthy life years annually; along with sanitation, water availability and quality are well recognized as important risk factors for infectious diarrhea and other major diseases. Some 1.1 billion people lack access to clean drinking water and more than 2.6 million lack access to sanitation. Related to these major diseases are vector-borne diseases, which cause approximately 1.4 million deaths a year, mainly due to malaria in Africa; these infections are both an effect and a cause of poverty, with the prevalence of these infectious diseases appearing to be growing, and environmental changes such as deforestation, dam construction, road building, agricultural conversion, and urbanization are contributing factors in many cases. Climate change will only exacerbate these effects.

Psychologically there are also consequent mental health effects, with consequences including mild stress and distress, high-risk coping behavior such as increased alcohol use, and occasionally, mental disorders such as depression, anxiety, and post-traumatic stress. Climate change-related impacts can also lead to job loss, force people to move, or lead to a loss of social support and community resources, all of which have mental health effects. In turn, the combined physiological and psychological effects of climate change may result in negative behavioral outcomes, that will only make it more challenging and difficult for individuals, families, and communities to live a healthy life, and for societies to work together in addressing the effects of climate change in both the short- and long-term.

Recommendations

A key factor for all economical metrics must be to significantly prioritize caregiving for human physical and mental health, as it's a driver that will also positively impact environmental sustainability.

Towards this end, study how research and quantitative approaches can assess physiological and psychological adaptations resulting from climate change which can be integrated into economic models as a population factor of productivity/output. Then identify strategies and factors (integrated into the economic model) to support improved productivity and output for those based on circumstance.

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Issue 5

Rural economies are too dependent or linked with urban economies. Also, urban issues may get a greater attention than rural challenges. Need to ensure rural economies also thrive and actively participate in sustainability activities.

Background

Thriving rural areas are a condition for the growth of sustainable global communities.
The social and economic crisis caused by the COVID-19 pandemic has highlighted further the importance of access to services for vulnerable population groups within rural regions and the importance of sustainable food supply chains to neighboring metropolitan areas.

The Green corridors, which were piloted throughout the pandemic exemplify the unshakeable connection between rural and urban. Within the EU the expansive discussion of "smart cities" has transitioned toward "smart cities and communities", bringing forth the capacity to connect these interlinked systems. As a provider of agriculture products for the food industry, the rural region plays a significant role in the security of a country (exemplified by supply chain pressures), while it remains representative of the vulnerability and disparities in various regions. Rural areas are sparsely populated and with an aging population(notedly for Europe, where Eurostat consistently reports demographic decline and depopulation of large areas).

Rural areas are sparsely populated and with an aging population (notedly for Europe, where Eurostat consistently reports demographic decline and depopulation of large areas). Rural areas have higher poverty rates (25.5%) than cities and towns with 24% and 22%, respectively (Eurostat, 2017). Wage and labour retention significantly vary between urban and rural areas and between the various rural areas in the European Union (EU) and globally. FAO 2019 reports that 14% of rural business owners in the EU-28 (including UK) face difficulties in access to basic digital education. The same is true, globally where a significant portion of small and medium farmers face difficulties in acquiring access to digital services and solutions. At the same time, rural areas are expected to adopt a more sustainable approach to agriculture production practices and to reduce greenhouse emissions for which agriculture is primarily responsible (with 1/3 of greenhouse emissions coming from agriculture produce).

Climate change impact is most significantly present within rural economies at local, regional, and global scale with lengthening seasons of droughts (most recently exemplified by 10-year record heatwave in Italy) and consistent need for irrigation, and support of the ecosystems involved in local production and livelihoods. Ecosystem pressures continue to weigh down produce quantity and quality, affecting food security and human health. The considerable impact which can be translated to monetizable values is present in soil pressure and water systems, fundamental to sustain human existence, and under the pressure of sporadic seasonal changes and impact.

The challenges with which rural areas are faced can be summarised in a number of dimensions – demographics (depopulation and aging population, vulnerable groups), economic (access to basic services and economic growth challenges), climate change challenges (pressures on systems and livelihoods), digital (equitable access to tools and solutions). These challenges are also quite specific and should be considered from the perspective of regional and geographic context.

Recommendations

Rural economies have a significant role to play towards the solution of global climate change issues and to reach the targets of the sustainable development goals (UN SDG 17). There is an interlink between the various challenges and pressures that rural economies face, which makes them that much more difficult to solve.

Demographic considerations the creation of jobs and provision of equitable services within rural areas is important for the growth of sparsely populated regions. Rural revitalization is an important consideration for European areas and is covered by the Common Agriculture Policy's (CAP) second pillar, where growth and cohesion are subsided, but the demographic trends persist. *Further analytics is necessary, which ought to connect policy with long-term outcomes.*

Economic considerations Rural economies are a significant producer of goods and services, which pertain to, most importantly, the food industry. Ecosystems present in rural areas are the "backbone" of biodiversity and species conservation. While the significance of these systems cannot be understated the income gap between populations in rural areas and within cities continues to grow. *Additional considerations are needed for the monetization of rural ecosystem services, to support the growth of rural areas, and to support their demographics.*

Climate change impact consideration *Smart farming solutions can help resolve some of the issues with which rural areas are faced.* Precision farming could be utilized to reduce the use of irrigation water by 18%, nitrogen fertilizers by 35%, and total herbicides by 62%, in comparison to conventional farming practice (ENRD,2018). But the implementation of digital solutions is still a challenge, due to the need for improvement of *digital literacy.*

Further Resources

- . *https://www.ers.usda.gov/topics/international-markets-u-s-trade/countries-regions/european-union/common-agricultural-policy/ - Common Agriculture Policy(CAP)*
- *https://www.iotforall.com/smart-farming-future-of-agriculture - Smart Farming*
- *https://enrd.ec.europa.eu/home-page_en - European Network for Rural Development*
- *http://www.fao.org/news/story/en/item/1379373/icode/*
- *https://www.oecd.org/greengrowth/sustainable-agriculture/2739771.pdf - OECD report on sustainable agriculture*
- *https://ec.europa.eu/clima/policies/strategies/2050_en - EU Strategy 2050*

Issue 6

Landfills are sources of Greenhouse Gas emissions (GHGs) as well as disrupt livelihoods of people living nearby them. The core reason for products ending up in landfills is because they are marked as worthless at some point. Recycling products has not been effective.

Background

There is a need to facilitate a universal framework for producers of goods (such as apparel) preventing these from ending up in landfills. This requires a playbook based on principles of Science, Design, and Technology to identify production processes and materials to make products and move us towards a circular economy.

Challenges to be addressed include:

- Making sustainably made goods affordable to the masses
- Lack of awareness of the negative impact producers have on the environment
- Waste from materials (e.g., synthetic fibers) that cannot be recycled
- Attitudes regarding consumption varying across the globe
- Brands fearing the loss of profit and resistance to "degrowth"

Recommendations

Develop a framework that makes the adoption of responsible practices i.e., keeping products and materials out of landfills and in circulation for as long as possible) attainable. Enable producers to take responsibility for the end of life of their products using the following:

- Develop best practices for responsible supply chain management on a global scale
- Create a global framework for producers to implement responsible supply chain management where products stay out of landfills
- Develop economic incentives for producers to adopt the new framework for responsible supply chain management

- Incentivize local production.

- Create a fund for universal subventions tailored to producers' production costs, if these are more local, fair priced, and ethical. Responsible brands should be compensated with subsidies so that their retail price can be reduced to meet consumer's purchase restraints.

- Consumers must be made aware before purchasing how the product will stay the responsibility of the brand it is purchased from

- In case of producer's bankruptcy, there should be an alternative in place such as a communal solution for collection of goods that are no longer desired by the consumer (in the words of Marie Kondo: things that no longer spark joy)

- Create a fund to support circular brands whose supply chains meet the standards of these best practices for responsible supply chain management (i.e., pre-consumer and post-consumer phase)

- Develop business models to stimulate degrowth, while increasing job opportunities

- Frame guidelines and potentially fines for dumping pre- and post-consumer goods into landfills so that there are negative economic outcomes for not addressing landfills

Further Resources

- https://environment.ec.europa.eu/strategy/textiles-strategy_en: The EU strategy for sustainable and circular textiles addresses the production and consumption of textiles, whilst recognising the importance of the textiles sector.

- https://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm : Extended Producer Responsibility (EPR) is a policy approach under which producers are given a significant responsibility - financial and/ or physical - for the treatment or disposal of post-consumer products.

Issue 7

All sustainability initiatives must be based on verifiable evidence, transparent assumptions, and economic trade-offs that need to be made at an individual country and specific ecosystem level (Forests, Rivers, Lakes Cities etc.). This requires organisations to open source their data, software code, and sustainability models for the benefit of all.

Background

Forward thinking sustainability programs aim to bring a multi-faceted approach to sustainability addressing climate change actions required as well as the sustainable use of planetary resources. This requires collecting and curating massive amounts of granular, historical data; documenting and verifying assumptions from a variety of experts; future projections and trade-offs that need to be made by policy makers, businesses, and individuals. This requires:

- Disparate data sources and assumptions.
- Models specific to countries/regions or sectors that cannot be scaled easily
- Trade-offs to be made between several interacting factors remain unclear
- Lack of systemic approach and methodology that is open and transparent

Recommendations

Sustainability-based organizations should adopt a three-phase approach of first curating existing open data and models, followed by defining best practices and interactions between different models, and finally obtaining funding to expand and integrate models focused on sustainability areas focused on reducing GHGs and increasing ecosystems regeneration.

- Create a global repository of data sources by focus areas and by country
- Create a global repository of government, NGO, and private groups addressing similar focus areas
- Develop key economic trade-offs within each of the major ecosystems' areas
- Develop best practices for open data and open models for ecosystems and societal based areas
- Develop business models to enable the integration and building of models in ecosystems and societal based areas.

- Create integrated multi-factorial datasets that include demographic/population data, environmental/geographic distribution data, as well as weather models (i.e. which countries are at greater risk of weather events resulting from climate change)

Further Resources

1. https://opensustain.tech/: A curated list of open technology projects to sustain a stable climate, energy supply, and natural resources.
2. https://www.climateinteractive.org/world-climate-simulation/: Role playing game that stimulates country-level action on the speed and level of action required to address global climate change.
3. https://www.climateinteractive.org/ourwork/: En-ROADS simulator that models cross-sector policies for energy, transportation, land use, and new technologies to limit climate change. C-ROADS simulator that models national and regional gas reductions for China, US, EU, India, and others to meet Paris Agreement targets. Both simulators are freely available
4. https://naturalcapitalproject.stanford.edu/software/urban-invest: Urban Invest provides integrated valuation of ecosystem services and tradeoffs.
5. The importance of open source in tacking climate change
6. Green Software Foundation: Trusted ecosystem of people, standards, tooling, and best practices for green software.

Issue 8

Greenwashing, also called "green sheen", started as a form of marketing spin in which green PR and green marketing were deceptively used to persuade the public that an organization's products, aims and policies were environmentally friendly. While this continues in many forms, the most recent iterations of the trend are far more insidious and involve more than marketing and PR.

Background

There is a need for multi-faceted approach to identifying and combating Greenwashing to facilitate the fair and transparent interaction of both private investment and government services to ESG minded entities.

This requires a reimagining of the ways in which data is analyzed and shared with the public, including:

- Collecting and curating massive amounts of granular, historical data;
- Documenting and verifying assumptions from a variety of experts;
- Future projections and trade-offs that need to be made by policy makers, businesses, and individuals.
- The transfer of this data into a blockchain or distributed ledger based system that allows competing actors to reach consensus around appropriate projects.

Steps involved towards a solution:

First and foremost, analyze the competing technology options from the centralized vs decentralized systems. Next, analyze the following:

- Data verification challenges. Understanding how a unified standard of acceptable environmental, social benchmarks are determined and analyzed by ML and AI enabled systems
- Discussion concerning environmental impacts of blockchain and Distributed Ledger Technology solutions vs traditional methods. (Carbon intensive bitcoin proof of work vs. carbon negative DLTs like Nano and Hedera)
- Use of a self-verifying distributed autonomous organization (DAO) to allow for the elimination of human verifications
- Scalability and reliability of existing and future smart contracts to enable self-verifying digital assets

- Models specific to countries/regions or sectors that cannot be scaled easily and the need for a unified approach to data access and audit

Recommendations

- Create a global repository of DLT/blockchain enabled data sources by focus areas and by country
- Create a global repository of government, NGO, and private groups addressing similar focus areas
- Create policy measures that de-incentivize greenwashing by imposing negative economic results on entities that indulge in greenwashing

Issue 9

Protecting the Climate should be framed as the responsibility of Corporations, not Consumers.

Background

In our capitalist society, economic success is considered a constant competition. Interventions that might temporarily disadvantage a party (e.g., organisation or country) in this battle are thus understood as unbearable; being slowed down is not an option.
Such framing leads to a detrimental narrative around climate protective measures: Since companies cannot be exposed to serious regulation, the onus is moved downstream to the consumer. If the user would purchase goods that are sustainable, the companies would be nudged towards producing sustainable products, completely without being disadvantaged in the battle of modern capitalism.

This causes problems on different levels. Firstly, let us consider the consumers themselves. The narrative puts enormous pressure on their everyday purchase decisions. To be able to select the most sustainable option, extensive knowledge about emissions, water usage, fertilisers, and several other factors is required. Not every consumer has the time - or motivation - to acquire this form of knowledge, and most people that attempt to are feeling overwhelmed. Additionally, the most sustainable purchase decision is often more expensive (e.g. flight tickets vs train, organic food vs discounter). Moreover, it requires to forgo comfortable habits or experiences, another motivational issue. Holidays on another continent, consuming animal products, or purchasing products that undergo trends are just examples of such pleasurable, but unsustainable choices.

Since not everyone is informed, affluent, or motivated enough to undergo such waivers, companies are incentivised to deceive consumers into believing that they are in line with climate protective measures (see Greenwashing chapter): They can sell more products and consumers feel relieved from the impossible burden placed onto them. These dynamics produce overwhelmed consumers that are trying to navigate between their own pleasure, their consciousness, the greenwashing campaigns of marketing teams, and the feeling of helplessness in this social goods dilemma - and, last but not least, - anger. Rightfully, the question emerges why the onus is on them. They are asked to make hundreds of compromises every day - regarding their eating habits, mode of transport, even the amount of children they feel entitled to have -, many of which can severely compromise their financial and psychological well-being.

Contrasting to this, companies are largely untouched by regulations, or are only negligibly incentivised to stir their course towards sustainability. This is detrimental, if we consider that 70 percent of the world's greenhouse gas emissions can be traced back to 100 companies (CDP Carbon Majors Report 2017). It is not surprising that many consumers resign their responsibility in face of such openly unfair treatment, paired with the fact that they can only marginally through even the most significant of behaviour changes. They give up on this constructed battle of responsible individuals against ruthless, unregulated companies. Thereby, we seem to forget that companies are made out of humans, too.

Recommendations

We need to end the double-standard between consumers and organisations. It causes frustration and resignation in this social goods dilemma. This has to be achieved through fair, equally distributed regulation. Additionally, it might be fruitful to appeal to the human that is directing a company's mission. GermanZero, for example, is in dialogue with various CEOs to understand and sign their climate pledge.

Issue 10

The tourism industry is worsening the climate crisis and over time it will negatively impact economies around the world because of the reduction of tourists particularly in coastal cities.

Background

Overall, the travel and tourism industry generate $5.81 trillion in economic output; supporting 289 million jobs worldwide and nearly 6.1 percent of global GDP. While the travel and tourism industry significantly contribute to global GDP, it also has been instrumental in worsening the climate crisis. It is estimated that global tourism emits roughly 8% in global emissions on an annual basis.

Climate change is already affecting the hospitality sector. Extreme weather is increasing the cost of operations and reducing the number of tourists visiting certain destinations, while local and national environmental policies and penalties are being introduced in cities and countries around the world.

The hotel sector accounts for around 1% of global carbon emissions[1] and this is set to increase. Hospitality, like other industries, has a responsibility to manage its impact on our planet.

Research has found that the hotel industry needs to reduce its carbon emissions by 66 percent per room by 2030, and by 90 percent per room by 2050 to ensure that the growth forecast for the industry does not lead to a corresponding increase in carbon emissions. The industry will need to go even further to help limit warming to 1.5°C and avoid the very worst impacts of climate change.[2]

Recommendations

The tourism industry needs to collaborate with governments to provide incentives (grants and tax credits) to create a more sustainable industry. The following suggestions will help reduce the carbon footprint of the industry:

- Sustainable fuels
- Sustainable building design
- Local sourcing

- Reducing waste
- Increasing renewable energy usage
- Water conservation

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Appendix: How will the "Great Transformation" to preserve our planet be financed? The case of EU

The question of how much saving the planet will cost and what amounts will have to be raised, how and by whom, can be roughly divided into three dimensions of consideration:

1. **The private sector**, out of its own interest, especially to develop its future markets, will direct considerable investments of its own into products and services that will at the same time have a direct effect on the climate, as well as on the profitability of the companies. Thus, we are talking primarily about a wide range of products and processes directly aimed at improving environmental conditions, such as alternative energy production through solar, wind and geothermal technologies, CO2-reducing or -storing techniques, exhaust gas treatment; creation and loss prevention of fresh water, water treatment processes such as seawater desalination; avoidance of industrial chemical substances e.g. in agricultural fertilization - and thousands of other options that are emerging as opportunities for new business.

2. **Public investment and funding** in healthy and climate-improving measures. These public funds go either directly into infrastructural projects, such as greening, planting trees, and deconstructing sealed soil areas, or as premiums to promote new forms of mobility, such as tax incentives for electric vehicles. Indirectly, but also belonging to this segment, are budget funds for research and development at universities or research centres that are geared toward improving living conditions. In the overall picture of budgeting (especially in Europe), both at the level of the European Commission and at the national levels, expenditures for research and development occupy the second highest position - after support for agriculture.

3. Provision of financial resources. This is seen as the strongest lever in Europe for redirecting the economy towards a green economy. The first means of choice are regulations that affect the financial sector, especially rules that determine where banks and financial institutions should direct their financial resources as a matter of priority. The basic principle here is that financiers must prove that they are directing a sufficiently high proportion into genuinely green projects.

In addition to this, the EU Commission initially sets up its own financial resources in order to provoke public-private financing, whereby the Commission assumes that its own contribution will have a stimulating character minor in size and that the financial markets will provide the actual larger funds in the sense of a "matching financing" model.

Insofar as the public sector, in this case specifically the European Union, has to ensure that the transformation process actually and effectively takes place, two complementary lines of action, each with its own "materiality", are set up in relation to sections 2. and 3. above:

I. The immediate regulatory line, which, in the form of a large number of directives, laws and regulations, sets the regulatory framework to which companies must conform. This also includes specific financial measures, such as tax incentives, adaptation subsidies or the provision of research funds, for individual sectors that specifically have major conversion problems.

II. The indirectly influencing line via regulatory control of financial flows in order to direct them towards green investments.

In order to determine which measures and financing are "genuinely" green, a so-called *Taxonomy Catalogue* has been developed for Europe, which comprehensively describes which projects and investments are to be assessed as truly green. This catalogue was developed in negotiations between the European countries and the EU Commission and must therefore be considered as a political compromise. (Cases in which the countries do not agree, such as the use of nuclear energy, are and remain controversial. The polar positions are taken, for example, by France, with a total reliance on nuclear energy, versus Austria, where renunciation of nuclear energy is constitutional.)

The framework for the two main lines described above has been compiled by the EU Commission into a model that attempts to capture the immense complexity of the entire project of transformation toward a climate-neutral, planetary economy in an image representing the *European Green Deal*, reproduced below.

The question now of how to raise the funds for the "Green Deal transformation" and how to direct them must be given an even higher degree of complexity, because there is no central investment pot to be managed, but the various lines of fund generations and their use will be realized via a variety of models. The following picture can only give a rough idea, where the money will come from today’s perspective.

Global Methodologies Committee

Introduction

It is 2030 and the interaction between humans and the planet that was out of balance, is now harmonic—the planet is treated with respect and empathy as a starting point for all personal and civic activities as well as global technology and policy. Humans, animals, and the spaces they inhabit have become protected in multiple ways that champion the value of lived experiences, communities, and nature via transdisciplinary collaboration and the positively regulated use of the UN's SDGs for all products, services, and policies created.

The awareness of the prioritization of the planet is present in the daily life for all people and is reflected in their activities. Any activity that directly or indirectly involves the use of natural resources is remodeled to protect, respect, and regenerate the environment. This was possible through the application of a recommended network of global methodologies that enabled substantial progress toward reducing greenhouse gas emissions, increasing regenerative and resilience of earth's ecosystems while transforming society, re-establishing values, improving the social wellbeing of humanity, and involving a wide and diverse group of stakeholders.

This mindset is pervasive and has restored balance to bring peace, happiness, and prosperity to all living beings, stemming from a focus on collaborative and deep sustainability education beginning in 2022.

In this context, the Global Methodologies refers to an evolving network of methodologies, both macro and micro, used at local, regional or global level, addressing an omnipresent lack of care in the world and the consequences to humanity's relationships to living beings and the planetary environment. The committee's underlying motivator for this evolving network is the concept of Ubuntu (ùɓúnt'ù), ia Nguni Bantu term for humanity, translated as "I am because you are," a philosophical belief in interconnectedness —a universal bond that connects humanity through sharing.

Global Methodologies Committee Focus:

Considering the goals set for Planet Positive 2030 (PP2030) initiative, Global Methodologies' focus is to identify values, principles and methods that relate partially or totally to worldwide challenges. No single methodology or discipline totally addresses the lack of care for humanity and the planet or serves the purpose of identifying all gaps and challenges that exist for the diversity in natural life (e.g. people, professions, sciences, cultures, social structures, wisdom traditions, natural life, and geography). As such, this committee draws inspiration and knowledge from human-centered and environmental-centered systems and design thinking to discuss and propose ways to meet the barriers and challenges by supporting the applicability and facilitation of existing and emerging recommendations effectively. This includes consideration of adaptations to align emerging technologies with the goals of PP2030.

Meeting our goals has been, and will only continue to be, possible through a transdisciplinary and collaborative approach—an integration of methods, practices, policies, and ways of thinking that encompass and serve the realities and challenges involved to restore and sustain well-being for the diversity of peoples, animals, ecosystems, environments, resources, and natural life that exist on Earth.

In that spirit, we offer this message from the Chief Perry of the Ramapough Lenape Nation:

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

Continuing Committee Goals:

- Improve and create networks map of global methodologies, including the methodologies used globally for specific branches and purposes that align to the overall purpose of the PP2030 initiative (e.g. cities & towns, lakes, metrics). A systems map will lay out macro and micro pathways as well as provide a container to connect to the resources provided from each committee. Understanding that methodologies are evolving constantly, we intend to build in a process to reassess inputs and outputs, including human behaviors.

  With this intention, Global Methodologies is encompassing purposes; macro & micro systems design thinking (both between & within systems) with goals to create a systems map to:

- Encompass the complex constellation of effective and evolving methodologies applied globally to address the most urgent consequences of climate damage
- Identify and map effective applied methods that support the focus of each committee.

- Clarify how Lack of Care is related to each Issue

- Evolving intentions & priorities discussed:

  a) Build on Systems and Design Thinking with Regenerative Principles as we consider applying methods--building empathetic bridges in partnerships with technology. Establish compassion as essential to human and planetary flourishing.

  b) Establish the foundational interconnection of human holistic health & well-being (mental, physical, emotional, spiritual) with planetary well-being.

  c) Establish how are these directly connected to actions and processes?

  d) Increasing equitable contributions & feedback (language, stakeholders, etc.). This includes multimodal communication (e.g. storytelling & visual). This is an enormous issue with massive potential missed opportunities. For example, Kelvin Doe, now a brilliant engineer at MIT– at eleven years old, was self-taught and figured out how to generate electricity for his village in Sierra Leone using trash. Consider that these are not anomalies. When we limit our problem solving to experts, we miss these opportunities for new solutions.

To ensure clarity and communication and to increase inclusion of diverse stakeholder groups, the end of this chapter includes appendices to support the work of the PP2030 initiative. This includes:

- **Key Concepts Glossary** (beginning with Ubuntu as the foundation) to include definitions and descriptions— with symbols, where applicable to communicate with a wider range of modalities) See Appendix #1
- **Existing Methodologies Resources Library** See Appendix #2
- **Methodologies Map** See Section #5 (*to be expanded as an appendix)
  - Description: Although it is clear that no singular "Global" process or method may fit all challenges, some effective methods that apply to multiple areas of focus, such as suggested by practitioners successful in the regenerative field may be highlighted.

Issue 1

Lack of Care. Current economic models and technological advancements disincentivize care of our environment by prioritizing quantifiable outcomes and consumption over lived experiences. Global, regional, and local methodologies for dealing with sustainability issues must do the opposite. They must have "care" (but also be able to quantify this level of care) over "quantifiable outcomes" at the core of their values linking all processes and actors to the planet. (*To include content from Metrics/Indicators, Economics/Regulation, and human Wisdom/Culture chapters as well as illustrations clarifying the differences between GDP & GNH as necessary measures for Care as well as Climate Sustainability.)

This committee's working definition of Care, includes well-being and values, moving away from care being only associated with traditional, colonized and modernized roles and practices of caretaking professions and avvocational roles in society. Care, in this context, is an ethical (moral theory) and practical imperative approach emphasizes the importance of responsibility, concern, and relationship over consequences (utilitarianism) or rules (deontologism). Although a central part of medical and nursing ethics, this definition of care points to broader applications in relation to social sciences & technology. This definition as virtue or as related to, acknowledging the importance of fundamental elements of relationships and the dependencies in human life that involves meeting the needs of self and others, especially for those in the ecosystem who are dependent and vulnerable. From a state (legal) perspective, care refers to the state's positive obligations towards protecting individuals. (resources: Carol Gilligan, Nel Noddings)

Background

As data-driven technologies at scale and exploitative economic practices continue to grow unchecked, care practices and the cultures and professions from which they emanate will continue to be diminished. The decline of care across public and private sectors would invariably lead to implicit and explicit challenges to human and animal rights as well as the preservation of natural spaces. Current economic models and technological advancements disincentivize care by prioritizing quantifiable outcomes over lived experiences.

Humans are the primary technology in care, referring to technology here as the practitioners applying scientific knowledge to the practical aims of human life and manipulation of the human environment.

"Planetary homeostasis," the healthy self-regulation of Mother Earth (aka Mama Gaia), fits with the Care paradigm as James Lovelock and Margulis' Gaia hypothesis [Gaia 2.0] describes. Gaia 2.0, another methodology conjoining human and nonhuman cognition, may lend us wisdom here. The hypothesis states that "living things form part of a planetary scale self-regulating system that has maintained habitable conditions for the past 3.5 billion years. In this concept, Gaia expanded from within the Earth system and came over time to alter the climate and dominate the surface cycling of nutrients. Gaia has operated without foresight or planning on the part of other organisms, but the evolution of humans and their tech-nology is changing that." The hypothesis describes how the Earth, "has now entered a new epoch termed the Anthropocene (3), and humans are beginning to become aware of the global consequences of their actions. As a result, deliberate self-regulation—from personal action to reduce carbon footprints, to global geoengineering schemes—is either happening or imminently possible." This argues that humans, through self-awareness, could make conscious choices that could add to the Earth's regenerative goals for self-regulation, that could become an "effective framework for fostering global sustainability."

Recommendations

To achieve our vision of a Planet Positive 2030, we must work to validate the importance of care and proactively bolster care as a methodology that is at once universal and contextually defined through the following actions:

- **Increasing our Valuation of Care**: (Considering Care as defined as the issue). By validating and supporting existing care cultures, care professions, and hidden caretaking work, policy makers can work against current narratives that minimize the universal importance of care and understanding and work towards developing legislative measures that foster care while lauding those who provide it. This includes (but is not limited to) validating the care elements in human-facing professions such as education, law, medicine, social services and so on, as well as the provision of care in fields that support wildlife and nature conservation.
- **Prioritizing Care Over Profit**: Systems that place efficiency and profits over all else are antithetical to care. To achieve the vision of the 2030 community, governments, corporations, and stakeholders must work to prioritize existing care cultures while resisting moves towards automated mechanisms designed to provide synthetic care (e.g., AI chat bot therapy). In practice, this may involve working at the ground level (i.e., holding regular meetings with care practitioners) to understand how to better meet the needs of specific care providers rather than outsourcing growing care responsibilities to third-party systems.
- **Minimal Market Input:** To drive increased societal valuation of care, we must minimize the role that economic markets play in determining the worth of caregiving. Care for humans, animals, and natural spaces is a collective, longitudinal investment that does not lend itself

to input-output models of capitalist production. To achieve our vision for 2030, supporting and providing care must be viewed as a non-negotiable principle rather than an aspirational anomaly.

- **Care as a Universal Value**: All creatures and spaces require some form of care. As such, it is important to center care as a moral imperative in ongoing discussions of emerging tech, ecological policy, economic frameworks, and updated human rights initiatives while working towards the Planet Positive goals. This includes care for the whole, greater and the individual self, meeting one's own needs to be able to provide care to others to foster balance and equilibrium.
- **Care in Context:** In recognizing the universality of care as a moral imperative, it is essential to highlight that care practices and norms are contextually defined and should remain as such. In recognizing care practices as locally derived, we can avoid the current proclivity for purporting white, western, anglocentric ideals as the global standard. Ensuring that concepts of care are diverse, rooted in indigenous practices, and agentically defined by the communities in which they will be enacted prevents furthering established colonialist practices while amplifying ancient ways of knowing (e.g., Indigenous fire management practices). This also provides an opportunity to educate and share knowledge of diverse topics and subject matter to increase learning of different backgrounds, experiences, and cultures. This includes diverse mindfulness philosophies, practices, and systems.
- **Education:** Clarifying a definition of care to include social well-being and values that support the health of the planet and humanity will require outreach and education to invite engagement for this transformation.

*Figure 1. Validating and Prioritizing Care, Allison Banzon Macey

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Issue 2

The novel and interconnected nature of the challenges currently facing all of humanity call for intersectional transdisciplinary methodological approach to mitigate these global challenges. There is a need for holistic, integrative, multi-faceted observation and analysis of the worldwide challenges contextualized equitably. This applies to societal needs and challenges to more accurately identify and measure the impact of emerging technology across the spectrum of human life and planet. Unfortunately, the tendency to work and collaborate in silos, competitively, and based on resource consumption versus recyclement, to compartmentalize disciplines, communities, and stakeholders in complex problem-solving is present in all sectors of global society.

Background

The global problems faced by humanity are interconnected, yet often have been addressed one by one by the people who work in the field of that problem, without considering their interconnectedness. For example, the problem of renewable energy is being solved by engineers and scientists. For renewable energy to be effectively used by everyone, people with different skills, perspectives, and living situations need to be included in the collaboration to attain the best pros and cons balance that will benefit the planet instead of a small group of people.

Today, many people are not considered to have the “acceptable credentials” to participate in the problem-solving spaces. Transdisciplinary collaboration can increase the problem-solving capacity by widening the field of experience and skills (as the Human Wisdom and Culture committee discusses). Transdisciplinary (TD) collaboration mixes “disciplines” (like an electrical engineer and a native person from the Amazon) together to solve problems. This approach has the potential to unify branches of knowledge (e.g., technical, natural, social, and health sciences) to form an entirely new approach, that the individual contributors could not create themselves.

Transdisciplinary collaboration is different from the more traditional and familiar approaches (e.g., multidisciplinary, cross-disciplinary, and interdisciplinary collaborative approaches). To better understand the differences in disciplinary approaches, see Figure 2. below.

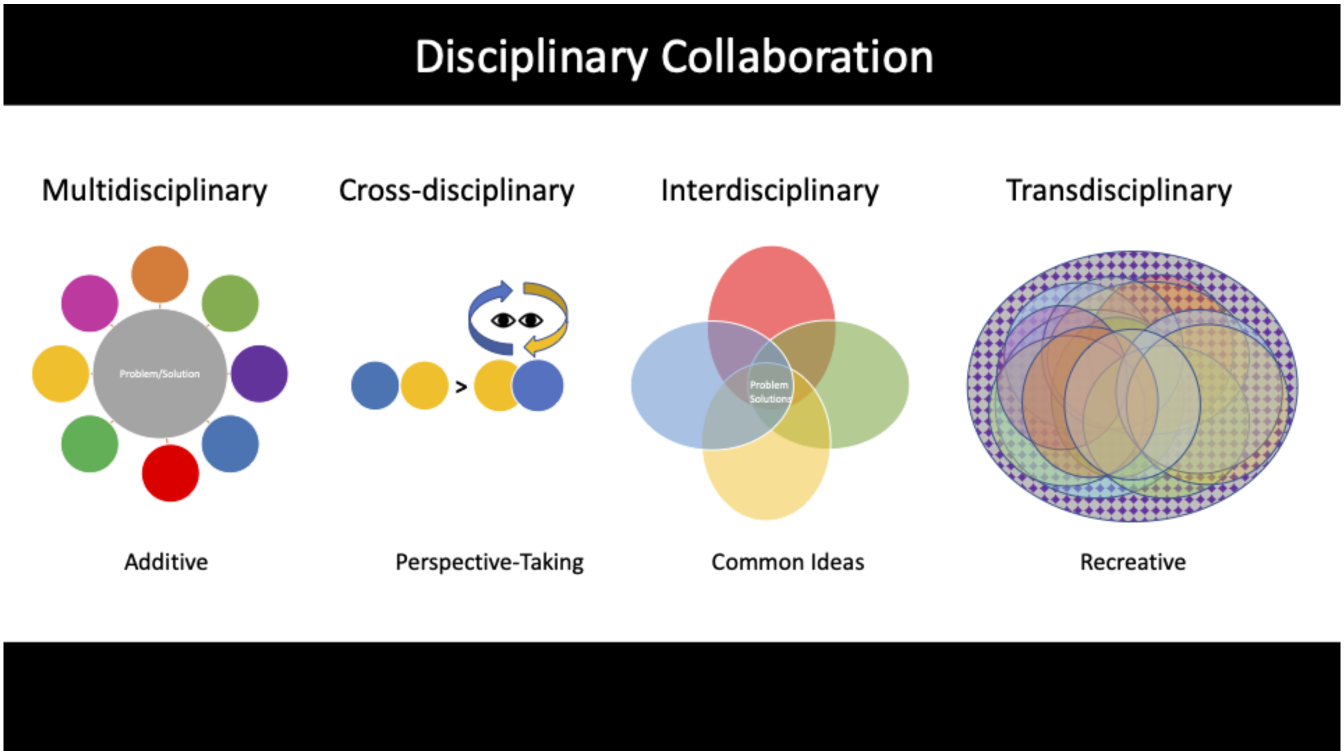

*Figure 2. Image from : IEEE AI Ethics Committee, The Benefits of A Multidisciplinary Lens for AI System 2022, Marisa Zalabak

Specific differences in disciplinary approaches:

- **Transdisciplinary** collaboration, referred to as xenogenesis (i.e., between, across, and beyond disciplines), transcends boundaries, unifying individual disciplines, branches of knowledge, and/or intellectual frameworks (e.g., technical, natural, social, and health sciences) to form an entirely new approach, unlike any of the contributing parts. With Transdisciplinary collaboration, a messier and less predictable approach, some of the most innovative ideas and concepts emerge, while challenges increase in the process and facilitation of a non conventional approach.

- **Multidisciplinary** collaboration is additive, meaning that people from several different disciplines, domains, or groups remain within their individual boundaries (e.g disciplines, specializations, and perspectives) and collaborate by adding ideas to the problem-solving space.

- **Cross-disciplinary** collaboration is based in perspective-taking, where cognitive empathy is employed to view the problem-space from the perspective of another, while individual boundaries still remain.

- **Interdisciplinary** collaboration is consensus-based, where two or more individual disciplinary boundaries are combined. Like a venn diagram, with a common, shared agreement or disagreement regarding the problem-space. This leads to the creation of a new level of integration— while remaining within each member's or groups' disciplinary frameworks— with a recognition that each discipline can transfer methods that affect the output of the other.

When using a TD collaboration approach, it is also important to consider social exclusion and the role it plays in limiting the perspectives, knowledge and experiences. Although the challenges facing our planet affect everyone, many people are not considered to have the "acceptable credentials" to participate in the problem-solving spaces. This applies as well to the ethical concerns with collaborations around designing, developing ,and mobilizing technologies. With this in mind, TD collaboration can increase equity and problem-solving capacity by widening the field of experience and skill. (add* PP2030 Guiding Principles reference on equity)

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

a) Grow psychological resilience and flexibility for navigating unknowns and adversity (e.g., Tolerance for Ambiguity, ability to express one's POV while being aware that it is a limited perspective due to one's conditioning and unconscious biases.)

b) Reveal unexpected opportunities, risks and leverage points in the collective field-of-effect

c) Architect narratives that translate complex experiences into meaningful explanations and contributions while attracting and energizing others to join the learning journey

d) Increase experiential, educational opportunities through learning from and of others from different backgrounds, perspectives, and expertise.

Recommendations

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

1. Establish restorative circles practices, an indigenous practice of deep listening, ensuring all voices are heard and honored, increasing equity, trust, & psychological safety needed to:
    - Create new pathways for solutions to emerge.

- Develop people's ability for navigating the unknown; an essential part of the transdisciplinary process. (e.g. Tolerance for ambiguity)

- Utilize and expand the practice of storytelling of Circles by using platforms, These circles can also be continued through diverse platforms (e.g. Why It Matters app, WhatsApp, Slack) attracting and energizing others to join the journey by enabling storytellers to share experiences of doing meaningful work.

2. Create collaborative agreements (social) that elevate and mobilize collective intelligence. This should be a "living" document, adapted and amended as needed throughout the collaboration to increase efficacy and meaning. This also serves to incorporate wisdom traditions and best practices for processing conflict constructively. This can be extended to include methodological & technical agreements.

   This document will:

   - Collect feedback for effective ongoing constructive collaboration

   - Help demystify the experience of working in a transdisciplinary environment for those who haven't experienced it

3. Increase equity in the process (e.g., language, gender, ethnicity, race, socioeconomic status, education, religion, age). This includes establishing processes for collecting and sharing information.
   -

   - Apply multimodal and multi-perspective communication practices between all stakeholders. This includes demystifying the language, concepts, and terminology used in technical professions when sharing information.

4. Consider what is being measured. Use mixed methods with an extra focus on quantitative metrics. Technologies centered around care are modeled after humans, it is important to be aware of who and what is being measured and whose lens is used to process the data. *One consideration is that technology is defined as separate from humans, although humans apply human skills as tools in daily life.

5. Increase education on the causes and effects of climate change. For example, adopt storytelling and other multimodal forms of communication as tools for weaving human connection and understanding, cognitively aligning, and enabling effective innovation.

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Issue 3

Focus: Technical Barriers

All methodologies are intended to be meaningful and have a purpose, based from their creator and designer, in their own right. However, no methodology individually captures the entirety of the global society, environment, and natural world in all its breadth and depth. While there are often strong overlaps in terms of intentionality and philosophy between the various methodologies, today there are no clearly defined links that connect them (via objectives, strategies, targets, metrics). **To be add: details from metrics/indicators, as well as referencing forests & trees, rivers & lakes, towns & cities, oceans & coasts, farmlands & grasslands, mountains & peatlands, etc.*

There are knowledge gaps, divisions, lack of care or understanding, over-reliance, and/or barriers specific to differences in technological concepts, language, and methods and a lack of unification and understanding. For example, technical solutions to some challenges existing today are not globally applied because of gaps; if a community can't understand the technological concept of a solution, they cannot apply it themselves.

Background

A significant percentage of the world's population shares the intention to live in a sustainable and responsible manner. Over time humans have created a plethora of different methodologies, movements, cultures, concepts, philosophies, technologies, approaches, and organizations to promote a balanced pro-evolutionary mindset and responsible sustainable behaviors throughout all aspects of life on this planet.

These methodologies reach from traditional indigenous wisdom as embodied through the seven generation rule and Ubuntu, which are thousands of years old, to newer methodologies like Conscious Capitalism, the Purpose Economy, and B Corp—just to name a few. One might also argue that the UN Sustainable Development Goals (SDGs) represent the biggest global consensus on long-term life-promoting and consciousness-enhancing policies today. Currently, all of these methodologies exist in isolation (with a few exceptions) and do not capitalize on the vast overlaps, potential synergies, and possible symbiotic relationships.

The biggest hindrance to the collaborative path is ego—an individual or collective-organizational sentiment of superiority that prevents working together as equal partners to reach the same objectives. In addition, the temporality and regional contextuality of methodological approaches are barriers for implementation.

There is an evolution visible within the various methodologies, which are aimed at tackling global challenges (e.g., SDGs). Their initial conceptualizations are in itself examples of the ways in which global methodologies evolve and transition to reflect current challenges. Within the next couple of decades, the set of global goals may evolve once more to reflect challenges we cannot currently comprehend. For example, the 17 SDGs that we currently have as a basis for our global efforts may once more evolve to include more goals. There is a temporal element to the ontology of human knowledge and its evolution is what we should count on, while developing the start off points.

What is urgently needed at this point in history is concerted action via all existing sustainability-oriented methodologies through specific technologies and policies that have significant followership around the globe—beyond all ego. Therefore, linking these methodologies in a meaningful and pragmatic manner is paramount for reaching the tipping point for a positive turnaround. Only through collaboration, by uniting and bundling efforts, can we manifest a more just and sustainable world.

Recommendations

All major global methodologies must be linked in a meaningful and practical way via objectives, strategies, targets, and metrics in order to collectively reach the tipping point of a positive sustainable turnaround in time. We recommend the following:

- Establish a global organizational entity that proactively drives the connection effort between the various methodologies and facilitates alignment process
(can be an United Nations agency or a private entity).
- Leverage artificial intelligence technology to map methodologies and create transparency and alignment with respect to objectives, strategies, targets, and metrics.
- Create a global communications campaign to incentivize outreach to other organizations, exchange and collaboration.
- Ensure that the development of a global repository of methodologies is not applied in a “one size fits all” manner and allow for context specific/community-drive/localized usage of these methodologies to support local/community level agency.
- Provide some form of valuation/metric for each methodology that communicates the success of the methodology.
- Modulize/disseminate the individual methodologies included so that in the future, people can re-assemble these modules for their context specific needs (open access, methodology localized implementation)
- Utilize Why It Matters app to match organizations and individuals with the same goals; create communication channels amongst organizations and individuals with the same goals;

and connect organizations solving problems to people who on the ground who are affected by them.

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Issue 4

Focus: Human Barriers

The complexity of human diversity individual, collective and social (e.g. socioeconomic, cultural, political, geographic realities and experiences.etc.) present barriers to collective action. While we face global challenges as humans living on the same planet, like climate change, the place we live in determines how we can solve the problem.

These, in-turn, are affected by the temporality and regional contextuality of methodological approaches (adding details and examples from forest/trees, rivers/lakes, towns/cities, oceans/coasts, farmlands/grasslands, mountains/peatlands).

For example, the political norms in the country we live in are a factor that determines our ability to create change. In some countries, citizens have the power to create movements of change, while others are suppressed when trying to do so. In addition to political norms, cultural norms, and socioeconomic structures, affect our ability to create and spread change.

This includes psychological factors affecting applications of methodologies. For example: Change will require new mindsets and deep engagement of all levels of society, industry, and communities in systemic ways that reflect the interconnectedness of all life and elements on Earth, which must cooperate and combine their efforts to meet these challenges. A global methodology to support and enable deep engagement and mindset change amongst diverse populations and geo-political spheres is required to enable real-word aspirations for Planet Positive 2030. (include details from Wisdom Traditions).

Background

There is an evolution visible within the various methodologies, which are aimed at tackling global challenges. From their initial conceptualization, the sustainable development goals (SDGs) have evolved to include more than the original eight Millennium Goals, which is in itself an example of the ways in which global methodologies evolve and transition to reflect current challenges. Within the next couple of decades, the set of global goals may evolve once more to reflect challenges we cannot currently comprehend. Therefore, the 17 SDGs that we currently have as a basis for our global efforts may once more evolve to include more goals. There is a temporal element to the ontology of human knowledge and its evolution is what we should count on, while developing the start off points.

Within the wider context of global knowledge (within sociology, geography, and regional sciences) there are two distinguishable factors, which represent traceable plotline throughout various scientific fields—individual and environmental factors. Individual relates to the personal experience of a human being within day-to-day parameters, while environmental relates to external events, which may affect wider groups, regions, and nations. The interaction between these two spheres is where impact resides. We fit, organize the targets of environmental methodologies, raising the KPIs to higher ranges with every single iteration, so that each methodology is more ambitious than the one before. This can be exemplified by the current European Green Deal, which targets much more ambitious goals as opposed to the plans in the prior programming periods. But there is little emphasis paid to the societal processes that need to occur to translate these targets into concrete actions.

There are several layers of analytics, which concern the implementation element of the frameworks we have; there is the initial set of individual/environmental, then there is the regional geographic context, and then there is the global context. Each of these contexts present a different playground for implementation of green methodologies and may bring forth a new wave of challenges.

The barrier to change in mindset and to enabling change in one's self and the community around us is due to the limitation of current mental models sustained and built by one's own experience of the world, derived from familiarity and self-reinforcing habits learned over a lifetime. In other words, the barrier to change is due to the way our learning typically takes place, due to not being able to recognise what we see, not being able to say what we think, not being able to do what we say, and not being able to see what we do, which plays out as a 'blind spot' in our perception and ability to change.

A fundamental shift in mindset is required to overcome these barriers. A shift is required to a more holistic approach, where sustainability is inherently valued, is a core expectation, and is measured, monitored, and designed accordingly, both for compliance and to drive sustainable innovation.

In order to shift entrenched mindsets, deeper levels of learning are required to create an awareness of other and greater paradigms of holistic thinking. This deeper insight leads to seismic shifts of perception and consequential action to reinforce learning.

Recommendations

In order for us to benefit from the establishment of a society 6. 0 (technologically advanced and environmentally conscious), we ought to consider the contextual and temporal layering of our approach to the current environment paradigm and its local, regional, and global dimensions and its very individual importance.

- Within the process of their implementation, iterations should be introduced to the wider framework that comes from the ground-up in order to engage society and to improve the impact of the various goals.

- This is already an approach ingrained in the Horizon Europe framework with its destinations and within a number of the program frameworks within the EU, but the ground-up approach ought to be present within the implementation of private and public green strategies and the growth of green technologies.
- Impact assessment reports will be needed, differentiated by target, goals, and focus of impact. This includes the need for the impacts of technologies.

Regarding Minsets: A fundamental change in mindset of individuals, communities and nations is required in order to overcome their 'blind spot', to let nature work, to re-establish and unleash its self-healing capacity.

'Theory U' fundamentally distinguishes between different levels of the emerging knowledge and understanding, and how consequential action comes into being, to overcome the blind spot. It provides a map to move through levels of understanding and being to emerge with a new mindset and thus enable authentic change.

The levels of change are briefly described as:

1. Holding the space of listening

2. Observing whilst suspending judgment

3. Sensing with an open mind, open heart and open will.

4. "Presencing" which is the capacity to connect to the deepest sources of self—to go to the inner place of stillness where knowing comes to the surface.

5. Crystallizing and committing to a shared purpose

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

7. Co-Evolving as a group, convening the right sets of players in order to help them to co-sense and co-create at the scale of the whole.

*Theory U has been utilized by the United Nations Development Coordination Office together with the Presencing Institute in 2021 to assist fourteen countries in the adoption of the UN Sustainable Development Goals (SDG), through the SDG Leadership Labs, to advance the UN Agenda 2030. The result of use of Theory U has been a heightened sense of system thinking through complex systems, collaboration and action learning, and 42 new prototypes.

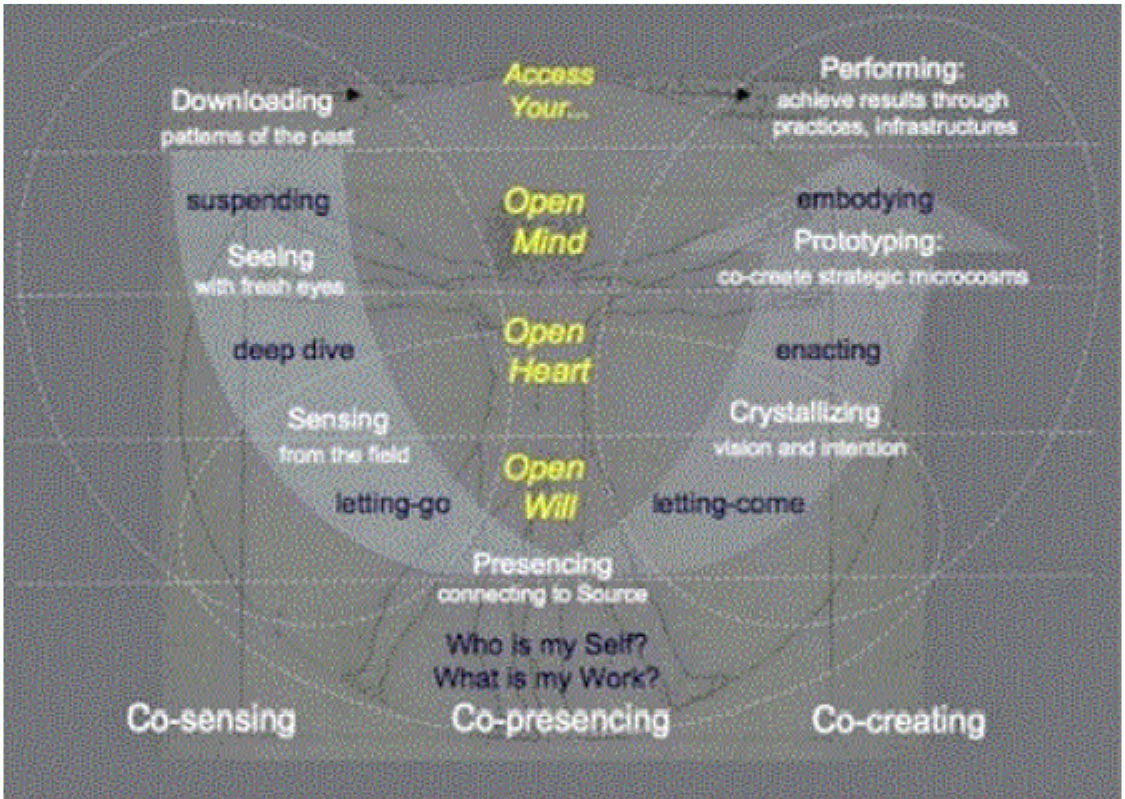

Figure 3. Theory U, Presencing Institute

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- https://www.u-school.org/theory-u
- https://www.u-school.org/news/sdg-leadership-labs-taking-theory-u-into-the-unitednations

Issue 5

Focus: Mapping

Difficulty in achieving consensus and resolving divergent priorities when selecting plans, policies, and actions to achieve objectives of reducing Greenhouse Gas emissions while also improving the social and personal wellbeing of the global population.

Issue 5 characterizes the expected divergence of priorities among multiple stakeholder communities when attempting to reach a consensus on plans, policies and actions to achieve the combined and interrelated objectives of reducing Greenhouse Gas emissions while simultaneously improving the social and wellbeing of the global population. So issue five entails both the realization that different priorities will lead to a lack of consensus (ie. that it exists) and that it will be difficult to resolve to achieve a consensus..

Background

The anticipated participating stakeholder communities are expected to be large and very diverse. As a consequence, considerable effort and supporting methodological protocol and tools should be available to facilitate obtaining consensus and consilience among advocates, practitioners, and non-technical people and cultures. (*to be included: metrics indicators)

Recommendations

The difficulty in achieving consensus and resolving conflict can be minimized through technological and non-technological solutions. Some proposals are as follows:

- Create and expand a methodologies systems map (example below, Figure 3):

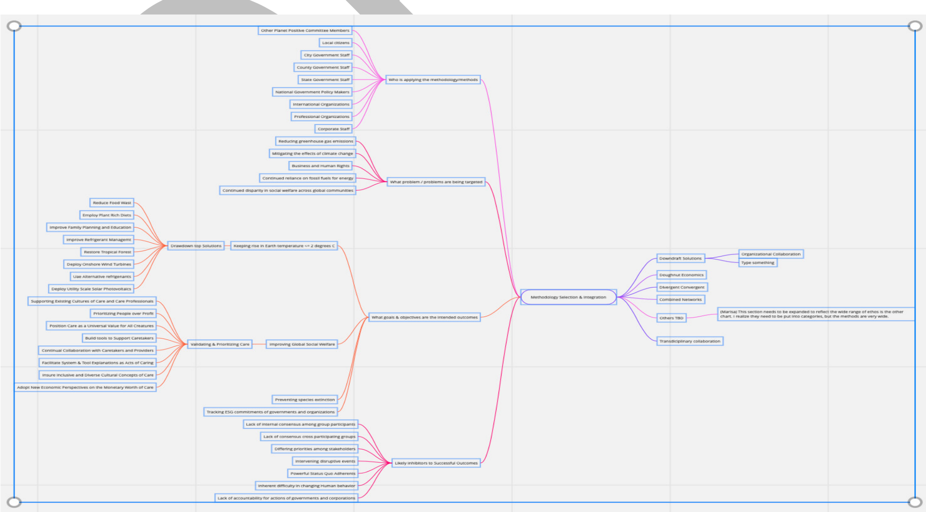

*Figure 4. Methodologies Systems Mapping: Mike Houghtaling

- Apply apps and online systems supporting: elicitation and documentation of deliberation dialogues and position statements; generation and analysis of public policy and visualization of argumentation schemes that enable critical thinking using concepts such as Critical Question, Premise, Supporting Argument/Assertion, Opposing Argument/Assertion, Answering Argument/Assertion, Attack and Conclusion. (This includes employing on-line argumentation tools that help to visibly and graphically elucidate justifications and counter positions for premises, position statements, and argument assertions associated with alternative choices in reaching a consensus. There are many tools supporting either classic argumentation protocols or critical thinking approaches.) *Attached are additional diagrams for a few of the references (* *Figures to be relabeled*)

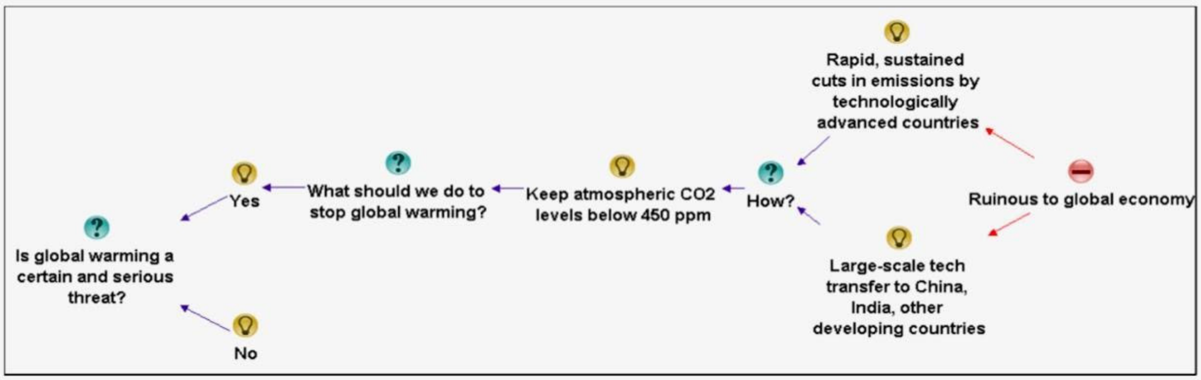

Figure 2

*Figure 5: to be relabeled

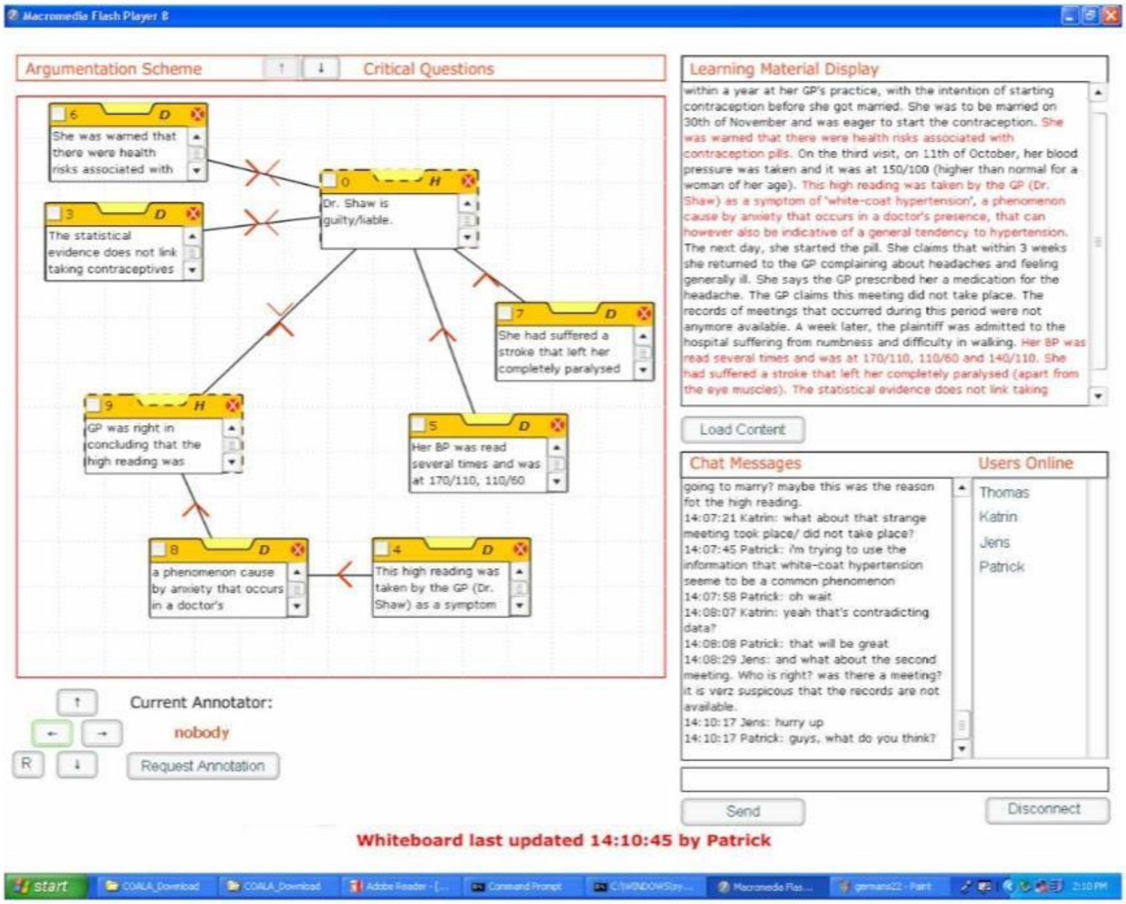

Figure 3. The COALA user interface

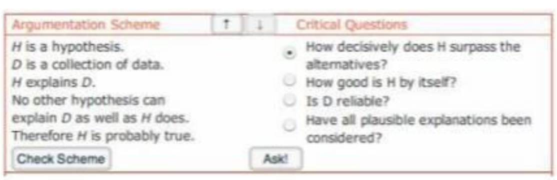

Figure 4. The argumentation scheme tool

*Figure 6: to be relabeled

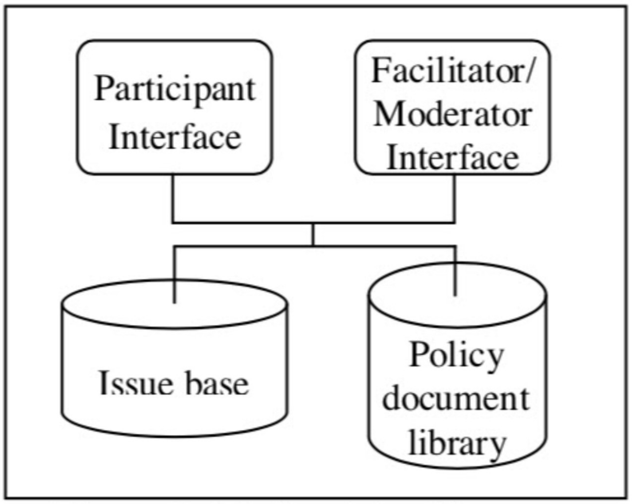

*Figure 7: Notional Architecture

- Incorporate a range of practices for constructive conflict mediation. This includes indigenous, cultural, religious and practices from social sciences that create opportunities for conflicts to result in a "win-win" outcome versus temporary compromise. This includes empathetic listening, establishing a shared language for conceptual understanding, respect for individual, cultural and religious values, as well as distinguishing between what is wanted and what is needed by all parties and the community involved. Some examples include indigenous-based Restorative Circles, Non-Violent Communication, and the United Nations. One example of a technical augmentation is an app created by Million Peacemakers to help users apply empathic, perspective-taking strategies in daily life to mediate conflicts constructively.

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- http://www.cognexus.org/Papers/Growing_a_Global_Issue_Base.pdf
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- [4] Chris Reed, Katarzyna Budzynska, Rory Duthie, Mathilde Janier, Barbara Konat, John Lawrence, Alison Pease, and Mark Snath, "The Argument Web: an Online Ecosystem of Tools, Systems, and Services for Argumentation", *Philosophy & Technology,* 2017, 30(2), 137-160 .https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6979725/

Additional Resource for ongoing work and potential case studies regarding mapping:

- US government dashboard application CMRA (Climate Mapping for Resilience and Adaptation) that integrates information from across the federal government to help people learn about climate related hazards and to then work
    1. CMRA home site https://resilience.climate.gov
    2. Case studies listed at CMRA site https://toolkit.climate.gov/case-studies
    3. Open Data at CMRA site https://resilience.climate.gov/#open-data
    4. Southwest Sky Islands case sample: https://toolkit.climate.gov/case-studies/boosting-ecosystem-resilience-southwests-sky-islands
    5. Bracing for Heat case example https://toolkit.climate.gov/case-studies/bracing-heat

Example of Proposed Methodological Collaboration and Agreements and Action:

Six transdisciplinary examples for how agreed collaboration can be applied in governance and policy as items with sub-bullet pointed links:

- Hold organizations, including institutions, corporations, governments, and associations, accountable for all three Scopes of greenhouse gas emissions, at the regulatory, statutory, treaty, and Environmental Sustainability and Governance (ESG) asset pricing model levels. Ref.:
  - https://www.carbontrust.com/resources/briefing-what-are-scope-3-emissions
- Support and encourage the use of green hydrogen for power storage, e.g.
  - https://pv-magazine-usa.com/2022/02/17/la-could-soon-be-home-to-the-nations-largest-green-hydrogen-infrastructure-system/
  - https://www.controlglobal.com/articles/2022/hydrogen-is-key-to-sustainable-green-energy/
  - https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M451/K500/451500036.PDF
  - https://ww2.arb.ca.gov/sites/default/files/2020-07/ghc_cn_fuels_infra_july2020.pdf
- Require all new and retrofitted desalination facilities to simultaneously perform direct ocean capture of carbonate:
  - https://www.sciencedirect.com/science/article/abs/pii/S0011916419316042
  - https://pubs.rsc.org/en/content/articlelanding/2012/ee/c2ee03393c
  - https://www.sciencedirect.com/science/article/abs/pii/S1750583617304322
  - Lab sand Secretary Condi Rice on Google Project Foghorn:
    - https://x.company/projects/foghorn (it was discontinued when oil was below $50 per barrel, but has not been reinstated yet.)
- Widely disseminate and effectively communicate the extent to which rapid transition to near-100% renewable power will save money and time to mitigate and adapt, e.g.:
  - https://www.linkedin.com/news/story/is-clean-energy-switch-worth-it-5951898/
- Encourage and support the use of ammonia for power storage when pumped hydroelectric, grid-scale battery, green hydrogen, or other forms of storage are costly or

otherwise prohibitive, but pipeline transmission is advantageous over build-out and maintenance of the high voltage electrical grid; especially in cooperation with the agricultural ammonia market.

  - https://web.archive.org/web/20130921055300/http://www.intpowertechcorp.com/ASME-IMECE-12-87097-FINAL-30Jul12-C.pdf
  - http://www.leightyfoundation.org/wp-content/uploads/lces-2012-guangzhou-21oct.pdf

- Support and encourage corporate partnerships to maximize the rate at which carbon negative technologies are deployed, such as the Carbon Removal X Prize and e.g. https://www.walmartsustainabilityhub.com/climate/project-gigaton

Further Committee Resources:

- Asset-Based community Development, https://www.nurturedevelopment.org/asset-based-community-development/, https://resources.depaul.edu/abcd-institute/Pages/default.aspx
- The blind spots of the green energy transition, https://www.ted.com/talks/olivia_lazard_the_blind_spots_of_the_green_energy_transition/transcript
- "Ethics of Care" by V. Held (2005). https://voidnetwork.gr/wp-content/uploads/2016/10/The-Ethics-of-Care-Personal-Political-and-Global-by-Virginia-Held.pdf
- GoingCircular, https://curiositystream.com/goingcircular/index.html?utm_source=social&utm_medium=social&utm_campaign=startgoingcircular+link+Going+Circular+landing+page&utm_id=startgoingcircular+link+Going+Circular+landing+page
- Nature of Consciousness & Disruption, https://www.youtube.com/watch?v=eJWWEd8j_Y8
- Partnerism, Rianne Eisler, https://www.partnerism.org
- Sawubona, https://www.youtube.com/watch?v=2IjUkVZRPK8
- Sustainable Education and Approaches, https://www.mdpi.com/journal/sustainability/sections/education_and_approaches
- Sustainability as Cognitive “Friction”: A Narrative Approach to Understand the Moral Dissonance of Sustainability and Harmonization Strategies, https://www.frontiersin.org/articles/10.3389/fcomm.2020.00008/full

- Sustainability Storytelling is Not Just Telling Stories About Sustainability, https://www.academia.edu/42010744/Sustainability_Storytelling_is_Not_Just_Telling_Stories_About_Sustainability
- System of Preconditions for Successful Arts, Humanities and Social Sciences Integration, https://zenodo.org/record/4478450#.YsLtFBNBxQI
- The Great Simplification**,** https://www.youtube.com/watch?v=-xr9rIQxwj4

Typology of Indigenous Engagement in Australian Environmental Management: Implications for Knowledge Integration and Social-ecological System Sustainability, https://www.ecologyandsociety.org/vol17/iss1/art23/

Appendices

Appendix #1: Key Concepts & Definitions Glossary (to be expanded)

This section contains a list of terms, their definitions and resources, that were used across this chapter. ***Be aware this list is not final and all items can be changed to better reflect the use and consensus of the PP2030 community**.

Term/Concept	**Definition**	**Resources**	**Graphic Depiction/symbols**
Care	The process of protecting someone or something and providing what that person or thing needs. Effort made to do something correctly, safely, or without causing damage Ad defined by the Global Methodologies Committee: The committee's working definition of Care, includes well-being and values, moving away from care being only associated with traditional, colonized and modernized roles and practices of caretaking professions and avvocational roles in society. Care, in this context, is an ethical (moral theory) and practical imperative approach emphasizes the importance of responsibility, concern, and	https://dictionary.cambridge.org/us/dictionary/english/care https://www.britannica.com/dictionary/care	

	relationship over consequences (utilitarianism) or rules (deontologism). Although a central part of medical and nursing ethics, this definition of care points to broader applications in relation to social sciences & technology. This definition as virtue or as related to, acknowledging the importance of fundamental elements of relationships and the dependencies in human life that involves meeting the needs of self and others, especially for those in the ecosystem who are dependent and vulnerable. From a state (legal) perspective, care refers to the state's positive obligations towards protecting individuals. (resources: Carol Gilligan, Nel Noddings)		
Collaborative Agreements	To be further specified…Differences in application of the term (e.g. social vs professional or agency).		
Design Thinking	Set of cognitive, strategic and practical procedures used by designers in the		

	process of designing, and to the body of knowledge that has been developed about how people reason when engaging with design problems.		
Methodology	1: a body of methods, rules, and postulates employed by a discipline : a particular procedure or set of procedures 2 : the analysis of the principles or procedures of inquiry in a particular field		
Regenerative	Processes that restore, renew or revitalize their own sources of energy and materials. Regenerative design uses whole systems thinking to create resilient and equitable systems that integrate the needs of society with the integrity of nature. Gaia 2.0: Planetary Homeostasis	https://en.wikipedia.org/wiki/Regenerative_design https://www.sciencedirect.com/topics/earth-and-planetary-sciences/gaia-hypothesis	
Sustainability	A form of intergenerational ethics in which the environmental and economic actions taken by present persons do not diminish the opportunities	https://www.britannica.com/science/sustainability	

	of future persons to enjoy similar levels of wealth, utility, or welfare		
Systems Design	1. Process of defining elements of a system (e.g. modules, architecture, components and their interfaces) and data for a system based on the specified requirements. 2. The process of defining, developing and designing systems which satisfies the specific needs and requirements of a business or organization.		
Technology	Application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment	https://www.britannica.com/technology/technology	

Appendix #2: Methodologies

This section contains some representative existing methodologies that were discussed and analyzed within the committee. **(This is by no means a complete list. We have more than 100 methodologies in a separate document and Miro board, which will be incorporated.)**

Methodology	Example/Exemplar	Source	Applies to….
Caring Economies	B-Corps Doughnut Economics Net Positive Partnerism ESGs SDGs		
Regenerative Design	EarthCharter Gaia 2.0 Project Drawdown Regeneration.org Resilience.org		
Seven Generations Relational Systems Thinking Indigenous Wisdom	Melanie Goodchild: Turtle Island Sawubona Ubuntu Wisdom Traditions		
Social Action Impact	Ostroms Commons Partnerism Presencing Institute Prosocial SDGs		

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Forests and Trees

It is 2030. Our natural world is thriving thanks to humankind's sustainable stewardship. In less than a decade, the introduction of robust ecosystem policies, technological breakthroughs, and grass-roots movements has inspired whole generations and communities to protect and restore nature. Humanity was able to turn the tide on the tragedy of the commons—halting and reversing global deforestation, stopping species extinction, massive biodiversity loss, and the overall deterioration of nature.

After years of discussion, the global community decided on science-based regulations that addressed large market failures when it comes to nature conservation.

Robust carbon credits, backed by integrity standards and scientific boards raised the level of quality of nature-based solutions. The introduction of a biodiversity index and payments for ecosystem services contributed that nature-based carbon sequestration projects are biologically diverse, strengthening the overall health of ecosystems.

This not only removed policies that drove deforestation but also created a new and greener business model for local communities around the world as well as inspired large enterprises to double down on their zero-deforestation commitments.

Citizen-led grassroots movements played an important role. The global ecosystem restoration movement inspired communities around the world to restore and reconnect with nature. At the end of the decade, the movement fulfilled its ambitious goal of planting one trillion biodiverse trees, restoring valuable ecosystems, and preventing ecological tipping points. Large-scale syntropic farming models have been developed and successfully implemented, regenerating healthy agro-ecosystems.

By reconnecting with nature, civilization has rediscovered the vital importance of Indigenous wisdom and communities. There is reciprocity between humans and the natural world. Excessive extraction is replaced by respect and responsibility for nature's gifts. The "Indigenous renaissance" enabled not only a newfound mutual respect between alternative worldviews but also allowed local communities to legally regain the ownership rights of their ancestral land. Under Indigenous leadership, rainforests are thriving with life, and science and business are acquiring knowledge about novel medicines and forest products.

The demand for impact assessment, transparency, traceability, resilience, sustainability, and efficiency in these new markets now drives and supports technological innovation, and in return technology delivers. Global satellite data combined with advancements in artificial intelligence allows the transparent tracing and tracking of land use change and conservation progress all around the world. Additionally, innovations in on-ground and aerial mapping technology empower local communities to map, understand, monitor, and provide better management of their project sites even in traditionally inaccessible areas below the forest canopy.

Novel field-based sensors such as bio-acoustics and environmental DNA collection allow data analysts to measure biodiversity and the richness of life in unprecedented ways, to capture even the most concealed of species. Establishing mutual respect and affordable high-speed internet access will empower local and Indigenous communities to provide valuable information and feedback to decision-makers. They are crucial stakeholders when it comes to deciphering the collected data and providing sustainable, integrated, and resilient solutions.

Economically stable, corruption-free, and ecologically sustainable cryptocurrencies have now become mainstream in many parts of the world when it comes to carbon accounting—providing global and liquid financial access to communities, while at the same time, transparently tracing supply chains and carbon credits.

Digital citizenship flourished in emerging economies, creating new paradigms of regenerative wealth creation, where physical natural resources were measured and then transformed into digital wealth. Those who steward nature received livelihood payments from this pool of natural capital, and there is a vibrant eco-tourism industry in space (mediated by VR/AR) that brings the value of participating in the immersive travel experiences filmed and captured in these remote regions. Destruction and exploitation of natural resources led to real-time digital penalties, as well as a decrease in community social standing through a social reputational system that became used for international travel and individual social banking.

Advances in legal courts led to the definition of “personhood” in more forestry areas, where entire portions of the forest are considered to be legal persons now. Decentralized community-led conservation groups established closed boundaries that encapsulate large pieces of land and assigned the entire area of the forest to the “body” representing legal personhood.

The global rejuvenation of our natural world comes with immense benefits for all of humankind. Thanks to it, people now enjoy reliable access to ecosystem services such as freshwater, flood protection, and clean air, resulting in increased health and happiness benefits. Cities, being immersed in dense urban forests, benefit from the protection from natural hazards such as cool shades during heatwaves. Ecological forestry and early detection of fire risks through technological monitoring have put an end to megafires. To the surprise of many scientists, many endangered species are reappearing in their natural habitat.

Section One: Deforestation and forest degradation are key drivers of the climate crisis

Issue 1

Deforestation and land use change account for 18% of global anthropogenic emissions and contribute to driving up atmospheric carbon levels (IPCC 2019). Climate change increases the risk of forest fires, creating a vicious cycle.

Background:

Land use is a key component, accounting for approximately 18% of total greenhouse gasses (GHG). Since the year 2000, we have lost 361 million ha of forest cover, equivalent to the size of Europe. If tropical deforestation would be a country, it would be the world's third largest emitter (after China and the US). Land use includes a wide range of critical issues, from deforestation and forest degradation to agriculture. The domain is particularly challenging, given that the world's growing population and rising standards of living exert increasing pressure on food and consumer goods production, both of which may lead to conflicting objectives regarding climate change and biodiversity. Forests face increasing risk and frequency of wildfires, droughts, and extreme weather, forest ecosystems are under severe pressure (Shi et al. 2021). To avoid planetary tipping points (Nobre et al. 2016) and maintain a stable and livable climate, mankind urgently needs to reduce carbon emissions until 2030 and preserve essential ecosystems (IPCC 2021). The REDD+ program (Reducing Emissions from Deforestation and Forest Degradation), is UNFCCCs scheme for the reduction of emissions caused by forest protection measures.

Recommendations:

To avoid planetary tipping points and maintain a stable and livable climate, mankind urgently needs to reduce carbon emissions until 2050 and restore essential ecosystems. Forests and natural carbon sequestration are important climate change mitigation strategies with a biophysical mitigation potential of 5,380 MtCO2 per year on average until 2050 . Forestry is a large industry and the causes of deforestation are mostly economically driven.
There is thus a need for higher quality carbon offsetting protocols and higher transparency and accountability of the MVR of these projects.

The rest of the recommendations for the overall issue have been expanded over the "additional background material" and include the following:

1. Satellite Mapping
2. Digital Twins
3. Decentralized Ledgers and On-Chain Representation
4. AI NLP Speech Partners - AI Lorax
5. Enhanced MRV MVRMRV

Further Resources:

Carlos A. Nobre, Gilvan Sampaio, Laura S. Borma, Juan Carlos Castilla-Rubio, José S. Silva, and Manoel Cardoso, Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm, Proceedings of the National Academy of Sciences, 113, (39), September 16, 2016, https://doi.org/10.1073/pnas.1605516113

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Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems, 7–11.
IPCC. 2021. 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

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Adam Vaughan (March 07, 2022) Amazon rainforest nears tipping point that may see it become savannah, newscientist.com, https://www.newscientist.com/article/2311097-amazon-rainforest-nears-tipping-point-that-may-see-it-become-savannah/

Saul Elbein (June 24, 2022) How climate change is making fires worse, thehill.com, https://thehill-com.cdn.ampproject.org/v/s/thehill.com/policy/equilibrium-sustainability/3535264-climate-change-fueling-worsening-droughts-wildfires/amp/?amp_gsa=1&amp_js_v=a9&usqp=mq331AQKKAFQArABIIACAw%3D%3D#amp_tf=From%20%251%24s&aoh=16578690899048&referrer=https%3A%2F%

Jofre Carnicer, Andres Alegria, Christos Giannakopoulos, Francesca Di Giuseppe, Anna Karali, Nikos Koutsias, Piero Lionello, Mark Parrington and Claudia Vitolo (June 20, 2022) Global warming is shifting the relationships between fire weather and realized fire-induced CO2 emissions in Europe, nature.com, https://nature.com/articles/s41598-022-14480-8

Issue 2

Nature is essential for human existence and good quality of life. Most of nature's contributions to people are not fully replaceable, and some are irreplaceable. The natural world is deteriorating in rates unparalleled in human history (IPBES, 2019), resulting in a currently ongoing sixth mass extinction.

Background:

Forests, especially tropical forests provide habitats for 80% of land-based biodiversity. Harmful activities, including habitat destruction, poor farming practices and pollution, have altered ecosystems significantly, driving many species past the point of recovery. Globally, there are an estimated one million at risk, with biodiversity declining at a faster rate than at any time in human history (IPBES, 2019). The climate crisis is exacerbating the issue as many species simply cannot adapt to the scale and pace of changing temperatures. Furthermore, there is danger of a vicious cycle: biodiversity loss can reduce forest carbon storage and exacerbate climate change which can, again, spur biodiversity loss. Pioneered more than two decades ago by the IUCN but now increasing in popularity is the concept of Nature-based Solutions. Nature-based Solutions (NBS) are "actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature" (IUCN, 2022). The 2019 UN Climate Action Summit convened by the UN Secretary-General brought great political attention to the power of NBS, and in particular, the NBS Coalition co-led by China and New Zealand launched the NBS for Climate Manifesto, with the support of more than 70 governments, private sector, civil society and international organizations, and outlining nearly 200 initiatives and best practices from around the world on Nature Based Solutions. NBS in general offers a "third way" beyond the original idea of REDD+.

Recommendations:

- All ecosystems, including grasslands and wetlands, play vital roles for local and global environments. We should not plant trees over wetlands and natural grasslands.
- Treat the climate and biodiversity crisis as twin crises that affect each other.
- Advocate for restoring natural levels of biodiversity. Support projects that restore a healthy diversity of native species in any location that should naturally support trees. Monocultures not only capture less carbon but also don't support biodiversity and can even harm nearby ecosystems.

Further Resources:

S. Díaz, J. Settele, E. S. et al. **IPBES (2019): Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.**

Ceballos, G.; and Ehrlich, P. **2018. The misunderstood sixth mass extinction. Science, 360: 1080.2–1081.**

Issue 3

Forestry sudden death from infectious diseases is an issue that affects tree species in various degrees.

Background

The state of California and the USDA (with the help of DHS/CBP) are vigilant to limit the influx of infection vectors. Dutch Elm Disease which affects species in the genera Ulmus and Zelkova was a major challenge in north eastern North America (US/Canada) more 40+ years ago. Another pest is the Spruce Budworm:
Budworm outbreaks can have significant economic impacts on the forestry industry. As a result, the eastern spruce budworm is considered one of the most destructive forest pests in North America, and various methods of control are utilized. However, the species is also ecologically important, and several bird species are specialised on feeding on budworms during the breeding season.
Citrus trees are also victims of Asian Citrus Psyllid (ACP) which can spread very fast from infected trees to healthy ones by the psyllid.

Recommendation

- Washing and disinfecting shoes, tires, and anything that can transport vegetative particles and dirt.
- Don't Move Firewood: Buy it where you burn it. Do not bring oak, fir, redwood, madrone, or tanoak unless they are certified to be free of Phytophthora ramorum outside of the area. This would limit the spread of this pathogen. United States Department of Agriculture's Animal and Plant Health Inspection Service's Phytophthora ramorum/Sudden Oak Death web page.
- Spread the word about SOD, especially to those who engage in hiking, biking, and driving in and out of infected areas.
- Remember the importance of oaks. In addition to being a part of our cultural heritage they are a keystone species in our ecological communities. Whole ecosystems of plants, animals, and fungi are dependant on the survival of our oaks.

Further Resources:

B. R. Schadel; W. Wesela **(July 2020) APHIS List1 of Regulated Hosts and Plants Proven or Associated with Phytophthora ramorum.**

Code of Federal Regulations **2022 § 301.92-2 Restricted, regulated, and associated articles; lists of proven hosts and associated plant taxa.**

Section Two: Global reforestation potential has a large and cost-effective mitigation potential *when done right*

Issue 4

Forests and natural carbon sequestration are important climate change mitigation strategies (Canadell and Raupach 2008) with a biophysical mitigation potential of 5,380 MtCO2 per year on average until 2050 (IPCC 2019) yet Forestry is a large industry and the causes of deforestation are mostly economically driven (FAO 2020) (Geist and Lambin 2001) which means the future of our forests are currently dependent on exponential financial growth versus ecosystem health.

Background:

The causes of deforestation are mostly economically driven: expansion of commercial or subsistence agriculture, logging, fuelwood collection, or livestock grazing (Hosonuma et al., 2012)). However, the mitigation potential of reversing the deterioration of nature is large. Every year, the ocean absorbs about 30% of human-made carbon emissions, and terrestrial ecosystems absorb slightly less. The rest of our emissions enter the atmosphere. Over the years, this has caused the accumulation of ~300 Gt of excess carbon in the atmosphere. Our study finds an additional 0.9 billion hectares of forests could capture approximately 205 Gt carbon, i.e. two-thirds of the total human-made carbon emissions currently in the atmosphere. To counteract the economic incentives, payments for ecosystem services (PES) (Wunder, 2007) are increasingly (Donofrio et al., 2019) provided to forest conserving or restoring landowners by international stakeholders (e.g., through the governmental UN-REDD program (Gibbs et al., 2007) or

the commercial voluntary carbon market (Donofrio et al., 2019)). Money from carbon offsets can provide vital financial support for projects seeking to protect and restore some of the most beautiful threatened ecosystems around the world. Given that nature-based solutions can make a significant contribution to the climate mitigation needed to stabilize global heating, a functioning finance channel will be important for climate change progress, and particularly for developing countries. However so far only 2% of all global climate finance has been invested into nature-based solutions.

Recommendation:

- Utilize UN SDG and ESG metrics demonstrating "triple bottom line" metrics of success for society and business that prioritize planet and people before or in conjunction with profit to ensure long term health of our forests and those orgs who practice genuine sustainable business practices.
- To avoid catastrophic climate change, we need to cut emissions quickly and drastically, and we need to draw down the excess carbon that's already in the atmosphere. Achieving this will require many solutions. Restored trees will accumulate carbon slowly over the rest of this century and beyond. Like many climate change solutions, this is a long-term vision, which highlights the urgent need for action now. Planting trees is not a silver bullet for climate change but can help, but significant cuts to current emissions are still essential.

Further Resources:

Bastin, Jean-Francois, Yelena Finegold, Claude Garcia, Danilo Mollicone, Marcelo Rezende, Devin Routh, Constantin M. Zohner, and Thomas W. Crowther. **"The global tree restoration potential." Science 365, no. 6448 (2019): 76-79.**

Section Three: Monitoring, verification and reporting of nature-based solutions is capital and labor-intensive

Issue 5

The certification process for forest carbon offsetting projects is capital- and labor- intensive, especially due to the high cost of manual monitoring, reporting and verification (MRV) of the forest carbon stock.

Background:

For the last 20 years, major conservation efforts have been underway to mitigate and safeguard against these losses. One of the global financing strategies is carbon offsets (Blaufelder et al. 2021). Initially, it started as the Clean Development Mechanism (CDM) under the Kyoto Protocol, allowing governments and business organizations from industrialized countries to invest in forestry in developing countries by buying carbon credits to offset industrialized emissions (FAO 2020). Several other independent bodies have later developed official standards for verifying and certifying carbon offsetting projects, such as the Gold Standard (GS) and the Verified Carbon Standard (VERRA). The certification process for forest carbon offset projects is capital- and labor-intensive, especially due to the high cost of manual monitoring, reporting and verification (MRV) of the forest carbon stock. The carbon offsetting market is rapidly increasing and expected to grow by a factor of 100 until 2050 due to high demand and available capital (Blaufelder et al. 2021). However, the main obstacle is limited supply of offsetting projects as forest owners lack upfront capital and market access (Kreibich and Hermwille 2021). Current methods for monitoring, reporting, and verification (MRV) of the landowner-provided forest ecosystem services are either based on 1) on-ground inspection, which is too expensive (USD 20-30k), delayed (up to two years), corruptible, and biased (Gold Standard, 2017), 2) satellite, which is low-cost, but limited to the binary verification of forest/no-forest cover (Hansen et al., 2013), or 3) drones. The carbon offsetting market is rapidly increasing and expected to grow by a factor of 100 until 2050 due to high demand and available capital (Blaufelder et al. 2021). However, the main obstacle is limited supply of offsetting projects as forest owners lack upfront capital and market access (Kreibich and Hermwille 2021).

Recommendation

- Invest in technology innovation such as satellite monitoring, drone analysis, and automated on-ground data collection that allows for low-cost MRV
- Acknowledge that technology is not a silver bullet and seek to accelerate those applications that correctly address the barriers to scale in the use of tech for environmental good: Data compatibility, making more geospatial and in-situ data accessible for model training – effective use of ML is hindered by a lack of accessible data. Harnessing AI & ML to create new, and scale promising existing granular climate models. Access to computing resources for the purpose of training AI models – especially for developing countries. Technical expertise and skills to integrate data, computing resources and tools and models to produce insights. The domain expertise and management capabilities to turn AI-generated climate insights into policy making decisions.
- Empower local communities to own and decentralize the technology

Further Resources

Blaufelder, C.; Levy, C.; Mannion, P.; Pinner, D.; and Weterings, J. 2021.
McKinsey&Co: A Blueprint for Scaling Voluntary Carbon Markets to Meet the Climate Challenge.

Brown, S.; and Iverson, L. 1992.
Biomass estimates for tropical forest. World Res. Rev., 4: 366–383.

Hanan, N. P.; and Anchang, J. Y. 2020.
Satellites could soon map every tree on Earth. Nature, 587

Issue 6

Forest carbon offsets and methodologies are prone to errors and deliberate systematic over accounting, undermining trust in offsets while providing large industries an opportunity to greenwash.

Background:

The forest protection carbon offsetting market is used by major airlines for claims of carbon-neutral flying and by major fossil fuel companies to showcase their climate ambition. However, it faces a significant credibility problem. Experts are warning the system is not fit for purpose. Recent research investigations (Badgley et al. 2021; West et al. 2020) have shown that the current manual forest carbon stock practices systematically overestimate forestry carbon offsetting projects with up to 29% of the offsets analyzed, totaling up to 30 million tCO_2e (CO_2 equivalents) and worth approximately $410 million. The overestimation was identified to come from subjective estimations and modeling of the carbon stock baseline and of the project's additional and leakage reporting,

Recommendation

- Radical Transparency: Open up methodologies, baselines, algorithms and models transparently for independent audits to create trust
- Co-design robust and adaptable methodologies with all stakeholders

Further Resources

Badgley, G.; Freeman, J.; Hamman, J. J.; Haya, B.; Trugman, A. T.; Anderegg, W. R.; and Cullenward, D. **2021. Systematic over-crediting in California's forest carbon offsets program. bioRxiv.**

Section Five: The issue of Tree Accounting

Issue 7

Individual Tree accounting is almost non-existent, making various techniques such as selective logging and selection cutting with no trace and very easy to execute more likely to happen.

Background

No individual identification exists for trees to track their existence, so when trees are cut and hauled away, there is no way for law enforcement to record their loss. Trees don't have serial numbers. On one hand, we don't have any accounting for how many trees we are losing and no legal process to account for losses even on privately owned land. On the other hand, cities like Mountain View tout their canopy coverage by promoting that the city has the best canopy foliage by counting the number of shrubs and young trees planted for every mature tree cut. Sometimes trees as old as 200 years are cut and replaced with three or four smaller shrubs which will take another 30-40 years to even reach a few feet.

Recommendation

There are high end solutions like geospatial mapping feed into machine learning models to assess the number of trees. As with everything, we actually do not need AI for this. We can take old google aerial views of the past to compare to the present. Most cities have extensive paper trails for every process, so we could track the number of trees removed by their process paper work alone, all tallied on good old excel sheets. It requires the public to demand transparency and that is the issue; making the public care enough to demand transparency from their governments. Simple QR codes and geotagging have worked well in many countries to track trees, we need to make it more common. Maybe we could require that kind of tagging for every tree existing and new ones planted.

Further Resources

L.Yao; T. Liu; J. Qin; N. Lu; C. Zhou; Ecological Indicators Volume 125 (June 2021) Tree counting with high spatial-resolution satellite imagery based on deep neural networks.

M. Noack 2018 Is Mountain View losing its trees? New city data still leaves question up in the air.
M. Vyawahare 2019, Mongabay Tree-planting programs turn to tech solutions to track effectiveness.
R. Njambi, Up 42, 2021, Tackling Deforestation in India: Why You Need Satellite Data
S. Nix 2019. 3 Ways Your Trees Can Be Stolen.

Additional Background Material (Further Resources for Chapter)

Despite the social media driven push for corporate engagement on tree planting, numerous organizations have advocated that the process of tree and forestry protection is much more effective than that of virgin tree planting.

The key debate is between the merits of reforestation, and the merits of preserving what we have available. Some simple analysis by EcoCart shows:

- 1. Trees can take up to 10 years before they start absorbing more carbon dioxide than they emit
- 2. Planting new trees requires more work,
- 3. Planting new trees is expensive,
- 4. Reforestation projects can be less sustainable, as it is uncertain whether the newly-planted forests will be capable of supporting animal, insect, and plant ecosystems as current forests actively do.

https://ecocart.wunderdogs.xyz/why-protecting-existing-trees-can-be-better-than-planting-new-one

Mass tree planting initiatives also require thoughtful planning and execution. Planting the wrong trees in the wrong place may reduce biodiversity, speed up extinctions and reduce resiliency of ecosystems.
https://www.nytimes.com/2022/03/14/climate/tree-planting-reforestation-climate.html

Advocates from the WWF acknowledge: “Planting trees is good. Saving existing forests is better. Protecting people and nature is best” (source: https://www.worldwildlife.org/blogs/sustainability-works/posts/planting-trees-is-good-saving-existing-forests-is-better-protecting-people-and-nature-is-best)

The mathematics behind forestry protection being much better than reforestation

GainForest: GainForest is an open platform that empowers sustainable conservation efforts by unifying 1) accessible and automated monitoring, 2) auditable and decentralized payments and 3) stakeholder engagement and user-focused token incentives into one system. Tracing the impact of a donor's individual donation is difficult, making it hard for them to develop a sense of ownership. GainForest NFTrees make payments to conservation organizations more tangible. They are unique digital assets that track the ownership of virtual sites of a conservation or restoration project using blockchain technology. Virtual sites correspond to a predefined land area within the project with possibly multiple plants. NFTree tokens include unique artwork from local communities and indigenous artists for each project. Each token links to a unique monitoring website that provides geospatial and ecological information of the corresponding site, displaying recent drone and satellite data, current and potential tree cover, which species of flora exists, and how much carbon is currently stored, or could potentially be stored if the ecosystem was intact. The group of corresponding plants within an NFTree can change during its lifetime due to survival rates and active restoration efforts. NFTree holders can follow recent updates and progress on their respective conservation areas through the NFTree profile website, dynamic artwork and data airdrops. Investments raised from NFTrees are first parked in a decentralized fund. Payments are automatically released to conservation organizations after achieving specific milestones during the verifiable "Proof-of-Care" stage, which consists of automated digital MRV.

Food for thought:
https://www.nytimesn7cgmftshazwhfgzm37qxb44r64ytbb2dj3x62d2lljsciiyd.onion/2022/07/13/magazine/planting-trees-climate-change.html

From a marketing perspective, though, carbon credits have several disadvantages. They require expensive third-party verification. They are abstract. Their transactions tend to happen in metric tons and hectares, the unit of measurement favored by professional foresters. The word "hectare" has never appeared in an inspiring quote. Individual trees, on the other hand, can be grasped by even the most ill-informed consumer, can be quickly added together into fantastic-sounding sums and, in theory at least, provide all the same carbon-storing, climate-mending benefits of more carefully vetted carbon credits. They lend their planters an air of wisdom, even saintliness."

Karen Holl, a restoration ecologist at the University of California, Santa Cruz, suggests a conceptual shift. “We should be growing trees, not planting trees,” she says, “We need to think about whether those trees are surviving over time, because it’s going to take 10, 20 years, a century, before we really get the benefits that we want.

The race for a trillion trees can continue to motivate donors, but Finkbeiner says that his organization is no longer focused on counting trees. Ultimately, he believes, the movement’s success or failure in restoring the world’s forests will be judged not by the number of trees planted, but via satellite imagery, viewed over the long term, and discussed the old-fashioned way — in hectares."

Satellite Mapping: Earth observation with machine learning-based methods plays a crucial role in environmental and climate sciences. Being able to continuously monitor and report changes is an important tool for decision makers to address urgent challenges in climate change mitigation and adaptation, especially for forestry where land use change is one of the key factors to understand. Earth observation data is stored in the petabyte scales. Public institutional data such as European Space Agency's Sentinel-1 synthetic aperture radar data and Sentinel-2 optical images produces 4 PB of data. Private providers such as Maxar have reportedly stored more than 110 petabytes in its image library since 2000, adding up to 80 TB of satellite data per day. Leveraging this data, researchers have developed global maps on tree cover loss and gains (Hansen et al., 2011), reforestation potential (Crowther et al., 2019) and biodiversity richness (Jetz et al., 2012).

Digital Twins: Creating digital replicas that mirror the existence and dynamics of physical objects, processes, assets, or arrangements is known as the creation of Digital Twins. Using advances in satellite, aerial, and on-ground sensing technologies, we can create realistic records of land cover, forest type, biomass, and canopy height. The ever-growing spatio-temporal data records are used to improve the accuracy of Digital Twins, namely climate and land surface models, such that it can forecast the state and health of forests. Forest Digital Twins could be advanced towards mapping ecosystem health, carbon content, biodiversity or rapid exploration of climate policy impacts, visualizing future scenarios. Advances in Digital Twins have historically been applied extensively in architecture, BEAM modeling, and simulation design, and for the sake of the IEEE Planet Positive application, we propose to focus on data curation, collection, sensing, mapping and simulating challenging forestry landscapes and the interior canopy of rainforests.

Decentralized Ledgers and On-Chain Representation: Decentralized ledger technology as a whole is oriented towards the use of an open and public decentralized ledger to create a permanent record keeping of account. For the sake of economic support, as well as representation of digital environmental attributes such as carbon removal credits and hectares of land preservation

AI NLP Speech Partners - AI Lorax : Drawing from the existing advancements in Artificial intelligence for Natural Language Processing (NLP) - there are opportunities to make a AI chatbot that can persuasively and humanely interact with external audiences, bringing an emphatic "voice" and "character" to an otherwise amorphous concept of trees and hectares. Humorously code-named the Lorax AI Project - we are exploring the idea of using the key tools and advances in AI to scalably represent and design a mass market-facing awareness-building tool - for example, by allowing the Lorax AI to actively engage with conversations and tweets on Twitter.

New Thought Paradigms:

- **Sacred Economics:** How we can give value to nature is critical and it starts with a base level reframing of what the underlying pillar of economics is. Through his chapters on sacred economics, Charles Eisenstein has a chance to re-examine the original act of generosity, and "gifting" that underpins the early foundations of life, and now underpins our own foundation.
- Sequestered carbon has 'an unbreakable and continuous bond to living biomass and can therefore never be fully divorced from the place of production or the people who produce them' (Osborne and Shapiro-Garza, 2017: 4). Signature additions to carbon offsets e.g. the incorporation of the story of these bonds (Brill 2021) or the 'inalienable ancestral cultural signature' of indigenous-produced carbon offsets can expand the defined value of a carbon credit. Such value additions, if conducted ethically, may 'initiate processes of potentially enduring exchange and engagement… embed[ing] peoples' relations with it, with each other, and with the places from which the offset is generated' (Jackson et. al 2017).

- **Payment for Environmental Services:** The growing recognition that the natural capital of the planet deserves better accounting and financial representation management

Future Application and Enhancement Page:

Enhanced MRV

There are three key aspects that are important for the use of remote sensing in MVR of forest carbon stock. One aspect is financial; using available and accessible technology and sensors to lower the cost and upfront capital requirements for forest owners to get certified, especially in low and middle-income countries. The second aspect is reducing subjectivity in estimating carbon stock and increasing trustworthiness and transparency in the carbon offsetting certification protocols. And lastly, the solutions need to be scalable due to the urgency of financing forest restoration, especially in tropical regions.

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Rivers and Lakes

It is 2030. Key technology developments, policy implementations, and, perhaps most difficult of all, the focus of human will, have together resulted in the regeneration of the ecosystems of the world's rivers and lakes. Inspired to address the many problems brought about by an exploding population engaged in unsustainable environmental practices, we chose to come together. We chose to imagine what was possible and as a result, we achieved the victories in these areas that we experience today.

Access to clean potable water has been democratized across cultural and economic divides. Water-use rights and access to water have expanded, even as water waste has dramatically dropped.

The world's commercial agriculture businesses have diversified. Crops include more regionally appropriate "less thirsty" crops, decreasing the demand for agricultural irrigation as well as diminishing the runoff from pesticides, fertilizers, and other nutrient pollutants into neighboring rivers and lakes. This has also decreased the need for flow diversion via dams and other artificial means. In response, freshwater ecosystems have rebounded with an increasing number of healthy plant and animal species.

Pollution from Earth's manufacturing facilities and urban infrastructure is significantly reduced. New technologies, bolstered by educational and media efforts, have addressed physical, chemical, and biological pollutants at their source, bringing back a biological diversity not seen in generations. The world's urban areas have made significant progress in integrating natural ecosystems into their urban developments. Parks, woodlands, rivers, and lakes have an expanded natural presence within their boundaries, helping to reduce the effects of climate change.

Human influences on the water's temperature and flow direction affected the natural water and land interaction in the past, disrupting its chemical makeup, affecting the diversity of flora and fauna, of which, and this is the ironic and salient point, humans are included. Most humans viewed themselves as occupants, settlers, even conquerors of this planet, using its resources to fulfill their needs and desires. This attitude shifted in 2022 when a majority of Earth's people recognized that all are indigenous planet Earth members, reliant on its rich diversity of species to survive. They began to realize that as much as species depend on a healthy habitat for their survival, so too do habitats rely on each other. And as people knew the importance of their own cardiovascular health, so too did they begin to recognize the sacred importance of Earth's lungs and heart and made better efforts to understand it for their own good. People all around the world recognized they needed to become a responsible species.

This shift was inspired by science and the realization that the Earth's "**wetlands store about five times more CO_2 than forests and as much as 500 times more than oceans**"[64] This is phenomenal! And this was back in 2022! The shift represented a significant turning point for humans as they began to consider nature as something to care for (rather than to dominate.) Previous to this, over centuries, humans drained wetlands, treating them as obstructions or undesirable swamps [literally mucking up people's foolhardy] attempting to reclaim as much inhabitable land as possible for agriculture and settlement purposes. Why? Renowned novelist and journalist, Annie Proulx elegantly reflected on this with respect to the early settlement of North America in "Swamped," published in *The New Yorker*:

> The original occupants of the continent knew the rivers and swamps, the bogs and lakes, as they knew the terrain and one another. But for most English settlers and European newcomers nature consisted of passive and inanimate substances and situations waiting to be used to human advantage. **Preservation and care of nature were not what they had come for.**[65]

Regarding the North American continent, for example, over the decades in the short history of its settlement, according to the US Environmental Protection Agency (EPA), there were roughly 220 million acres of wetlands in the area comprising the continental USA in the 1600s, and by 2009, roughly half of that was gone.[66],[67] Stunning! This is not isolated to the North American continent, of course. A United Nations report cites a source revealing even more stunning data: worldwide "some 85 percent of wetlands present in 1700, were lost by 2000, many drained to

[64] Duke University, Nicholas School of the Environment (May 2022) "Land-Building Marsh Plants are Champions of Carbon Capture"

[65] Annie Proulx (Jul 2022) "Swamps Can Protect Against Climate Change, If We Only Let Them" Published in *The New Yorker*

[66] US EPA (n.d.) "Wetlands - Status and Trends"

[67] Thomas E. Dahl, U.S. Fish and Wildlife Service and Gregory J. Allord, U.S. Geological Survey (n.d.) "History of Wetlands in the Conterminous United States" published by the *US Geological Survey, National Water Summary on Wetland Resources*

make way for development, farming or other 'productive' uses." While evidence suggests it is slowing, we will lose 1% of the world's wetlands in 2022; however, "the good news is, people now know how to restore these wetlands at a scale that was never before possible and in a way that both stops this release of carbon and re-establishes the wetland's carbon storing capacity."[68],[69,70]

It was with this knowledge, and in the spirit of pioneer conservationist Rachel Carson, that collectively, Earth's riverbanks and lakes enjoy regeneration.

Today, our water planet predictably spins on its axis propelling winds in opposite directions above and below its equator, driving surface and deep ocean currents affecting temperature changes across this azure and tawny sphere. Evaporation occurs. Clouds form. Storms develop. Rain falls. Watershed commences and water's journey back to the sea begins. Like blood vessels, rivers and lakes work with oceans and the atmosphere to pump water around the globe. It's the Earth's cardiovascular system.[71] Life imitating life. Along its way, water runoff enlivens and enriches ecosystems on a mass scale beginning in the Lilliputian world of a phytotelma, ending in an estuary that slow-dances with its ocean partner to the tune of a tide. In between, millions of species of flora and fauna, including humans, now living symbiotically and sustainably with our planet, surviving and thriving in habitats naturally created in an amalgam of water and land, adapting to temperature and gravity forces compelling water along its way.

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[68] Thomas E. Dahl, U.S. Fish and Wildlife Service and Gregory J. Allord, U.S. Geological Survey (n.d.) "History of Wetlands in the Conterminous United States" published by the *US Geological Survey, National Water Summary on Wetland Resources*

[69] Duke University, Nicholas School of the Environment (May 2022) "Land-Building Marsh Plants are Champions of Carbon Capture"

[70] The Nimmie-Caira Project, Celebrating a *Successful* Partnership published by the NSW Dept of Planning and Environment within Australia, project completed 2019.

[71] Romullo Baratto (Jun 2020), "Global Watersheds and Waterways Captured in Vibrant Colorized Maps" published in *Arch Daily*

TABLE OF CONTENTS

1 HUMAN POPULATION GROWTH

Over millennia, Earth's growing population spread across the planet. Developing increasingly sophisticated socioeconomic systems, migrating across continents, fighting wars and other conflicts, Earth's populations competed for available water resources. Clean accessible water was *life*: for agriculture, for villages, towns, and cities, for developing industries. It was the foundation upon which human civilization was built.

War and Violent Conflicts
Access Rights
Food Security
Water Security
Potability
Over Use/Waste

War and Violent Conflicts

Issue

Humans resort to violence over water scarcity in parts of the world impacted by drought. Conversely, similar conflicts may arise from flooded regions. Ultimately, access to clean water drives many conflicts worldwide.

Background

War and violent conflicts have a significant impact upon Earth's rivers and lakes. Since 2500 BC, societies have engaged in some 1300 *known* conflicts.[72]

Causes and results vary. "Underground water is being pumped so aggressively around the globe that land is sinking, civil wars are being waged, and agriculture is being transformed."[73],[74] But "Studies reveal that water scarcity acts as a security threat multiplier in regions characterized by rising population, social and political tensions."[75] The scale is global and has doubled in the last decade.[76]

The immediate effects of these historic, widespread, and climate change-exacerbated conflict behaviors have resulted in worldwide habitat destruction with attendant long-term social, economic, and health effects. Within the current accelerating climate crisis, violent conflict compounds climate change effects and the sustainability and regenerative abilities of the planet.

Recommendations

1. Development and implementation of three broad categories of tools

[72] Water Conflict Timeline List https://www.worldwater.org/conflict/list/
[73] What You Need to Know About the World's Water Wars (Editor's Pick: 10 Violent Water Conflicts
[74] Editor's Pick: 10 Violent Water Conflicts - World | ReliefWeb)
[75] (Yemen's Water Crisis: A New Urgency to an Old Problem https://peacelab.blog/2021/04/yemens-water-crisis-a-new-urgency-to-an-old-problem)
[76] (World water conflicts: The global hot spots https://www.dw.com/en/world-water-conflicts-the-global-hot-spots/g-52417245)

a. Expanded **Political and Legal** options[77],[78]

i. Literature survey[79]

ii. Policy and sustainability[80]

b. Expanded **Economic and Financial** tools

i. Heinberg, R. (2005), "Powerdown: options and actions for a post-carbon world", European Business Review, Vol. 17 No. 5. https://doi.org/10.1108/ebr.2005.05417eab.002

c. Expanded **Policy and Governance** strategies

i. Wiegleb Viviana, Bruns Antje, What Is Driving the Water-Energy-Food Nexus? Discourses, Knowledge, and Politics of an Emerging Resource Governance Concept,Frontiers in Environmental Science, 6, 2018, https://www.frontiersin.org/articles/10.3389/fenvs.2018.00128 DOI=10.3389/fenvs.2018.00128

2. Strengthen support for existing transnational/transcultural organizations
   a. United Nations
   b. World Economic Forum

Case Studies

1. Zhou, Xiaofang, Jianzhong Li, Heng Tao Shen, Masaru Kitsuregawa and Yanchun Zhang. "Frontiers of WWW Research and Development - APWeb 2006, 8th Asia-Pacific Web Conference, Harbin, China,

[77] Bannon, Ian., Collier, Paul. Natural Resources and Violent Conflict: Options and Actions. Ukraine: World Bank, 2003.
[78] Ballentine, Karen, and Heiko Nitzschke. "Business and Armed Conflict: An Assessment of Issues and Options." *Die Friedens-Warte* 79, no. 1/2 (2004): 35–56. http://www.jstor.org/stable/23773715.
[79] Stevens, P. (2003). Resource impact: curse or blessing? A literature survey. *Journal of Energy Literature*, *9*(1), 3-42. http://www.oxfordenergy.org/jelindex.php
[80] Economic Development and Environmental Sustainability: New Policy Options. United Kingdom: OUP Oxford, 2006.

January 16-18, 2006, Proceedings." *APWeb* (2006). Case Studies - Water Conflict Resolution | Program in Water Conflict Management and Transformation | Oregon State University

2. Mexican Village Sets International Precedent in Water Conflict Resolution - Resilience
3. Hong, Chang-Yu. "The Conflict Resolution Case Study in Urban Life: Bull Run Watershed Case." *Journal of Contemporary Eastern Asia* 15 (2016): 211-224. The Conflict Resolution Case Study in Urban Life: Bull Run Watershed Case (pdx.edu)
4. The Nile River Basin: A Case Study in Surface Water Conflict Resolution - El-Fadel - 2003 - Journal of Natural Resources and Life Sciences Education - Wiley Online Library
5. Water-Sharing Conflict: A Case Study in the Ganga Waters Dispute between India and Bangladesh by Thi Thuy Trang Pham :: SSRN
6. Southern Africa in water crisis – A case study of the Pangara River water shortage, 1987–1996 – ACCORD
7. Yemen's Water Crisis: A New Urgency to an Old Problem https://peacelab.blog/2021/04/yemens-water-crisis-a-new-urgency-to-an-old-problem
8. Conflict Over Water in the Aral Sea https://climate-diplomacy.org/case-studies/conflict-over-water-aral-sea
9. Conflicts on Irrigation Water in the South of the Kyrgyz Republic https://www.usaid.gov/sites/default/files/documents/1861/COMTACA%20Irrigation%20Water%20Conflict%20Sources%20Report-%20English.pdf
10. Roic, Kristina, Dustin E. Garrick and Manzoor Qadir. "The Ebb and Flow of Water Conflicts: A Case Study of India and Pakistan." (2017).
11. Hora, Deeksha, Luiz Fernando Loureiro Legey and Mônica. "Water Resource Conflict in the Amazon Region: The Case of Hydropower Generation and Multiple Water uses in the Tocantins and Araguaia River Basins." *Global Journal of Research In Engineering* 15 (2015): n. Pag.
12. Water, conflict resolution and environmental sustainability in the Middle East https://ag.arizona.edu/OALS/ALN/aln44/charrier.html

Further Resources

1. Levy, Barry S. and Victor W. Sidel. "Water Rights and Water Fights: Preventing and Resolving Conflicts Before They Boil Over." *American journal of public health* 101 5 (2011): 778-80
2. "Researchers Link Syrian Conflict to a Drought Made Worse by Climate Change" ~ *NY Times*, Mar 2015
3. "The Chinese Threat to Lower Brahmaputra Riparians India and Bangladesh" by Jaideep Saikia, published by The Diplomat (02/2022). https://thediplomat.com/2022/02/the-chinese-threat-to-lower-brahmaputra-riparians-india-and-bangladesh/
4. Water Conflict Chronology Timeline List https://www.worldwater.org/conflict/list/
5. Editor's Pick: 10 Violent Water Conflicts - World | ReliefWeb https://reliefweb.int/report/world/editor-s-pick-10-violent-water-conflicts#:~:text=%20Editor%E2%80%99s%20Pick%3A%2010%20Violent%20Water%20Conflicts%20,conflict%20over%20the%20Euphrates-Tigris.%20The%20Euphrates-Tigris...%20More%20
6. World water conflicts: The global hot spots https://www.dw.com/en/world-water-conflicts-the-global-hot-spots/g-52417245
7. Three International Water Conflicts to Watch https://www.geopoliticalmonitor.com/three-international-water-conflicts-watch/
8. Water Management Conflict and the Challenges of Globalisation notes https://www.accord.org.za/ajcr-issues/water-management-conflict-and-the-challenges-of-globalisation-notes/
9. What you need to Know about the World's Water Wars NatGeo
10. How to Solve Water-Related Conflicts https://www.wri.org/insights/how-solve-water-related-conflicts
11. Special Issue "Water Conflict Prevention" https://www.mdpi.com/journal/water/special_issues/Water_Conflict
12. Tayia, Ahmed. "Transboundary Water Conflict Resolution Mechanisms: Substitutes or Complements." *Water* (2019): n. Pag.
13. Resolving Water Conflicts https://www.udel.edu/udaily/2020/january/resolving-international-water-conflicts-ukraine-russia/
14. Nandalal, K. D. Wasantha and S. P. Simonovic. "Resolving conflicts in water sharing: A systemic approach." *Water Resources Research* 39 (2003): n. Pag. doi/full/10.1029/2003WR002172

Access Rights

Issue

Humans, upstream societies, and legal policy all control access to clean water for others to thrive or in some cases, merely survive.

Background

Waterways naturally and unforgivingly flow across geopolitical borders. Historically, around the globe populations (most, if not all species) normally propagated near a reliable clean source of water for food, drinking, cleaning, transportation, power and pure existence. Times have changed such that water is no longer reliable and what water there is or should be is beyond the control of a given society. It is typically the upstream societies (communities, regions, states, countries) that retain leverage over water access at the potentially disastrous detriment of downstream societies. Where there is little water upstream, there may be none downstream, or where there may be plenty of water upstream the controlling societies may use most of it to establish, sustain and grow their economies that may be ruinous to downstream societies. Conversely, a controlling community may redirect an overflow of water to avert a local disaster only to convey the disaster to downstream communities.

Water access rights go back a long time, probably beyond recorded history. Over the centuries, colonization activities empowered governments to control access for whatever purpose they prioritized.[81] Today, water access control from a global perspective spans from full public access to government regulated to private access. Each of those has their own nuances, for example private access may be further restricted by law to be riparian versus prior-appropriation access rights.[82] Then there is the consideration of groundwater versus surface water. It's complicated.[83]

The core challenge then, how do we equitably share fresh water, the life-blood of this planet and all its inhabitants? This is largely a policy challenge. In 2010, the United Nations adopted

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[81] Mwanza, *African countries should 'decolonize' water, recognize customary rights: report* published in Reuters (10/2018)
[82] The National Agricultural Law Center, *Water Law: An Overview* (n.d.)
[83] IBID

resolution 64/292 recognizing the human right to water and sanitation, rallying the international community to action, especially in support of developing nations.[84] As of 2020, one in four people on this globe still did not have access to sanitary drinking water.[85] That's an improving statistic.

Recommendations

1. Learn from nations that have taken steps to rectify and improve equitable water access for all. Make note of a 2019 UN report listing examples.[86]
2. Devise a weather-forecasting approach for water to aid communities/states in better forecasting water availability and its capacity to support community viability as populations grow.
3. Learn from indigenous peoples on their knowledge of water usage that may have been passed along.
4. Learn from history on water rights that better balances the global need, not only for humans, but all species. Individual, private property water rights may not work; however, if the alternative to private rights is government regulated it is important that people trust the governing body. Trust is key regardless of the approach.
5. Explore and evolve the use of water markets, where possible, to help determine a fair price for water that encompasses all stakeholders.[87,88] Water markets, like any market can help manage scarce resource usage by assigning appropriate value to it. Today's water markets lean more towards agricultural benefits, weighing the water value against crop value. In order to benefit all of society, such markets should continue to broaden their participation to encompass all water users, attributing a fairness factor that considers the importance of the water to each stakeholder, balancing seasonal,

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[84] United Nations, *International Decade for Action 'WATER FOR LIFE' 2005-2015* (05/2014)
[85] Ritche and Moser, *Clean Water* published in Our World in Data (06/2021)
[86] United Nations, *The Human Rights to Water and Sanitation in Practice* (2019)
and Sanitation in Practice
[87] Wheeler, *Assessing water markets around the world* published in Global Water Forum (Nov 2021); Wheeler, Loch, Crase, et al *Developing a water market readiness assessment framework* published in Science Direct for Journal of Hydrology (Volume 552, September 2017, Pages 807-820)
[88] Young *Trading Water, Saving Water published in PERC (Jul 2021)*

environmental, economical and safety factors, to name a few.[89] New technologically applied ideas may be of help to areas such as: further promote/market/educate, increase accessibility, assure equitable and inclusive participation among all stakeholders, including non-human.

6. Evolve the use of satellite and thermal technology to aid "in both monitoring and measuring both surface and groundwater extractions, and consumptive use."[90]
7. Establish clean water standards targeted at, and appropriate for specific communities, and that encompass the native species of the region.
8. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[91]
9. Education with lateral thinking. Today's society, including university research, tends to be overly specialized. We need more research and educational efforts that cut across disciplines, that bring together topics that at first appearance seem unrelated, e.g., ecology, history, and agriculture. We don't live in a siloed world. Our research and education would benefit from aligning with reality.

> *"Examples from transdisciplinary collaborations show how more integrative and inclusive approaches promote the implementation of basic and applied ecological research into land use practices."*[92]

10. Devise ways to better expose those portions of the public who have little opportunity to appreciate the power of nature and where humans fit. This is education that indigenous peoples likely passed along to their progeny about their homeland. Let's help restore that. This should come in forms beyond formal education, e.g., podcasts that appeal to

[89] Ritcher, et al, *Water Share - Using water markets and impact investment to drive sustainability* published by The Nature Conservancy (2016)

[90] Wheeler, *Assessing water markets around the world*

[91] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

[92] Maas, Ocampo-Ariza, Whelan, *Cross-disciplinary approaches for better research: The case of birds and bats* published in Science Direct (11/2021)

younger audiences such as PBS program, "America Outdoors with Baratunde Thruston".[93]

11. Push-me/Pull-me!
    This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, and euphoria we feel, the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.

12. Look to technology more to help fill gaps of underway activities than be a solution unto itself. The UN has already initiated programs.[94] Be the glue. Fill the gaps. Be mindful that "tech" is more likely useful as a tool to aid/accelerate solutions rather than central to them. For example, using Artificial General Intelligence (AGI) to help gather data, identify patterns and present them in meaningful/helpful manners to help humans better understand problems and seek solutions that are likely best addressed through cross-disciplinary approaches, something in which we do not typically excel. An example where tech might help, as well as potentially become a ubiquitous marketing source, is to look at Smart Watch technology and how it encourages/reminds us to exercise more. Smart devices, especially smartphones are becoming widely adopted worldwide. Maybe

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[93] Thurston, *America Outdoors with Baratunde Thurston* produced by PBS (n.d.). https://www.pbs.org/show/america-outdoors-baratunde-thurston/

[94] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.

an app could use a camera to identify a food product and inform the consumer of its "ecoscore" and educate them about the sources, and offer alternatives.

Case Studies

1. Water trading markets in Australia have exhibited reasonable success as a means to balance the use of water as a scarce resource among competing parties. The market approaches vary by the water rights that are being traded, e.g., access entitlement, allocation, irrigation, delivery. The markets accommodate both economic and climate demands.[95]

Further Resources

1. "The American Southwest's Water Crisis, and Why Canada May Have the Solution" ~ *Glimpse from the Globe*, Jan 2022
2. "Potential Problems with Cross-Border Water Issues: The U.S. and Canada in the 21st Century" ~ *University of Victory*, CA <date?>
3. "Navigating Rough Waters: The Limitations of International Watercourse Governance" ~ *Council on Foreign Relations*, Sep 2020
4. "Water for Life Decade" ~ *United Nations*, <date?>
5. "International Water Law and Fresh Water Dispute Resolution: A Cosean Perspective" ~ University of Colorado Law Review, Mar 2021
6. "Water Wars: Who Controls The Flow?" ~ *NPR*, June 2013
7. Nebraska and Colorado Face Off Over Water ~ AP News May 18, 2022

[95] *Australian Water Markets* published by Australian Government Dept of Climate Change, Energy, Environment and Water (n.d.)

Food Security

Issue

Current human-centric, environmentally destructive management ethos and practices damages critical water resources on which earth's species depend, leading to a growing food security problem for humans and other species. This must be replaced by ecologically sound and sustainability-based human caretaking management practices.

Background

Human food security needs are best met by river and lake ecosystems proactively managed for optimal ecological health. This includes biological diversity, broad species-wide access rights, and effective management of human socioeconomic challenges.

Significant challenges include dam construction, commercial farming practices, pesticide and insecticide use, and overgrazing livestock. While not inherently destructive in many cases, focus on current human-centric business practices and their linear economic environment has pushed equally important ecological health and sustainability requirements to the background. This focus is rapidly bringing the planet to an environmental catastrophe in which food security assumes crisis proportions.

Recommendations

1. Development and promulgation of a cultures-inclusive, planetary-wide caretaking ethic and practice.
2. Transition food production processes from linearity to circular sustainability practices
    a. Transition commercial agricultural food production from Thirsty crops to regionally appropriate crops

Case Studies

1. Bhagawat Rimal, Roshan Sharma, Ripu Kunwar, Hamidreza Keshtkar, Nigel E. Stork, Sushila Rijal, Syed Ajijur Rahman, Himlal Baral, Effects of land use and land cover change

on ecosystem services in the Koshi River Basin, Eastern Nepal, Ecosystem Services, Volume 38, 2019, 100963, ISSN 2212-0416,.

2. Rongfang Lyu, Keith C. Clarke, Jianming Zhang, Junli Feng, Xuehui Jia, Jijun Li, Spatial correlations among ecosystem services and their socio-ecological driving factors: A case study in the city belt along the Yellow River in Ningxia, China, Applied Geography, Volume 108, 2019, Pages 64-73, ISSN 0143-6228.
3. Pueppke, Steven G., Sabir T. Nurtazin, Norman A. Graham, and Jiaguo Qi. 2018. "Central Asia's Ili River Ecosystem as a Wicked Problem: Unraveling Complex Interrelationships at the Interface of Water, Energy, and Food" *Water* 10, no. 5: 541.

Further Resources

1. Line J. Gordon, C. Max Finlayson, Malin Falkenmark, Managing water in agriculture for food production and other ecosystem services, Agricultural Water Management, Volume 97, Issue 4, 2010, Pages 512-519, ISSN 0378-3774
2. S. Postel; Rivers of Life: the challenge of restoring health to freshwater ecosystems. *Water Sci Technol* 1 June 2002; 45 (11): 3–8. doi:
3. Charlotte de Fraiture, David Molden, Dennis Wichelns, Investing in water for food, ecosystems, and livelihoods: An overview of the comprehensive assessment of water management in agriculture, Agricultural Water Management, Volume 97, Issue 4, 2010, Pages 495-501, ISSN 0378-3774.

Water Security

Issue

The current human-centric, ecologically destructive management ethos and practice is damaging the water resources on which earth's species depend and is leading to an increasingly severe water security problem for all species. This must be replaced by an ecologically-based human caretaking ethic.

Background

Human activity has disproportionately affected the planet's water systems. Subsurface groundwater reservoirs are being drained to critical lows. Rivers and lakes suffer increasingly shrinking volumes in addition to the widespread negative effects of multiple types of pollution. With the additional stress of human-facilitated climate warming, these issues are becoming increasingly problematic - and ultimately catastrophic.

Though exacerbated by a growing human population, it is the practices rather than the numbers of this population that is more problematic. Human water security needs are best met by river and lake ecosystems proactively managed for optimal ecological health. This includes biological diversity, broad species-wide access rights, and effective management of human socioeconomic challenges.

Recommendations

1. Develop and promulgate a governing culture-inclusive, planetary-wide caretaking ethic and practice. This ethic and practice must pragmatically address four broad water security issues:
    a. Human and animal welfare
    b. Equity in access and utilization
    c. Sustainability of water resources
    d. Water-related risks
2. Pragmatic solutions must address multidisciplinary issues::
    a. Disciplinary perspectives (e.g. engineering, environmental, public policy, public health)

   b. Problem-oriented perspectives (e.g. water shortage, flooding, water pollution),
   c. Goal-oriented perspectives (e.g. better water supply and sanitation, better sewerage and wastewater treatment, safety from flooding, proper urban drainage),
   d. Integrated-water versus water-integrated perspectives,
   e. Policy analytical versus governance perspectives.
3. Take a systems perspective on *urban* water security, taking the pressure-state-impact-response structure as an analytical framework and link that to the 'urban water transitions framework' as proposed by Brown et al (Water. Sci. Technol. 59 2009).[96] A systems approach can be helpful to comprehend the complexity of the urban system, including its relation with its (global) environment, and better understand the dynamics of urban water security.
4. Reflect on work done in the area of urban water security indices.

Implementation

- Water storage alternatives[97]
- Sensors for 'decision agriculture'[98]

Case Studies

1. Over the past decade Haiti has experienced an unprecedented concentration of natural disasters that forces its citizens to exist in unsafe conditions, one of which is water security. A USAID Water and Sanitation Project[99] has helped improve this situation over several years. The project focused on aiding the Haiti water service providers to not only improve their service but to help them better prepare for increasing extreme weather events. Deploying a situationally based Client Risk Management approach the project focused the following actions:

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[96] Hoekstra, Arjen Y., Joost Buurman and Kees C. H. van Ginkel. "Urban water security: A review." *Environmental Research Letters* 13 (2017): n. pag.
[97] MetroPolder provides smart water storage solutions integrated into flat roofs. https://metropolder.com/en/#polderroof
[98] Arable leverages sensors for 'decision agriculture' and helps keep 2.4b gallons of water out of the beef supply chain in Nebraska https://www.arable.com
[99] United States Agency International Development (USAID) Haiti: USAID Water and Sanitation Project; Climate Risk Management Case Study (Jan 2022)

- **Prioritize areas** experiencing the **highest impacts from climate changes**.
- Protecting water infrastructure in anticipation of changes in water levels and land degradation from extreme weather events.
- Building stakeholder capacity to manage potential climate-related damages to water and sanitation infrastructure and services.

The outcome from this approach was:

- Water savings through leak repairs.
- Protecting the water and sanitation infrastructure with future extreme weather events in mind.
- Improving water access to minimize travel time.
- Increase revenues for water service providers.
- Reduce likelihood of waterborne illnesses.

Over 13,000 more people now have access to water. Over 190,000 people have improved water service quality. Also, according to the report water utilities stabilized and improved their water delivery service capabilities, as well as their internal management processes.[100]

Further Resources

1. UNEP-DHI Partnership, UNEP-DTU, CTCN (August 11, 2017) Climate change adaptation technologies for water: a practitioner's guide to adaptation technologies for increased water sector resilience, UN Climate Technology Centre & Network UNFCCC Technology Mechanism, https://www.ctc-n.org/resources/climate-change-adaptation-technologies-water-practitioner-s-guide-adaptation-technologies
2. G.T. Patle, Mukesh Kumar, Manoj Khanna (July 29, 2019) Climate-smart water technologies for sustainable agriculture: a review, Journal of Water and Climate Change, https://iwaponline.com/jwcc/article/11/4/1455/69011/Climate-smart-water-technologies-for-sustainable
3. Vörösmarty, C., McIntyre, P., Gessner, M. *et al.* Global threats to human water security and river biodiversity. *Nature* 467, 555–561 (2010).
4. Dumont, Egon, Richard J. Williams, Virginie D. J. Keller, Anja Voss and Sirkka Tattari.

[100] United States Agency International Development (USAID) Haiti: USAID Water and Sanitation Project; Climate Risk Management Case Study (Jan 2022)

"Modelling indicators of water security, water pollution and aquatic biodiversity in Europe." *Hydrological Sciences Journal* 57 (2012): 1378 - 1403.

5. Hoekstra, Arjen Y., Joost Buurman and Kees C. H. van Ginkel. "Urban water security: A review." *Environmental Research Letters* 13 (2017): n. pag.
6. Jones, J.A.A. (2009). Threats to Global Water Security: Population Growth, Terrorism, Climate Change, or Commercialisation?. In: Jones, J.A.A., Vardanian, T.G., Hakopian, C. (eds) Threats to Global Water Security. NATO Science for Peace and Security Series C: Environmental Security. Springer, Dordrecht.

Potability

Issue Summary

Lack of widespread development and distribution of alternative-source potable water technologies is supporting the degradation and destruction of Earth's river and lakes ecosystems.

Background

Lack of alternative-source water extraction technologies across much of the world forces dependence upon naturally occurring surface and groundwater. This increasingly leads to ill-controlled access to surface water as climate change affects traditional water resources.

This results in the destruction of plant and animal habitat and loss of biological diversity as well as the loss of the water resource. It also puts increased pressure on groundwater use.

Case Studies

1. Spoor, Max. "The Aral Sea Basin Crisis: Transition and Environment in Former Soviet Central Asia - Spoor - 1998 - Development and Change - Wiley Online Library." *Development and Change* 29 (1998): 409-435.

2. Li, Qiang, Xin Li, Youhua Ran, Min Feng, Yanyun Nian, Meibao Tan and Xi Chen. "Investigate the relationships between the Aral Sea shrinkage and the expansion of cropland and reservoir in its drainage basins between 2000 and 2020." *International Journal of Digital Earth* 14 (2021): 661 - 677.

Recommendations

1. *Develop diverse alternative water resources.* Other alternative sources of water should be discovered so as to avoid further depletion.[101]

2. *Develop new technologies.* Existing technologies must be more widely implemented. Technologies already exist that can diversify water resources. Cost, scale, and other

[101] What is water depletion, causes and effects and what is effective water management - Natural Energy Hub

factors have often limited implementation. Improvements to existing technologies and development of new ones is ongoing. Implementation and political will have been the major hindrances.

a. Atmospheric water-extraction technologies
   i. Atmospheric Water Harvesting: Hope from Extracting Water from Air (theearthandi.org)
b. Nanotechnology in filtration
   i. All About Nanofiltration and What Is It (hydrologics.my)
   ii. (PDF) Nanofiltration technology in water treatment and reuse: Applications and costs (researchgate.net)
c. Membrane chemistry
   i. Membrane Filtration | SSWM - Find tools for sustainable sanitation and water management!
d. Seawater desalination
   i. Desalination | U.S. Geological Survey (usgs.gov)
   ii. Seawater Desalination - an overview | ScienceDirect Topics
e. Smart monitoring
   i. An Overview of Smart Water Technology | High Tide Technologies (htt.io)
f. Intelligent irrigation
   i. (PDF) INTELLIGENT IRRIGATION SYSTEM USING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING: A COMPREHENSIVE REVIEW (researchgate.net)
g. Wastewater processing
   i. Potable Water Reuse and Drinking Water | US EPA
h. Mobile recycling facilities
   i. The future of Mobile Water Recycling in the Industry - EWJI

3. Newer technology should be developed so that proper storage of groundwater can be attained without leakage. This can reduce depletion to an extent. Comprehensive research should be done to find new methods.[102]

4. *Increase societal awareness.* Effective campaigns must be developed and implemented to make people aware of how precious and priceless the water resources are.

[102] What is water depletion, causes and effects and what is effective water management - Natural Energy Hub

Awareness should reach all levels of ALL societies including children to reduce and avoid water depletion.[103]

5. *Plant more trees*. Afforestation reduces water depletion. Plant and tree roots help soil hold more water thus increasing the groundwater as well as preventing soil erosion.[104]
6. *Don't pollute water.* Stopping pollution of water resources preserves the naturality of the water available which can be for future use.[105]
7. *Restrict groundwater pumping.* Groundwater pumping must be rigorously monitored so that it can be preserved.[106]

Implementation

- Water quality monitoring solutions[107]
- Elimination of toxins[108]

Further Resources

1. The new water technologies that could save the planet | Guardian sustainable business | The Guardian
2. What is water depletion, causes and effects and what is effective water management - Natural Energy Hub
3. Atmospheric Water Extraction (darpa.mil)
4. Pros & Cons Of Atmospheric Water Generation (& Harvesting Water From Air) - Better Meets Reality
5. Microsoft Word - 02-PPH-1010090-HMT 14.doc (rexresearch.com)
6. Water Extraction from the Atmosphere for Arid Zones | Encyclopedia MDPI

[103] ibid
[104] ibid
[105] ibid
[106] ibid
[107] Veracet provides microbial-based water quality monitoring solutions https://tracxn.com/d/companies/veracet.com
[108] EcoSpears provides green and sustainable technology to eliminate toxins https://www.ecospears.com

7. An Overview of Various Techniques of Atmospheric Water Extraction from Humid Air | SpringerLink
8. Energies | Free Full-Text | A Recent and Systematic Review on Water Extraction from the Atmosphere for Arid Zones | HTML (mdpi.com)
9. Products and concepts that harvest water from the air (ecofriend.com)
10. Solar-powered system extracts drinkable water from "dry" air | MIT News | Massachusetts Institute of Technology
11. Indian Institute of Technology Madras (iitm.ac.in)
12. Content Search | Indian Institute of Technology Madras (iitm.ac.in)

Over Use/Waste

Issue

To those who live in the developed world, water can seem limitless as it is often the turn of a faucet or a water sprinkler away. Ready access means that many have developed habits, even around basic sanitary needs such as brushing teeth and washing dishes that lead to overuse of water. It's not only sanitation. What people value also leads to overuse. Beauty for one. Green lawns, require maintenance that involves unnecessary water usage. This leads to waste. The overuse and waste problem applies beyond individuals. Over use and waste happens in agricultural, commercial, and industrial uses, too. Where it is plentiful and inexpensive there will be a tendency to neglect spillage and runoff waste. Even where water is scarce, in less developed countries, water rights owners or those with means to pay for the water may feel entitled to water use as if it is a limitless resource.

Background

Many things including increasing temperatures associated with climate change impact projections that freshwater supply may be decreasing.[109] The issue of water overuse, is one that impacts everyone, including each direct consumer. This matters because it is projected that even as "the U.S. water supply decreases, demand is set to increase." Specifically, "On average, each American uses 80 to 100 gallons of water every day, with the nation's estimated

[109] Heggie, *Why is America Running Out of Water*, published in National Geographic (08/2020)

total daily usage topping 345 billion gallons – enough to sink the state of Rhode Island under a foot of water." As the population increases, water stress will increase accordingly. Progress is happening with simple technological creations such as effective household greywater capture systems that might affect greater impact were there broader adoption.[110],[111]

Recommendations

1. Explore the use of water markets where it is possible, to help determine a fair price for water that encompasses all stakeholders including indigeonous peoples and biological species.[112,113,114,115] Water markets, like any market can help manage scarce resource usage by assigning appropriate value to it. Today's water markets lean more towards agricultural benefits, weighing the water value against crop value. In order to benefit all of society, such markets should continue to broaden their participation to encompass all water users, attributing a fairness factor that considers the importance of the water to each stakeholder, balancing seasonal, environmental, economical and safety factors, to name a few.[116]
2. Evolve the use of satellite and thermal technology to aid "in both monitoring and measuring both surface and groundwater extractions, and consumptive use."[117]
3. Inspire and support maintenance of old infrastructure, such as leaky pipes. Replace old fixtures with new, efficient ones. How can we install and incentivize water efficient fixtures and appliances?[118]Consider incentives to inspire everyone to do the same.

[110] Gelt, *Home Use of Graywater, Rainwater Conserves Water--and May Save Money* published in University of Arizona Water Resource Research Center (1993)
[111] Boano, Carusoa, Costamagna, et al, *A review of nature-based solutions for greywater treatment: Applications, hydraulic design, and environmental benefits* published in Science Direct (April 2020)
[112] James, *Overuse leading to food shortages, study warns : Less water – and less to eat*, published in The New York Times (10/2002)
[113] Wheeler, *Assessing water markets around the world* published in Global Water Forum (Nov 2021); Wheeler, Loch, Crase, et al *Developing a water market readiness assessment framework* published in Science Direct for Journal of Hydrology (Volume 552, September 2017, Pages 807-820)
[114] Young *Trading Water, Saving Water* published in PERC (Jul 2021)
[115] Wikipedia Water Trading (n.d.)
[116] Ritcher, et al, *Water Share - Using water markets and impact investment to drive sustainability* published by The Nature Conservancy (2016)
[117] Wheeler, *Assessing water markets around the world*
[118] US EPA, *Water Facts: Statistics and Facts: Why Save Water?* (05/2022)

(Imagine adjacent benefits – jobs for example that might be created as a result of this effort.)

4. Advocate for and incentivize use of water efficient technology.[119] Consider and inspire ongoing innovation in this area by promoting imaginative study, experimentation and entrepreneurship that may help us to continue to raise the bar. For example, where appropriate, advocate for more use of greywater technology to capture and reuse household water from laundry, bath, and kitchen usage to be applied toward non-edible landscape vegetation.[120,121]
5. Create inclusive campaigns that help people from all generations and backgrounds to reverse the power of old habits. Educate and inspire new water use habits such as running dishwashers, only when full. With an eye to the future, especially focus on building new habits with children.[122]
6. Consider the role cultural values play. Inspire new values for beauty. Plants that conserve water, rather than grass lawns, for example. Limit outdoor water use.[123]
7. Empower and educate leaders and influential managers to use water conservation means in commercial buildings.[124]
8. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[125]
9. Push-me/Pull-me!
   This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards

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[119] Energy.gov, *Water-Efficient Technology Opportunities. (08/2022)*

[120] Gelt, *Home Use of Graywater, Rainwater Conserves Water--and May Save Money* published in University of Arizona Water Resource Research Center (1993)

[121] Boano, Carusoa, Costamagna, et al, *A review of nature-based solutions for greywater treatment: Applications, hydraulic design, and environmental benefits* published in Science Direct (April 2020)

[122] US EPA, Water Facts: Water Sense for Kids (03/2022)

[123] Karlamanga, *Here's Where California Really Uses Its Water*, published in The New York Times (12/2021)

[124] US EPA, *Water Facts: Commercial Buildings* (06/2022)

[125] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, and euphoria we feel the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.

10. Look to technology to help identify and fill gaps that exist now. The UN has already initiated programs.[126] Use AGI to help gather data, identify patterns and present it in a manner that helps humans better understand problems and then seek solutions [that are likely best addressed through cross-disciplinary approaches] Use Smart Watch technology as inspiration. Consider how it encourages/reminds us to exercise more. Smart devices, especially smartphones are becoming widely adopted worldwide. *Maybe an app could use a camera to identify a food product and inform the consumer of its "ecoscore" and educate them about the sources, and offer alternatives.*

Assumptions

- Humans tend to waste water where it is plentiful and/or they have inexpensive access to it.[127]

Case Studies

1. San Diego County in California has actively managed its water resources for many years. They were especially motivated to rectify their water situation during a drought period of the 1990s. Their approach incorporates a combination of water rights access,

[126] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.
[127] Marsh, *What are the stats for water use around the world?* *(Mar 2018) published in* Envrionment.co

appropriate pricing, infrastructure (aquifers, stopping leaks, and desalination plants) and educating their constituents, including both industry and households about common-sense water conservancy practices. Today, where the rest of California residents will need to make major adjustments to being asked to reduce water consumption, San Diego County inhabitants will be less impacted given they are already conditioned for water scarcity.[128]

Further Resources

US EPA, *Water Facts: Statistics and Facts: Why Save Water?* (05/2022)

1. US Government, USGS, *Total Water Use in the United States* *(6/8/2018)*

   > *"**Thermoelectric power** and **irrigation** remained the two largest uses of water (in the USA) in 2015, and total withdrawals decreased for **thermoelectric power** but increased for **irrigation**."*

2. UN World Water Development Report, *Groundwater Making the Invisible, Visible* (2022)
3. https://www.showlowaz.gov/392/Excessive-Water-Use
4. Household water waste solutions Angie's List - 7 Ways to Ensure Your Water is Always Hot
5. Groundwater depletion embedded in International Food Trade
6. City Living With Less Water
7. Here's Where California Really Uses Its Water
8. Overuse leading to food shortages, study warns, Less water, and less to eat
9. EPA Statistics and Facts
10. Trends in Water Usage in the US
11. Why is America Running Out of Water?

[128] Naishadham, *How San Diego secured its water supply, at a cost* published in AP (May 2022)

2 URBANIZATION, COMMERCIAL AGRICULTURE AND MANUFACTURING

Growing urbanization increasingly strained Earth's water resources. City infrastructure led to surface water runoff. Agriculture, construction and manufacturing needs resulted in deforestation. Supply chains drained resources out of regions. Commercial agriculture introduced thirsty crops ill-suited for the regions in which they were grown. Rivers were dammed and diverted. Fertilizer and other nutrient pollution destroyed river and lake ecosystems in an increasingly unsustainable water usage system.

Scale/Overgrowth

Issue

Humans group together in communities. Companies gather near population centers for access to consumers and/or labor and/or research, etc. The scaling effect, while seemingly efficient may have the unexpected result of overtaxing available water resources.

Background

As populations grow in various countries the pressure for already scarce water resources increases exponentially. The surrounding infrastructure upon which people rely to sustain itself in various regions scales to meet the demand of ballooning populations. "According to the World Health Organization (WHO), between 50 and 100 litres of water per person per day are needed to ensure that most basic needs are met and few health concerns arise."[129] Community planners must accommodate such a fundamental requirement. Compounding this basic infrastructure demand in water stressed regions, layering into this mix household consumption and agriculture the water competition amplifies the potential for disaster in such areas.[130]

Recommendations

1. Build better planning models. Rely on the UN and nations to identify regions of increasing water scarcity, breaking down that scarcity by its cause: natural, water diversion, pollution, industrial/commercial usage, etc (all the issues listed in this committee's paper). Then start modeling what effect occurs as causes are scaled down.

> *"Planning for future development and investments requires that we prepare water projections for the future. However, estimations are complicated because the future of the world's waters will be influenced by a combination of environmental, social, economic, and political factors, and*

[129] United Nations, The Human Right to Water and Sanitation: Media Brief (n.d.)
[130] Derla, *4 Billion People Face Water Shortage: Rising Populations, Agriculture Drive Water Demand* for Tech Times (02/2016); Parkinson, France's trouble nuclear fleet a bigger problem for Europe than Russia gas published in *Renew Economy* (08/2022)

> *there is only limited knowledge and data available about freshwater resources and how they are being used."*[131]

2. Educate the masses on the effect of scaling, and how to balance water needs with enterprise. Bigger is not necessarily better.
3. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[132]
4. Education with lateral thinking. Today's society, including university research, tends to be overly specialized. We need more research and educational efforts that cut across disciplines, that bring together topics that at first appearance seem unrelated, e.g., ecology, history, and agriculture. We don't live in a siloed world. Our research and education would benefit from aligning with reality.

> *"Examples from transdisciplinary collaborations show how more integrative and inclusive approaches promote the implementation of basic and applied ecological research into land use practices."*[133]

5. Devise ways to better expose those portions of the public who have little opportunity to appreciate the power of nature and where humans fit. This is education that indigenous peoples likely passed along to their progeny about their homeland. Lets help restore that. This should come in forms beyond formal education, e.g., podcasts that appeal to younger audiences such as PBS program, "America Outdoors with Baratunde Thruston".[134]

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[131] Wada, et al, *Modeling global water use for the 21st century: the Water Futures and Solutions (WFaS) initiative and its approaches* in Geoscientific Model Development (GMD) published by European Geosciences Union (01/2016)

[132] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

[133] Maas, Ocampo-Ariza, Whelan, *Cross-disciplinary approaches for better research: The case of birds and bats* published in Science Direct (11/2021)

[134] Thurston, *America Outdoors with Baratunde Thurston* produced by PBS (n.d.). https://www.pbs.org/show/america-outdoors-baratunde-thurston/

6. Push-me/Pull-me!
   This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, euphoria we feel the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.
7. Look to technology more to help fill gaps of underway activities than be a solution unto itself. The UN has already initiated programs.[135] Be the glue. Fill the gaps. Be mindful that "tech" is more likely useful as a tool to aid/accelerate solutions rather than central to them. For example, using AGI to help gather data, identify patterns and present them in meaningful/helpful manners to help humans better understand problems and seek solutions that are likely best addressed through cross-disciplinary approaches, something in which we do not typically excel. An example where tech might help, as well as potentially become a ubiquitous marketing source, is to look at Smart Watch tech and how it encourages/reminds us to exercise more. Smart devices, especially smartphones are becoming widely adopted worldwide. Maybe an app could use a camera to identify a food product and inform the consumer of its "ecoscore" and educate them about the sources, and offer alternatives.

Case Studies

[135] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.

1. Kuala Lampur invested over $1B via their "River of Life" project to clean and revive its Klang River with the intent to balance the area's natural resources with economic development. The city has been transformed by these changes.[136]

> *"Restoring river habitat and ecological processes not only enhanced the quality of the human experience, it also added resilience to local economies."*[137]

[136] Schneider, *A river restored breathes new life into Kuala Lumpur* published in Mongabay (Aug 2018)
[137] Schneider, *A river restored breathes new life into Kuala Lumpur* published in Mongabay (Aug 2018)

City Infrastructure

Issue

Our opportunity is to invest in city infrastructure that enables rather than detracts from healthy river and lake ecosystems, by minimizing barriers, elevating natural systems and advocating for sustainable practices.

Background

Cities have a "profound relationship," with rivers and lakes. In the past, these bodies of water served as sources of transportation and were used for industrial purposes. Now, rivers and lakes also serve as sources of pride for cities and their urban dwellers as leaders invest to build infrastructure that enhances the beauty of the waterfront and that invites people to use these bodies of water for recreational purposes. "A good waterfront development considers diversity, community engagement, safety and security, environment and sustainability."[138] Even so, the waterfront and city infrastructure can get in the way of natural ecosystems. For this reason it is important to take into account the ecosystem needs of rivers and lakes not only to maintain their functionality and their beauty, but also to ensure the health and safety of urban dwellers. To do this it is essential to building an infrastructure to support sustainable rivers and lakes and to minimize human-made pollution.

Recommendations

1. Implement "Green Infrastructure": Implement green infrastructure technologies that take care of storm water safely and effectively and sustainably. Encourage "green infrastructure," such as "natural infrastructure," such as "techniques that protect, restore, and replicate natural systems." "Restore floodplains, and preserve wetland forests through conservation programs." These might include things such as energy efficiency, water access, green walks along the waterfront.[139]

[138] Sustainable Urban Waterfronts Using Sustainable Assessment Rating System, by R.M.R. Hussein; World Academy of Science, Engineering and Technology International Journal of Architectural and Environmental Engineering Vol:8, No:4, 2014
[139] Sustainable Urban Waterfronts Using Sustainable Assessment Rating System, by R.M.R. Hussein; World Academy of Science, Engineering and Technology International Journal of Architectural and Environmental Engineering Vol:8, No:4, 2014

2. Public Greenspaces
3. Energy efficient building policies
4. Initiatives to create and protect healthy watersheds

Case Studies

1. Shanghai is experiencing a renaissance devised through development along the Huangpu River with the river as the centerpiece.

> *"The urban regeneration of the Huangpu riverfronts plays a key role with no less than 120 kilometres of waterfront transformation intended to eliminate polluting industries, create a continuous open public space (den Hartog, 2019), to make new ecological connections (den Hartog, in press), to reuse industrial heritage (den Hartog, 2020), and to add new landmarks. More than 50 kilometres new waterfronts have been already implemented."*[140]

Further Resources

1. *EPA Smart Growth and Water*
2. *Green Infrastructure: How to Manage Water in a Sustainable Way (See also: Invest in 21st Century Infrastructure)*
3. *How Development of America's Water Infrastructure Has Lurched Through History*
4. *Rivers and Lakes in European Cities*
5. Sustainable Urban Waterfronts Using Sustainable Assessment Rating System, by R.M.R. Hussein; World Academy of Science, Engineering and TEchnolgoy International Journal of Architectural and Environmental Engineering Vol:8, No:4, 2014
6. *The Relationship Between Rivers and Cities*
7. The 7 Most Sustainable Cities in the World

[140] den Hartog, *Shanghai's Regenerated Industrial Waterfronts: Urban Lab for Sustainability Transitions?* published as an Open Access Journal on Urban Planning in Cogititio (Feb 2021)

8. *Why Urban Waters EPA*

Construction/Deforestation

Issue

Modification of the natural environment through construction and deforestation has a detrimental impact on rivers and lakes by either increasing or impeding the natural flow of water, by increasing pollutants in the water and/or by disrupting the natural processes of interconnected ecosystems.

Background

The land area through which water naturally flows is called a watershed. Any human modification to the watershed interrupts the natural flow of water. This includes modifications humans make everyday including the construction of buildings and dwellings and things like parking lots. Interrupting the watershed by building structures such as parking lots can dramatically increase the water flow resulting in increased volumes of water which results in flooding and erosion.   It is not only construction though, other uses of the land such as harvesting materials like lumber, impact the natural flow of water. When the natural flow of water is interrupted, the receptacles of the water, such as streams, rivers and lakes are impacted. When trees are removed for human use, the natural process they play in our ecosystem is disrupted too. For example, trees facilitate the natural rivers in the sky. They do this by absorbing and then releasing water into the atmosphere that travels "hundreds or even thousands of miles away," feeding rivers and lakes across the world. Other impacts can range from increases in water flow – where barriers are reduced– which results in flooding and erosion– to the polluting of water as pollutants are collected during flow. When humans introduce barriers within the natural watershed, as water flows it can pick up contaminants and pollutants which impact rivers and lakes downstream.

Recommendations

1. Reforestation. Trees play a natural role in properly filtering and channeling water.
2. Use of eco-friendly materials for paving.
3. Incentives and/or Regulations to encourage eco-friendly construction.

Further Resources

1. Rivers and Lakes are the Most Degraded Ecosystems in the World
2. Rivers in the Sky How Deforestation is Affecting Global Water Cycles
3. Deforestation Remains High, Despite International Pledges
4. Tropical Forest Destruction Accelerated in 2020

Fertilizer/Pesticide/Nutrient Pollution

Issue

Farming practices have evolved over decades, even centuries to improve their effectiveness in meeting the sustenance of humanity, satisfying local, regional, statewide, even worldwide needs. An aspect of improving crop yield is the application of chemicals to accelerate growth and mitigate crop-destroying pests. Improving crop yield is largely resource-efficiency driven across the agriculture scale, be it effective financial capital usage in industrial farming by maximizing that crop yield with minimal capital and operational resources, or merely the economizing of personal time and labor effort at the smallest scale in local family run farms.

In addition, the adjacent issue of households, especially among advanced economies with substantial discretionary incomes, applying a similar fertilizing/pesticide-application practice to their gardens and lawns, and we begin to discover through improved water testing how much of those chemicals end up in our waterways. We're poisoning ourselves and our fellow species, the many critical native plants and animals, in pursuit of feeding ourselves with relatively inexpensive and convenient food while admiring our idyllic flower gardens and lawns.

Background

History

Fertilizing has been in practice for centuries. A study "says Europe's first farmers used far more sophisticated practices than was previously thought. A research team led by the University of Oxford has found that Neolithic farmers manured and watered their crops as early as 6,000 BC."[141] According to a Penn State University publication, insect pest control occurred as early as 2,500 BC where "Ancient Sumerians used sulfur compounds to kill insects."[142] The move towards synthetic pesticides started happening in the 1930s. "Prior to this time, insecticides were formulated from petroleum, coal tar distillates, plants or inorganic compounds."[143] In

[141] "Manure used by Europe's first farmers 8,000 years ago" ~ Oxford University via Science Daily (Jul 2013)
[142] "A Short History of Pest Management" ~ Penn State University (Mar 2010)
[143] Ibid

1958, The World Health Organization (WHO) established the Guidelines for Drinking Water Quality (GDWQ).

Current

"The (US) EPA's assessment found that 48% of water quality impairment in American surface waters is attributable to agriculture."[144]

Household lawns may be the largest crop in the US.

> *"Lawns comprise over 150 000 km^2 of land in the US, an area larger than that of any irrigated crop (Milesi et al 2005)"*[145]

We are over fertilizing. Result is increasing algal blooms. Quotes from a few different sources:

> *"Using lots of fertilizer wouldn't necessarily be a bad thing if all of it was used by the crops. Unfortunately, most of it isn't.*
> *"To capture this, we can look at the ratio of nitrogen in harvested products (our crops) compared to our inputs (fertilizers or manure); this ratio is called the 'nitrogen use efficiency' (NUE). (For example,) a NUE of 60% would mean that the amount of nitrogen in our crops was 60% of the nitrogen that was added to them as inputs. The remaining 40% of nitrogen was not used by the crops. A low NUE is bad.*
> *"Globally, NUE has been stubbornly low, at 40% to 50% since 1980. This is surprisingly low. It means that* ***less than half of the nitrogen we apply to our crops is actually***

[144] "Study: There Are Ways to Dramatically Reduce Agricultural Water Pollution" ~ Modern Farmer (Aug 2021)

[145] Peter M Groffman et al 2016 *Environ. Res. Lett*. 11 034004 "Satisfaction, water and fertilizer use in the American residential macrosystem" via IOP Science

> ***taken up by them. The rest is excess that leaks into the natural environment.***"[146]

> *"Nitrogen (N) is crucial for crop productivity. However, nowadays* ***more than half of the N added to cropland is lost to the environment****, wasting the resource, producing threats to air, water, soil and biodiversity, and generating greenhouse gas emissions."*[147]

> *"Nutrient pollution is the process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and can act like fertilizer,* ***causing excessive growth of algae.***" [148]

- When looking at the crop perspective of food, whether measuring per equivalent protein, weight of the food product, or just the product itself, **meat proteins** in the form of beef (both dairy and meat) as well as farmed fish tend to **contribute the highest sources of nutrient runoff pollution**.[149]
- How much protein do we need in our diet? Are we getting too much? The answer to this is probably society dependent, wherein some societies tend towards a more vegetarian diet possibly for religious reasons and other societies have less access to meat proteins. It may be that some advanced wealthy societies such as the US may generally over eat such that the amount of protein consumed may be proportionally appropriate but in volume, unnecessary.[150]

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[146] Hannah Ritchie and Max Roser (2013) "Fertilizers". *Published online at OurWorldInData.org.*

[147] Lassaletta, L., Billen, G., Grizzetti, B., Anglade, J., & Garnier, J. (2014). 50 year trends in nitrogen use efficiency of world cropping systems: the relationship between yield and nitrogen input to cropland. *Environmental Research Letters*, 9(10), 10501

[148] "What is nutrient pollution?" ~ NOAA, US Dept of Commerce (date unknown)

[149] Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. OurWorldInData.org/environmental-impacts-of-food

[150] Harvard Health Publishing for Harvard Medical School (Mar 2020), "When it comes to protein, how much is too much?"

> *"Meat consumption is related to living standards, diet, livestock production and consumer prices, as well as macroeconomic uncertainty and shocks to GDP."*[151]

> *"Anywhere from 10% to 35% of your calories should come from protein."*[152]

- Coincidentally, it is notable that feeding cattle requires a great deal of grain, meaning that ancillary aspects of agriculture that also use valuable water sources are directly attributable to beef and dairy production creating an aggregate problem.[153]
- We are making progress! Effective sustainable farming practices are evolving. They balance the objectives of a healthy environment, economic profitability with social and economic equity.[154]

Recommendations

Household

1. Mowing at taller heights

   "Mowing at a taller height (3-3.5 inches) can also reduce pest problems, such as weeds, insects, and diseases."[155]

2. Use a landscaping service that is mindful of over-fertilizing and provides more natural means of pest control.
3. Allow a natural lawn to grow versus aiming for a perfectly uniform and unnatural lawn that requires more chemical treatment to maintain it.

[151] OECD Data
[152] Kristi Wempen, R.D.N., Nutrition (Apr 2022) for Mayo Clinic Health System publication, *Speaking of Health* "Are we getting too much protein?"
[153] USDA *Farm Service Agency* (n.d.) "Feed Grains and Oilseeds Analysis" (read *Importance*)
[154] *What is Sustainable Agriculture?* (n.d.) published by UC Davis Sustainable Agriculture Research & Education Program
[155] *Fertilizer and Water* (n.d.) published in Clear Choices Clean Water - Indiana

4. Grow native species that encourage and support a healthy habitat for surrounding indigenous flora and fauna.
5. Seek ways to make it trendy (social pressure) for households to establish a natural lawn and garden.
6. Provide readily accessible **education**, be it formal and/or via advertisements or whatever creative and ubiquitous manner to put such educational information in front of the public.
7. Devise ways to better expose those portions of the public who have little opportunity to appreciate the power of nature and where humans fit. This is education that indigenous peoples likely passed along to their progeny about their homeland. Lets help restore that. This should come in forms beyond formal education, e.g., podcasts that appeal to younger audiences such as PBS program, "America Outdoors with Baratunde Thruston".[156]

Agriculture

1. Crop rotation to re-introduce natural nutrients from a crop back into the soil for future crop benefit.
2. Financial incentives or disincentives to avert the overuse of fertilizers. For example, continue evolving and popularizing the use of Water Quality Trading (WQT). Much like Voluntary Carbon Markets (VCMs) use Greenhouse Gas (GHG) offsets traded among carbon producers to achieve lower carbon output to meet policy goals, WQT enables waterway nutrient polluters to achieve something similar. Its advantage is in attracting private capital market investment towards infrastructure required to clean the water. It brings together key stakeholders, e.g., government, non-government, agriculture, private industry, capital markets to achieve water quality policy goals such as the 1972 Clean Water Act in the U.S.[157],[158]
3. Update land use policies that ensure appropriate and balanced water usage is a key factor in granting agriculture usage land use rights.

[156] Thurston, *America Outdoors with Baratunde Thurston* produced by PBS (n.d.). https://www.pbs.org/show/america-outdoors-baratunde-thurston/
[157] Water Quality Trading published by Chesapeake Bay Foundation (n.d.)
[158] *Water Quality Trading published by U.S. Environmental Protection Agency (Feb 2022)*

4. Rebalance diet to include more vegetables and nuts, especially natively grown sources that don't themselves contribute to pressuring overtaxed water sources. This may be a better choice versus over reliance on beef and farmed fish for protein.[159] Note: this should be a gradual shift to permit the cattle ranchers and fish farmers the opportunity to maintain a livelihood as they readapt to a shifting market. These are stakeholders that should have a voice.
5. Grow indigenous food crops, i.e., farm crops where they are most likely to grow.
6. Education with lateral thinking. Today's society, including university research, tends to be overly specialized. We need more research and educational efforts that cut across disciplines, that bring together topics that at first appearance seem unrelated, e.g., ecology, history, and agriculture. We don't live in a siloed world. Our research and education would benefit from aligning with reality.

> *"Examples from transdisciplinary collaborations show how more integrative and inclusive approaches promote the implementation of basic and applied ecological research into land use practices."*[160]

7. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[161]
8. Continue evolving sustainable agriculture practices.[162]
9. Improve the efficiency of fertilizer application using new advances in science, both in analyzing results of applications, e.g., plant sap analysis[163], as well as exploring the viability of using Super-Absorbent Polymer (SAP) technology.

[159] Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers.OurWorldInData.org/environmental-impacts-of-food

[160] Maas, Ocampo-Ariza, Whelan, *Cross-disciplinary approaches for better research: The case of birds and bats* published in Science Direct (11/2021)

[161] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

[162] What is Sustainable Agriculture? (n.d.) published by UC Davis Sustainable Agriculture Research & Education Program

[163] Barrera *Reducing Fertilizer, Boosting Yields with Sap Analysis*, journalistic article publised in No-Till Farmer (Dec 2021)

> *"Besides improving water use efficiency of soil, SAPs are also used for controlled release of fertilizers. It is reported that about 40–70% of nitrogen (N) and about 80–90% of phosphorus (P) in conventional fertilizers cannot be absorbed by crops due to their high solubility in water and high diffusivity to the surrounding environment"*[164]

10. Push-me/Pull-me!
    This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, euphoria we feel the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.
11. Look to technology more to help fill gaps of underway activities than be a solution unto itself. The UN has already initiated programs.[165] Be the glue. Fill the gaps. Be mindful that "tech" is more likely useful as a tool to aid/accelerate solutions rather than central to them. For example, using AGI to help gather data, identify patterns and present them in meaningful/helpful manners to help humans better understand problems and seek solutions that are likely best addressed through cross-disciplinary approaches, something in which we do not typically excel. An example where tech might help, as well as potentially become a ubiquitous marketing source, is to look at Smart Watch

[164] Chang, Xu, Liu, Qiu, *Superabsorbent polymers used for agricultural water retention* published in Science Direct (Feb 2021)
[165] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.

tech and how it encourages/reminds us to exercise more. Smart devices, especially smartphones are becoming widely adopted worldwide. Maybe an app could use a camera to identify a food product and inform the consumer of its "ecoscore" and educate them about the sources, and offer alternatives.

Case Studies

1. The Pleasant Valley Branch of the Pecatonica River in Wisconsin managed to reduce sediment and chemical runoff by proactively engaging stakeholders to rally around a solution. That included government agencies, non-government agencies and farmers (voluntarily), applying a SNAP PLUS program (Soil Nutrient Application Planner) to identify "hot spots" and assess appropriate remediation. They managed to reduce the phosphorus pollution by 40% which improved the health of the fish and other species reliant on the river as their habitat, and dramatically reduced the algae growth in downstream waters. They incorporated a sustainable management model by introducing an automated sampler mechanism along the river.[166],[167]

   The farmers incorporated old practices such as contour farming, but also timed their fertilizer applications in suspect areas such that it minimized runoff from seasonal heavy rains that might typically flush the fertilizer into the waterways. They are also applying more no-till planting, retaining surface residues, all of which helps minimize soil runoff. Plus, they are doing more off-season cover-crop planting that can help consume the residual phosphorus.

Further Resources

1. https://www.nytimes.com/2017/07/27/climate/nitrogen-fertilizers-climate-change-pollution-waterways-global-warming.html
2. "Climate Change Is Intensifying the Effects of Fertilizer Runoff" ~ *Modern Farmer* (Dec 2021)
3. "Fertilizers, a Boon to Agriculture, Pose Growing Threat to U.S. Waterways" ~ *NY Times* (Jul 2017)

[166] Into the Outdoors YouTube station, A Water Pollution Solution - A Case Study in Success (Aug 2021)
[167] Organizations and Tools published in The Environmental Trading Network (n.d.)

4. "The Increasing Problem of Nutrient Runoff on the Coast" ~ *The American Scientist*, <date uncertain, post 2014>
5. "Pesticides and Water Pollution", ~ *Safe Drinking Water Foundation* (2017)
6. "Manure used by Europe's first farmers 8,000 years ago" ~ Oxford University via *Science Daily* (Jul 2013)
7. "A Short History of Pest Management" ~ Penn State University (Mar 2010)
8. "Nutrient Pollution, the Sources and Solution: Agriculture" ~ US EPA (Nov 2021)
9. "Preventing Runoff Into The Mississippi River" ~ Aug 2011 video interview of USDA/National Resource Conservation Service discussing efforts to mitigate nutrient runoff into waterways.
10. "Study: There Are Ways to Dramatically Reduce Agricultural Water Pollution" ~ *Modern Farmer* (Aug 2021)
11. "Fertilizer and Water" ~ *Clear Choices Clean Water - Indiana* (date unknown)
12. "Fertilizers". *Published online at OurWorldInData.org.*, Hannah Ritchie and Max Roser (2013)
13. "50 year trends in nitrogen use efficiency of world cropping systems: the relationship between yield and nitrogen input to cropland" ~ *Environmental Research Letters*, 9(10), 10501 Lassaletta, L., Billen, G., Grizzetti, B., Anglade, J., & Garnier, J. (2014).
14. "What is nutrient pollution?" ~ NOAA, US Dept of Commerce (date unknown)
15. Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers.OurWorldInData.org/environmental-impacts-of-food
16. Kristi Wempen, R.D.N., Nutrition (Apr 2022) for Mayo Clinic Health System publication, *Speaking of Health* "Are we getting too much protein?"
17. Peter M Groffman et al 2016 *Environ. Res. Lett*. 11 034004 "Satisfaction, water and fertilizer use in the American residential macrosystem" via IOP Science
18. Harvard Health Publishing for Harvard Medical School (Mar 2020), "When it comes to protein, how much is too much?"
19. OECD Data

20. USDA *Farm Service Agency* (date ??) "Feed Grains and Oilseeds Analysis" (read *Importance*)

Flow Diversion

Issue

Whether for energy, irrigation, transportation, household or industrial needs humans have long engaged in altering the natural flow of rivers and streams throughout the world. However, people are not always, maybe rarely considering the impact to other species habitats, and the compound effect across all species stakeholders in creating these diversions. The fact that people have made those choices over centuries without understanding how the impact to other species also affects humans in the long run.

Background

There are plenty of articles and studies evidencing the disrupting nature of dams, but it is prudent to ask if there are also ways to utilize dams that benefit other species as well as humans. We do need alternative sources of energy to relieve our dependency on fossil fuel, and dams provide such a choice. Of course, there are trade-offs to every choice. Each action by any species on earth affects others, sometimes negatively. It's a dance! And like a "dance", partners or troupes must work in unison to achieve harmony.

A 2017 study, "Designing flows to resolve human and environmental water needs in a dam-regulated river" from the *University of Washington School of Aquatic and Fishery Sciences*,

> *"One of the most promising approaches to **integrating human uses into the larger scope of ecological sustainability** is the concept of environmental flows, or the provision of water within rivers to support positive ecological outcomes while maintaining the water needs of human society."*[168]

[168] Chen and Olden, *Designing flows to resolve human and environmental water needs in a dam-regulated river*, published in Nature Communications (12/2017)

and subsequently described in this *Scientific American* article, "We Can Make Large Dams More Friendly to the Environment" provides hope of a possible positive compromise addressing this problem.[169]

Recommendations

1. Work out the timing of dam water releases to balance the needs of multiple stakeholders.[170] Also consider the impact of dam creation on the habitat of the native species that are important to maintaining the sustenance of the surroundings. In Assam, a state in India, the xihu (river dolphin) population is in serious decline in the Ganges River, partly attributable to dams that restrict the dolphins movement. Being at the top of the food chain, these dolphins help maintain the health of the rivers they inhabit. Any indication of their population decline is a sign of an unhealthy river.[171], [172]
2. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[173]
3. Determine if there are more appropriate crops to grow in a region that would lower or minimize the demand for water from the irrigation channels.
4. Education with lateral thinking. Today's society, including university research, tends to be overly specialized. We need more research and educational efforts that cut across disciplines, that bring together topics that at first appearance seem unrelated, e.g., ecology, history, and agriculture. We don't live in a siloed world. Our research and education would benefit from aligning with reality.

> *"Examples from transdisciplinary collaborations show how more integrative and inclusive approaches promote the implementation of basic*

[169] Chen, *We Can Make Large Dams More Friendly to the Environment*, published in Scientific American (04/2018)
[170] Chen, *We Can Make Large Dams More Friendly to the Environment*, published in Scientific American (04/2018)
[171] Swinton, Gomez, Platanista gangetica, Ganges river dolphin published in Animal Diversity Web (n.d.)
[172] Guha, Gangetic river dolphins in Assam decline in the wake of anthropogenic pressures published in Mongabay (Aug 2022)
[173] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

> *and applied ecological research into land use practices."*[174]

5. Devise ways to better expose those portions of the public who have little opportunity to appreciate the power of nature and where humans fit. This is education that indigenous peoples likely passed along to their progeny about their homeland. Lets help restore that. This should come in forms beyond formal education, e.g., podcasts that appeal to younger audiences such as PBS program, "America Outdoors with Baratunde Thruston".[175]

6. Push-me/Pull-me!
   This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, euphoria we feel the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.

7. Look to technology more to help fill gaps of underway activities than be a solution unto itself. The UN has already initiated programs.[176] Be the glue. Fill the gaps. Be mindful that "tech" is more likely useful as a tool to aid/accelerate solutions rather than central

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[174] Maas, Ocampo-Ariza, Whelan, *Cross-disciplinary approaches for better research: The case of birds and bats* published in Science Direct (11/2021)

[175] Thurston, *America Outdoors with Baratunde Thurston* produced by PBS (n.d.). https://www.pbs.org/show/america-outdoors-baratunde-thurston/

[176] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.

to them. For example, using AGI to help gather data, identify patterns and present them in meaningful/helpful manners to help humans better understand problems and seek solutions that are likely best addressed through cross-disciplinary approaches, something in which we do not typically excel. An example where tech might help, as well as potentially become a ubiquitous marketing source, is to look at Smart Watch tech and how it encourages/reminds us to exercise more. Smart devices, especially smartphones are becoming widely adopted worldwide. Maybe an app could use a camera to identify a food product and inform the consumer of its “ecoscore” and educate them about the sources, and offer alternatives.

Case Studies

1. France has been making concerted efforts to reduce the river flow diversions of its dams by scientifically researching and applying approaches. A major dam was removed from the Selune river with acknowledged success.[177]

> *"The way the river has been reborn is such an important message, a message of hope," says Roussel. "Just when you think that everything is going wrong with the environment, sometimes you can get a sign, a concrete example of nature reclaiming its territory. And I think that’s really comforting."*

Another dam, Poutes dam was retained, but lowered by nearly two-thirds with modifications to both its operational structure and schedule to provide a migration path for the declining Atlantic salmon population. This is a project in progress with encouraging results so far.

[177] Dekimpe, Dam busters: Tearing down concrete walls to save Atlantic salmon published by France24 (Apr 2022)

Thirsty crops

Issue

The agriculture industry is incentivized to grow crops that provide the greatest yield for their investment and available resources. In some cases the crops require more water than the land is natively capable of providing. Thirsty crops, it's an economic problem.[178]

> *"When growers are producing things, they think in terms of what income can you generate per unit of water, so a crop that doesn't use as much water per acre, might not generate much income" ~George Frisvold, Researcher, Univ of Arizona Dept of Agricultural and Resource Economics[179]*

For example, the US produces almonds largely in California and Arizona, two water-stressed areas. Almonds natively grow in the Mediterranean region, and they do require a great deal of water. This may no longer be a practical crop from a water usage perspective. It grows more complicated when intricate dependencies are unveiled about crops grown at scale to fulfill demands of the entire food industry from farm to wholesale to industrial to commercial to consumer, the entire vertical food industry.

Background

As a rule, the majority of Earth's farms are growing products, not food.[180] Plus it has spilled into the energy industry with ethanol. Ultimately, consumers drive much of the behavior, unknowingly. People have no emotional connection to the food products they purchase. They don't understand enough about the ingredients or processes involved in producing what they consume. This can be referred to as n-degrees of separation. The theory is that each additional degree of separation between items, components, ingredients, etc. and the people who engage with these items exponentially decreases human emotional understanding and accountability.

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[178] Smith, *The Twisty Logic Of The Drought: Grow Thirsty Crops To Dig Deeper Wells* published in NPR (08/2015); Foote, *How to plant, grow, and care for almond trees* published in Gardener's Path (06/2019)

[179] Myscofski, "Not here for some agrarian fantasy" Arizona Public Media (Aug 2022)

[180] Ray, *A shrinking fraction of the world's major crops goes to feed the hungry, with more used for nonfood purposes* published in The Conversation (05/2022)

Having an appropriate emotional connection might otherwise better inform their decisions, and propel them to address the hidden issues.

This 2016 article in the Austin American-Statesman, "5 reasons farmers grow thirsty crops in dry climates" reveals a great deal about the problematic relationship specifically in the US agriculture and water. Here are some key snippets.[181]

> *"**Corn's production value is higher than that of soy or wheat**, making it an attractive choice for farmers to plant. But corn also demands more water."*
>
> *"**Most of the corn grown in America goes to fatten up livestock**. It's also **used in starch, corn oil, beverage and industrial alcohol, sweeteners such as corn syrup, and fuel ethano**l.*
>
> *"**Irrigated land is worth more** than non-irrigated land in low-rainfall regions."*
>
> *"Farmers have a choice: **Fully irrigate or risk losing** the lease to a neighbor who's willing to do so."*
>
> *"Farmers who want to cut irrigation to conserve water only qualify for **dryland insurance policies that don't compensate** them nearly **as much** as an irrigated policy"*
>
> *"**Farmers** often purchase the equipment using **loans**. **To pay down the debt**, they **need to keep up production**, which usually **means irrigating**."*

Recommendations

1. Incentivize the agriculture industry to grow crops that fit the water profile of a region, i.e., avoid planting water thirsty crops in water stressed regions.
2. Educate the public on their product sources and the water stress impact of the product. This could be added to food product labels.
3. Devise ways to better expose those portions of the public who have little opportunity to appreciate the power of nature and where humans fit. This is education that indigenous peoples likely passed along to their progeny about their homeland. Lets help restore

[181] Wise, 5 reasons farmers grow thirsty crops in dry climates published in AustinAmerican Statesman (Sep 2018)

that. This should come in forms beyond formal education, e.g., podcasts that appeal to younger audiences such as PBS program, "America Outdoors with Baratunde Thruston".[182]

4. Incentivize the public the advantages of locally sourced foods, where possible, as well as on alternate sources of protein to aid in rebalancing the demand away from beef and dairy. It's important though, to support the cattle and dairy industry through a transition. That is in fairness to their business investment, both financial and sweat equity. Support for this industry while transitioning will bolster greater support, and avoid blowback that could turn political, completely undermining such efforts. One way to improve incentivization is to use tokens layered on blockchain technology to open access to a broader population that wishes to participate in affecting such changes.[183]
5. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[184]
6. Education with lateral thinking. Today's society, including university research, tends to be overly specialized. We need more research and educational efforts that cut across disciplines, that bring together topics that at first appearance seem unrelated, e.g., ecology, history, and agriculture. We don't live in a siloed world. Our research and education would benefit from aligning with reality.
    i. *"Examples from transdisciplinary collaborations show how more integrative and inclusive approaches promote the implementation of basic and applied ecological research into land use practices."*[185]
7. Push-me/Pull-me!
   This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards

[182] Thurston, *America Outdoors with Baratunde Thurston* produced by PBS (n.d.). https://www.pbs.org/show/america-outdoors-baratunde-thurston/
[183] Guo, *How can blockchain open access to carbon markets?* published in World Economic Forum (07/2022)
[184] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673
[185] Maas, Ocampo-Ariza, Whelan, *Cross-disciplinary approaches for better research: The case of birds and bats* published in Science Direct (11/2021)

the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, euphoria we feel the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.

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Implementation

- Water management system options[187]

Case Studies

[186] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.
[187] Evja provides solar-powered agriculture water management system https://www.evja.eu/#features

1. There is evidence that farmers are aware of this issue and taking measures to address it. They are looking more towards farming crops that are natively resilient to the local climate extremes, and then seeking a market for them. They become market-makers. That's as opposed to merely growing crops in the most cost-effective manner to meet existing world consumer demand.[188]

   > *"Some farmers are also starting to grow crops based not on what faraway foreign consumers already demand, but raising animals and crops which thrive on increasingly arid lands, and then create a demand for those commodities abroad."[189]*

   Accelerating such activity requires more financial help that supports farmers in this pivot. Programs such as the Environmental Quality Incentives Program (EQUIP) aim to do just that with participation from the National Resource Conservation Stewardship (NRCS). Also, the United States has passed recent legislation to further encourage and support such endeavors by way of bill, S.1251, the Growing Climate Solutions Act.[190]

Further Resources

1. "How thirsty the crops are: Emerging instrumentation for plant-based field measurement of water stress" ~ IEEE publication April 2020
2. "Using Satellites to Measure How Thirsty Crops are in the St. Mary-Milk Rivers Region" ~ Int'l Joint Commission November 2020. Reveals the important awareness of thirsty crops in resolving cross-border water sharing between Canada and USA. #thirstycrops #waterrights
3. "Water crisis: Thirsty crops drain India dry" ~ QRIUS March 2018. Discusses water problems in India agriculture. #economicincentives #thristycrops

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[188] Elbein, *As climate-driven drought slams farms in U.S. West, water solutions loom* published in Mongabay (Dec 2021)
[189] Elbein, *As climate-driven drought slams farms in U.S. West, water solutions loom* published in Mongabay (Dec 2021)
[190] U.S. Senate bill S.1251 *Growing Climate Solutions Act* revealed on U.S. Senate web site.

3 POLLUTION

The planet's river and lake ecosystems became increasingly polluted as growing populations used more of the planet's water resources. Physical trash. Chemical and hazardous wastes. Sewage. The growing biodiversity loss fostered algal blooms and other biologic imbalances compounded by the atmospheric pollution resulting from the overuse of fossil fuels.

Physical Trash/Plastics

Issue

Physical trash accumulating in Earth's river and lake ecosystems plays a significant role in ecosystem degradation and destruction and must be addressed at its sources.

Background

A steady stream of physical trash ends up in our rivers and lakes. A significant amount is generated by people's processes in disposing of end-use materials in their homes. Plastic, cardboard, paper. Building materials. Abandoned items. Illegally dumped items.

Single-use plastics are a particularly toxic form of trash pollution. Unlike cardboard, paper, and many metals, their biodegradability has a particularly long lifespan. Additionally, they are often physically harmful to plants and animals.

The continuing single-use economy exacerbates the problem.[191]

Regional, cultural, and economic differences complicate the problem, leading to the need for a multifaceted approach.

Recommendations

1. Transition to sustainable, regenerative, and circular economies appropriate for areas of differing physical, cultural, and economic development.
2. Dramatically develop and improve waste disposal technologies
3. Educate populations globally and locally through primary, highly visible private, government and media channels to change the principle worldview of societies

Case Studies

1. How Three Startups Are Using Innovative Methods to Clean and Restore River Ganga
2. Lake of garbage: Every winter pollution is swept from overflowing landfills into Balkan waterways

[191] Here's Where the World's Plastic Waste Will End Up, by 2050

3. Humpback whales and one of their food sources, Menhaden, have returned to the shores of New Jersey, a reflection of prior long-term policy driven efforts to clean the waterways feeding the U.S. coastal areas.[192]

> *"There is still a lot of ongoing research to determine why they're here, but certainly we're seeing the long-term benefits of action taken in the 1970s like the Clean Water Act and the Marine Mammal Protection Act," said Brown, a Rutgers doctoral candidate and head researcher for the advocacy group Gotham Whale.*

Further Resources

1. Sustaining Healthy Freshwater Ecosystems | US EPA
2. Implementing Ecosystem-Based Management | Duke Environmental Law & Policy Forum
3. River Cleanup (river-cleanup.org) https://www.river-cleanup.org/en
4. National River Cleanup® - American Rivers
5. Cleaning up rivers | The Rivers Trust
6. How can a river clean itself? – Water detective (water-detective.net)
7. Water Pollution: Everything You Need to Know
8. Learn About Aquatic Trash
9. Pollution of Lakes and Streams
10. Restoring Rivers to Reverse Impacts from Pollution https://darrp.noaa.gov/oil-spills-hazardous-waste/restoring-rivers-reverse-impacts-pollution
11. 12 Things you can do to Clean up your Rivers, Streams, and the Chesapeake Bay

[192] Fallon, Humpback whales continue surprising resurgence off NJ shores published in NorthJersey.com (Jul 2022)

Chemical and Hazardous Waste

Issue

Hazardous waste from commercial and private sources adversely affects the world's river and lake ecosystems, leading to ecosystem degradation and destruction, loss of biodiversity, and increasing human food and water insecurity.

Background

The US Environmental Protection Agency characterizes hazardous waste threats according to four broad categories: ignitability, corrosivity, reactivity, and toxicity.[193] "**Ignitable waste** can catch fire spontaneously or burn easily. Examples include charcoal lighter fluid, gasoline, kerosene, and nail polish remover. **Corrosive wastes** can cause a chemical action that eats away materials or living tissue. Battery acid is an example. **Reactive waste** can react with air, water, or other substances to cause rapid heating or explosions. Acids that heat up rapidly and spatter when mixed with water are examples. **Toxic wastes** can cause illness or death. Some such wastes are more dangerous than others. Exposure to a small concentration of a highly toxic chemical may cause symptoms of poisoning. Pesticides, cleaning products, paints, photographic supplies, and many art supplies are examples."[194] Waste with these characteristics is introduced into Earth's river and lake ecosystems from both commercial and private sources.

Commercial sources include manufacturing across a wide range of industries; mining activities[195] ; commercial agriculture; construction…. Introduction of their hazardous waste byproducts into rivers and lakes results from Inadequate disposal technology, water runoff, groundwater,[196] acid rain, and illegal dumping.

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[193] Defining Hazardous Waste: Listed, Characteristic and Mixed Radiological Wastes | US EPA
[194] NASD - Disposal of Hazardous Household Waste (nasdonline.org)
[195] Rivers, lakes, and oceans poisoned with 180 million tons of mine waste every year (dgrnewsservice.org)
[196] https://www.visualcapitalist.com/nasa-satellites-show-disturbing-trends-in-water-supply/

Residential sources consist of the products we buy: … Hazardous residue from these products enter rivers and lakes through runoff, groundwater and illegal dumping.[197]

Recommendations

1. Treating the problem at the source is the most efficient means of dealing with hazardous waste. This includes disposal technologies, public education and engagement…
2. Increase education around, and public exposure to, messaging around the environmental hazards of pouring oils, anti-freeze, paint, solvents, cleaners, preservatives, and prescription drugs down household and storm drains.
3. Develop and implement inert permeable paving systems that manage surface runoff by allowing rainwater to be introduced into groundwater. Roads, driveways, sidewalks and other urban infrastructure can be developed that allow more direct introduction of rainwater into groundwater. Concrete production has a high carbon footprint cost. Asphalt paving is fossil oil and gas resource intensive.
    a. https://www.visualcapitalist.com/sp/the-road-to-decarbonization-how-asphalt-is-affecting-the-planet/

Case Studies

1. Japanese-Peruvian Man Has Found A Way To Clean Up Polluted Lakes https://www.thethings.com/innovative-solution-to-lake-pollution/
2. Grassroots UK organization, "Surfers Against Sewage" education programs hat not only teach, but also teach-the-teacher.[198]

Further Resources

1. Defining Hazardous Waste: Listed, Characteristic and Mixed Radiological Wastes https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes
2. Hazardous Waste https://darrp.noaa.gov/hazardous-waste

[197] https://www.nrdc.org/stories/water-pollution-everything-you-need-know
[198] Education, published in Surfers Against Sewage (n.d.)

3. How Microbes Can Help Clean a Toxic River https://www.labroots.com/trending/microbiology/18486/microbes-help-clean-toxic-river
4. An Introduction to the Basic Concepts of Food Security al936e00.pdf (fao.org)
5. Food Security https://www.usda.gov/topics/food-and-nutrition/food-security
6. Food security and why it matters https://www.weforum.org/agenda/2016/01/food-security-and-why-it-matters/
7. Feeding the world: What are the challenges and how can we achieve global food security? https://www.weforum.org/agenda/2022/03/global-food-security-challenges-solutions/
8. End hunger, achieve food security and improved nutrition and promote sustainable agriculture https://sdgs.un.org/goals/goal2
9. 6 ways we can take action on malnutrition, according to the UN https://www.weforum.org/agenda/2021/07/un-food-security-malnutrition-mandela/
10. Food Security https://www.worldbank.org/en/topic/food-security
11. Our global food system is the primary driver of biodiversity loss https://www.unep.org/news-and-stories/press-release/our-global-food-system-primary-driver-biodiversity-loss
12. Global Report on Food Crises – 2021 https://www.wfp.org/publications/global-report-food-crises-2021
13. Declining Biodiversity Threatens Food Security https://www.welthungerhilfe.org/news/latest-articles/2021/the-loss-of-biodiversity-threatens-world-food-security/
14. What Are the Causes and Consequences of Biodiversity Loss? https://greentumble.com/consequences-of-biodiversity-loss/

Sewage

Issue

While land and water are capable of naturally treating sewage, everything has a capacity. Where humans have concentrated in growing population areas, if there are no separate sewage treatment mechanisms then, it is likely that the nearby natural waterways are polluted with human sewage.

Background

Sewage from outdated treatment plants and growing populations is polluting rivers and lakes worldwide.(How Sewage Pollution Ends Up In Rivers.[199] Medicines, household cleaners, biologic waste, and a host of other pollutants make their way into water supplies, damaging ecosystems and threatening public health. Changing or conflicting policies exacerbate the problem.[200] Climate change only worsens the problem.[201]

Recommendations

1. Education and public awareness https://www.sas.org.uk/water-quality/
2. Rebuild infrastructure in light of local climate change parameters/forecasts
3. Filtration technology developments

Implementation

- On-site treatment and reuse of urban wastewater[202]
- Zero liquid discharge wastewater treatment[203]

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[199] How Sewage Pollution Ends Up In Rivers - American Rivers
[200] E.P.A. Is Letting Cities Dump More Raw Sewage Into Rivers for Years to Come https://www.nytimes.com/2020/01/24/climate/epa-sewage-rivers.html
[201] Cities are investing billions in new sewage systems. They're already obsolete https://grist.org/cities/cities-are-investing-billions-in-new-sewage-systems-theyre-already-obsolete/.
[202] Epic Cleantec provides on-site treatment and reuse of urban wastewater https://epiccleantec.com
[203] Aquafortus provides zero liquid discharge wastewater treatment https://aquafortus.com

Case Studies

1. Grassroots UK organization, “Surfers Against Sewage” education programs that not only teach sustainable practices, but also teach-the-teacher.[204]

Further Resources

1. https://www.intechopen.com/chapters/79111
2. https://theriverstrust.org/key-issues/sewage-in-rivers
3. What is a Circular Economy? | US EPA
4. 4 key steps towards a circular economy | World Economic Forum (weforum.org)
5. 10 Examples of Circular Economy Solutions (stateofgreen.com)
6. Water Quality and Wastewater https://www.unwater.org/water-facts/quality-and-wastewater/
7. Water Pollution: Everything You Need to Know https://www.nrdc.org/stories/water-pollution-everything-you-need-know
8. How your medicines make their way into rivers, lakes and bays https://www.caryinstitute.org/news-insights/media-coverage/how-your-medicines-make-their-way-rivers-lakes-and-bays
9. 15 Interesting Facts About Water Pollution That You Should Know https://www.seametrics.com/blog/water-pollution-facts/
10. Most of Louisiana’s waterways are polluted. Biggest reasons? Fertilizer and sewage https://www.wwno.org/coastal-desk/2022-04-06/most-of-louisianas-waterways-are-polluted-biggest-reasons-fertilizer-and-sewage

[204] Education, published in Surfers Against Sewage (n.d.)

Harmful Algae Blooms (Heat/Nutrient Pollution)

Issue

Toxic algal blooms in lakes and rivers caused by rising temperatures as a result of climate change are not only a threat to the species living in them but also to humans and animals living nearby. *Harmful algal blooms are predicted to increase with warmer global temperatures. HAB's are "fed," by warm weather and 'nutrients,' such as fertilizers/fertilizer runoff into freshwater lakes. HAB's endanger human and animal health, marine life and the economy.*[205]

Background

Climate change, which causes higher air temperatures, has a corresponding effect on rising water temperatures as well. Stagnant water with higher water temperatures results in conditions for the growth of toxic as well as nontoxic algal blooms. These toxic algal blooms not only affect the quality of source water but also pose a threat to public health as a result of diminishing source water quality and affect individuals with various respiratory and other debilitating health conditions. Further, these harmful algal blooms also create toxins that can kill fish and other species. Apart from occurring naturally, toxic algal blooms can be caused by the flow of nutrients like nitrogen and phosphorus into the lake ecosystem. These nutrients may originate from fertilizers that are used in agriculture and through household use of chemicals and so forth.

Human and Animal Health

"Harmful algal blooms, or HABs, occur when colonies of algae –simple plants that live in the sea and freshwater–grow out of control and produce toxic or harmful effects on people, fish, shellfish, marine mammals and birds. The human illnesses caused by HABs, though rare, can be debilitating or even fatal."[206]

Economy

[205] https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms#:~:text=Scientists%20predict%20that%20climate%20change,and%20to%20be%20more%20intense.
[206] https://www.noaa.gov/what-is-harmful-algal-bloom)

Costs to the economy include healthcare costs for affected human beings as well as tourism and costs to mitigate the damage. There is also a cost to marine life. (See source: https://www.floridahealth.gov/environmental-health/aquatic-toxins/_documents/economic-impacts.pdf)

Recommendations

1. Implement sustainable algae management practices
2. Monitor water quality in real-time
3. Control algae using ultrasonic waves
4. Use chemical control like aquatic herbicides
5. Increase the level of oxygen in the lake water through technologies like aeration
6. Use nanobubbles technology
7. Control the use of fertilizers use
8. Use phosphorus-free fertilizers
9. Reduce the use of detergents

Case Studies

1. Lake George Association - The Jefferson Project: Building The Future of Freshwater Protection https://lakegeorgeassociation.org/science-protection/jefferson-project
2. The National Centers for Coastal Ocean Science (NCCOS) are working to monitor and address the impacts of climate change on coastal blooms - Monitoring and Event Response (MERHAB) https://coastalscience.noaa.gov/research/stressor-impacts-mitigation/merhab/
3. Moleaer's nanobubble technology is used for various purposes, including for treating the root cause of algal blooms https://www.moleaer.com

Further Resources

1. Chris Mays, Vivi Vajda, Stephen McLoughlin (July 1, 2022) Toxic Slime Contributed to Earth's Worst Mass Extinction – And It's Making a Comeback, scientificamerican.com https://www.scientificamerican.com/article/toxic-slime-contributed-to-earth-rsquo-s-worst-mass-extinction-mdash-and-it-rsquo-s-making-a-comeback

2. Josh K. Elliot (August 12, 2019) Woman's puppy playdate ends with 3 dogs dead from toxic algae, Global News, https://globalnews.ca/news/5754285/blue-green-algae-poisoning-dogs/
3. Adam M. Schaefer, Luke Yrastorza, Nicole Stockley, Kathi Harvey, Nancy Harris, Robert Grady, James Sullivan, Malcolm McFarland, John S. Reif (February 5, 2020) Exposure to microcystin among coastal residents during a cyanobacteria bloom in Florida, ScienceDirect, https://www.sciencedirect.com/science/article/abs/pii/S1568988320300457?via%3Dihub
4. Barbara Kirkpatrick, Richard Pierce, Yung Sung Cheng, Michael S. Henry, Patricia Blum, Shannon Osborn, Katie Nierenberg, Bradley A. Pederson, Lora E. Fleming, Andrew Reich, Jerome Naar, Gary Kirkpatrick, Lorraine C Backer, and Daniel Baden (February 1, 2010) Inland Transport of Aerosolized Florida Red Tide Toxins, Harmful Algae, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2796838/#_ffn_sectitle
5. Paul Alan Cox, David A. Davis, Deborah C. Mash, James S. Metcalf and Sandra Anne Banack (January 27, 2016) Dietary exposure to an environmental toxin triggers neurofibrillary tangles and amyloid deposits in the brain, Proceedings of The Royal Society B Biological Sciences, https://royalsocietypublishing.org/doi/10.1098/rspb.2015.2397
6. https://www.floridahealth.gov/environmental-health/aquatic-toxins/_documents/economic-impacts.pdf
7. https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms#:~:text=Scientists%20predict%20that%20climate%20change,and%20to%20be%20more%20intense.
8. https://www.epa.gov/nutrientpollution/harmful-algal-blooms
9. https://www.noaa.gov/what-is-harmful-algal-bloom
10. https://www.niehs.nih.gov/health/topics/agents/algal-blooms/index.cfm
11. https://www.mprnews.org/story/2022/06/18/wet-spring-warm-temps-in-minnesota-could-spur-toxic-algae-blooms

4 CLIMATE CRISIS

A growing climate crisis resulting from the overuse of fossil fuels accelerated the sustainability issues caused by human activities and the planet's population growth. As temperatures rose, droughts became increasingly frequent. With shrinking water sources in many areas while floods decimated others. Erosion and sedimentation altered river and lake ecosystems. Invasive species decimated biodiversity in many areas.

Drought/Shrinking Water Sources
Glacier melt water
Severe Flooding
Erosion, Sedimentation and Desertification
Invasive species

Drought/Shrinking Water Sources

Issue

Shrinking lakes and decreasing river flows are causing significant destruction to ecosystems and human settlement, food and water security needs.

Background

The temperature in the lakes are rising as a result of climate change, which is causing the water in them to evaporate quickly. The above condition is exacerbated by the lack of adequate rainfall during desired intervals to replenish them. The result is that the lakes are shrinking.

Recommendations

- Expand desalination efforts of offset shrinking supplies

Implementation

Water recovery and desalination[207]

Case Studies

1. Climate change and anthropogenic impacts on the rapid shrinkage of Lake Urmia - Alizadeh-Choobari - 2016 - International Journal of Climatology - Wiley Online Library
2. Marks, Danny. "Climate Change and Thailand: Impact and Response." *Contemporary Southeast Asia: A Journal of International and Strategic Affairs* 33, no. 2 (2011): 229-258. muse.jhu.edu/article/450064.

Further Resources

1. Christopher Flavelle (June 13, 2022) As the Great Salt Lake Dries Up, Utah Faces An 'Environmental Nuclear Bomb', nytimes.com https://www-nytimes-

[207] Aquasolis Global is one example that provides water recovery and desalination solutions offering significant savings on operational costs and environmental impact. https://aquasolisglobal.com

com.cdn.ampproject.org/v/s/www.nytimes.com/2022/06/07/climate/salt-lake-city-climate-disaster.amp.html?amp_gsa=1&amp_js_v=a9&usqp=mq331AQKKAFQArABIIACAw%3D%3D#amp_tf=From%20%251%24s&aoh=16555313749073&referrer=https%3A%2F%2

2. Alexander Villegas and Rodrigo Gutierrez (June 14, 2022) 'We beg God for water': Chilean lake turns to desert, sounding climate change alarm, reuters.com, https://www.reuters.com/business/environment/we-beg-god-water-chilean-lake-turns-desert-sounding-climate-change-alarm-2022-06-13/
3. Binh Pham-Duc, Florence Sylvestre and Jean-Francois Cretaux (March 26, 2022) The Lake Chad hydrology under current climate change, Scientific Reports, https://www.nature.com/articles/s41598-020-62417-w
4. https://www.visualcapitalist.com/202-drought-maps-of-california-show-dry/
5. US Geological Survey - Water Watch - Drought conditions https://waterwatch.usgs.gov/?id=ww_drought
6. Water, water, but not everywhere: analysis of shrinking water bodies using open access satellite data: International Journal of Sustainable Development & World Ecology: Vol 28, No 4 (tandfonline.com)

Glacial Meltwater

Issue

Diminishing glacial meltwater supplies feeding the planet's rivers and lakes is compromising existing ecological systems supporting human and other life.

Background

Glacial meltwater is one of the major sources of rivers, but with warmer climates the ice and snow covering them are vanishing due to vaporization. To add to the above, as glaciers melt, more water runs off downhill away from them, but as they shrink, the water supply diminishes further downstream. Hence, availability of freshwater resources to humans and other species is greatly reduced.

Recommendations

1. Short term, human populations will need to develop alternative water supply systems to meet needs. This may also entail population shifts until greenhouse gasses within the atmosphere are brought lower.
2. Long term, the reduction in greenhouse gas emissions, followed by the active sequestration of existing GHG from the atmosphere will allow the glaciation resumption and restoration to optimal ecological levels, re-establishing glacial-dependent ecosystems.

Case Studies

1. Mark, B., & Seltzer, G. (2003). Tropical glacier meltwater contribution to stream discharge: A case study in the Cordillera Blanca, Peru. *Journal of Glaciology, 49*(165), 271-281. doi:10.3189/172756503781830746

Further Resources

1. Finger, D., Hugentobler, A., Huss, M., Voinesco, A., Wernli, H., Fischer, D., Weber, E., Jeannin, P.-Y., Kauzlaric, M., Wirz, A., Vennemann, T., Hüsler, F., Schädler, B., and Weingartner, R.: Identification of glacial meltwater runoff in a karstic environment and

its implication for present and future water availability, Hydrol. Earth Syst. Sci., 17, 3261–3277, https://doi.org/10.5194/hess-17-3261-2013, 2013. (HESS - Identification of glacial meltwater runoff in a karstic environment and its implication for present and future water availability (copernicus.org))

2. Nick Eyles, The role of meltwater in glacial processes, Sedimentary Geology, Volume 190, Issues 1–4, 2006, Pages 257-268, ISSN 0037-0738, https://doi.org/10.1016/j.sedgeo.2006.05.018. (https://www.sciencedirect.com/science/article/pii/S0037073806001424)
3. Brown, L.E., Milner, A.M. & Hannah, D.M. Predicting river ecosystem response to glacial meltwater dynamics: a case study of quantitative water sourcing and glaciality index approaches. *Aquat. Sci.* 72, 325–334 (2010). https://doi.org/10.1007/s00027-010-0138-7
4. Bethan Davies (February 04, 2022) Glaciers as a water resource, antarcticglaciers.org, https://www.antarcticglaciers.org/glaciers-and-climate/glacier-recession/glaciers-as-a-water-resource/
5. Melting glaciers in Asia: 'One day we will leave here' | Environment | All topics from climate change to conservation | DW | 19.07.2022Climate change threatens terrestrial water storage over the Tibetan Plateau | Nature Climate Change
6. Exclusive-Glaciers vanishing at record rate in Alps following heatwaves | MarketScreener
7. Meltwater is a driving force behind disappearing glaciers • Earth.com
8. Melting Himalayan Glaciers to Affect Food Production in South Asia | NewsClick
9. Increased Global Flood Risk Due to Intense Frequency of Extreme Ice Melting in Greenland (scitechdaily.com)
10. Himalayan glaciers melting at 'exceptional rate' -- ScienceDaily
11. Meltwater lakes cause glaciers to retreat much more rapidly • Earth.com
12. Study: Glacier Lakes Are Responsible for Rapid Disappearance of Permanent Ice | Nature World News
13. Surface melting causes Antarctic glaciers to slip faster towards the ocean: Direct link between surface melting and short bursts of glacier acceleration in Antarctica -- ScienceDaily
14. Global glacier retreat has accelerated | EurekAlert!
15. Vulnerability of alpine stream biodiversity to shrinking glaciers and snowpacks - BROWN - 2007 - Global Change Biology - Wiley Online Library

Severe flooding

Issue

Flooding of rivers due to climate change is causing significant destruction to ecosystems and human settlement, food and water security needs.

Background

Severe and/or frequent floods caused by climate change increasingly devastate many parts of the world and have forced massive numbers of people to migrate. Further, frequent flooding of rivers caused by increased precipitation and hence, more rainfall, due to climate change, which can lead to sewer system overflows can cause disease outbreaks from water-borne bacteria. This increase in water flow in rivers also loosens debris and weakens the banks and levees of rivers overall changing the visibility, clarity, and pH of the water further stressing the native fauna and flora. This erosion also exposes the underside of any rooted plants on the bank allowing for further weathering of these plants creating a positive feedback loop of erosion.

Recommendations

1. Restore damaged levees/banks via planting strong rooted flora on the banks to secure soil.
2. Prevent flooding by addressing what is causing the excess water flow. This includes decreasing excessive snow melt, water diversion, and restoring meandering rivers.

Case Studies

1. Douglas I, Alam K, Maghenda M, Mcdonnell Y, Mclean L, Campbell J. Unjust waters: climate change, flooding and the urban poor in Africa. Environment and Urbanization. 2008;20(1):187-205. doi:10.1177/0956247808089156
2. Feasible adaptation strategies for increased risk of flooding in cities due to climate change | Water Science & Technology | IWA Publishing (iwaponline.com)
3. Low impact development techniques to mitigate the impacts of climate-change-induced urban floods: Current trends, issues and challenges - ScienceDirect

Implementation

- Real-time flood tracking[208]

[209]Further Resources

1. UNEP-DHI CENTRE (February, 2021) Support to Sustainable Development in Lake Turkana and its River Basins (Results of Modeling of Future Scenarios of Lake Turkana and its River Basins, Technical Report
2. Climate Change Indicators: River Flooding, United States Environmental Protection Agency, https://www.epa.gov/climate-indicators/climate-change-indicators-river-flooding
3. Hossein Tabari (August 13, 2022) Climate change impact on flood and extreme precipitation increases with water availability, Scientific Reports, https:/nature.com/articles/s41598-020-70816-2
4. Shagun (June 27, 2022) Raised shelters, changing crop patterns: How Assam is adapting to frequent floods, downtoearth.org.in, https://www.downtoearth.org.in/news/natural-disasters/amp/raised-shelters-changing-crop-patterns-how-assam-is-adapting-to-frequent-floods-83456
5. US Geological Survey - Water Watch - Flooding https://waterwatch.usgs.gov/index.php?id=ww_flood
6. N. Leroy Poff, Ecological response to and management of increased flooding caused by climate change, Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering SciencesVolume 360, Issue 1796, Published:24 May 2002 , https://doi.org/10.1098/rsta.2002.1012
7. Christensen, J., Christensen, O. Severe summertime flooding in Europe. *Nature* 421, 805–806 (2003). https://doi.org/10.1038/421805a
8. Zbigniew W. Kundzewicz, Shinjiro Kanae, Sonia I. Seneviratne, John Handmer, Neville Nicholls, Pascal Peduzzi, Reinhard Mechler, Laurens M. Bouwer, Nigel Arnell, Katharine Mach, Robert Muir-Wood, G. Robert Brakenridge, Wolfgang Kron, Gerardo Benito, Yasushi Honda, Kiyoshi Takahashi & Boris Sherstyukov (2014) Flood risk and climate

[208] Cloud to Street uses satellites and AI for real-time flood tracking for insurance companies and government https://www.cloudtostreet.ai
[209] StormSensor provides tracking and management of flow and flood risks in real time https://www.stormsensor.io

change: global and regional perspectives, Hydrological Sciences Journal, 59:1, 1-28, DOI: 10.1080/02626667.2013.857411

Erosion, Sedimentation and Desertification

Issue

Erosion, sedimentation and desertification of rivers due to climate change is causing significant destruction to ecosystems and human settlement, food and water security needs. This can be the result of either drought or flood waters, both a result of extreme weather patterns.

Background

Heavy and frequent rains and consequent stormwater runoff results in erosion of river banks and deposition of sediments downstream. This drastically hampers the water quality and negatively affects the entire ecosystem, consisting of fishes and other species, which provide valuable ecosystem services. Further, erosion and sedimentation puts severe strain on drinking water resources. At the other end of the precipitation spectrum, water scarcity can also lead to soil erosion, even desertification, causing loss of extremely important top soil nutrients, as well as damage to the microbial activity key to maintaining the health of the soil that supports the surrounding native species, or farmed animals and vegetation.[210]

Recommendations

1. Where agriculture is the concern[211]:
    a. Leaving crop residue to help retain moisture and better regulate the soil temperature.
    b. Planting cover-crops that are resilient to drought conditions and that may protect soil between primary crop plantings.
    c. Maintain crop diversity to balance the soil conditions.
    d. In water challenged regions minimize planting thirsty crops, i.e., crops that require relatively more water than others and grown mostly for their financial rewards despite the crops' heavy water needs.

[210] Al-Kaisis How Drought Affects Soil Health published in Iowa State Univ Integrated Crop Management (Aug 2017)
[211] IBID

e. Evaluate and trial the use of super-absorbant polymers (SAPs) as a way to more effectively utilize water.[212]

"Due to super high water absorption and water retention capacity, superabsorbent polymers (SAPs) can be applied to effectively ameliorate utilization of water in agriculture, such as retaining moisture in the soil and reducing the irrigation water consumption."

2. Continue evolving the valuable use of satellite technology to monitor for soil erosion worldwide.[213]
3. Partner with the UN, using the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to devise methods for the public, businesses, and local governments to understand and apply its guidance.[214]
4. Push-me/Pull-me!
This is a conceptual idea to frame how to approach influencing the masses. Where "Push-me" reflects a policy driven approach to incentivize public behavior, "Pull-me" reflects a marketing driven approach to pull or draw out an emotional response towards the desired public behavior. While a push-me is needed we should be mindful that it's better as a gentle "nudge" rather than a hard, mandated push, else there is blow-back that defeats the purpose. A "push-me" policy for access rights, for example, would acknowledge all stakeholders and seek to balance the needs of all parties, including non-human species, in as reasonable a manner as possible. For pull-me, employ an emotional persuasion campaign. As humans we remember best and feel most connected to subjects that are linked to emotions. The more pain, anger, and euphoria we feel the more motivated we are to act. Incentivizing the public to move requires a marketing approach, ethically-aligned, of course, to instill emotional persuasion, a connection to the topic. Make it ubiquitous. In access rights, for example, ensure the

[212] Chang, Xu, Liu, Qiu, Superabsorbent polymers used for agricultural water retention published in Science Direct (Feb 2021)
[213] Sepuru, Dube, An appraisal on the progress of remote sensing applications in soil erosion mapping and monitoring published in Science Direct (Jan 2018)
[214] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

affected constituents are aware of all stakeholders, and attempt to drive empathy across all of their needs among all parties to minimize overly selfish positions.

5. Look to technology to help identify and fill gaps that exist now. The UN has already initiated programs.[215] Use AGI to help gather data, identify patterns and present them in a meaningful manner that help humans better understand problems and then seek solutions that are likely best addressed through cross-disciplinary approaches. Use Smart Watch technology as inspiration. Consider how it encourages/reminds us to exercise more. Smart devices, especially smartphones are becoming widely adopted worldwide. Another possibility might be a mobile app that consumers could use to help them identify food products' "ecoscore" and educate them about their sources, potentially offering alternatives.

Case Studies

1. In Australia, specifically New South Wales (NSW) a wetlands restoration success story completed in 2019. This was the Nimmie-Caira Project. It took commitment from both public and private sector parties coming together to restore important wetlands, and included the indigenous people in the reclamation and on-going maintenance processes.[216]

Further Resources

1. Sanjoy Hazarika (June 25, 2022) River Reflections: Impermanence, Erosion, Migration On The Brahmaputra, indiaspend.com, https://www-indiaspend-com.cdn.ampproject.org/v/s/www.indiaspend.com/amp/river-reflections/assam-soil-erosion-migration-brahmaputra-flood-823388?amp_gsa=1&amp_js_v=a9&usqp=mq331AQIKAGwASCAAgM%3D#amp_tf=From%20%251%24s&aoh=16562143701047&csi=0&referrer=https%3A
2. Ching-Nuo Chen, Samkele Tfwala and Chih-Heng Tsai (August, 2020) Climate Change Impacts on Soil Erosion and Sediment Yield in a Watershed, researchgate.net https://www.researchgate.net/publication/343564964_Climate_Change_Impacts_on_Soil_Erosion_and_Sediment_Yield_in_a_Watershed

[215] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.
[216] The Nimmie-Caira Project, Celebrating a Successful Partnership published by the NSW Dept of Planning and Environment within Australia, project completed 2019.

3. Joris P.C. Eekhout and Joris de Vente (January 11, 2022) Global impact of climate change on soil erosion and potential for adaptation through soil conservation, sciencedirect.com, https://www.sciencedirect.com/science/article/pii/S0012825222000058

Invasive Species

Issue

The river and lake ecosystems have been threatened by invasive species as a result of the climate changing and human introduction of non-native species. These invasive species in some cases thrive due to being introduced into an ecosystem with no predators along with a substantial source of accessible food allowing them to prosper and outcompete other species.

Background

Due to warmer temperatures in rivers and lakes, the native species are shifting and migrating to cooler environments, and they are being replaced by invasive species that can better adapt to the warmer water. These invasive species pose serious challenges to the entire ecosystem. Further, the native species that are not able to move to tolerable areas face extinction.

Recommendations

1. Prevention:
    a. Enforce strict boat cleaning rules at boat ramps and docks preventing species from transferring from one body of water to another
    b. Educate fisherman on releasing live bait into bodies of waters
2. Removal:
    a. Encourage the hunting/harvesting of non-native species

Case Studies

1. Weber, M. J., Hennen, M. J., Brown, M. L., Lucchesi, D. O., & Sauver, T. R. S. (2016, March 10). Compensatory response of invasive common carp Cyprinus carpio to harvest. Fisheries Research. Retrieved August 20, 2022, from https://www.sciencedirect.com/science/article/pii/S0165783616300546

Further Resources

1. Heather Sackett (June 13, 2022) Declining levels at Lake Powell increase risk to humpback chub downstream, aspenjournalism.org,

https://aspenjournalism.org/declining-levels-at-lake-powell-increase-risk-to-humpback-chub-downstream/

2. Brian Owens (May 24, 2022) AI technology could be used to monitor invaders in the Great Lakes, greatlakesnow.org, https://www.greatlakesnow.org/2022/05/ai-technology-invaders-great-lakes/
3. "How to rewind a country: the story of Argentina" ~ Patrick Greenfield, The Guardian, Jun 2023

5 FUTURE ORIENTATED NARRATIVES

Only a collective, vigorous, proactive and resilient futures orientation, coupled with growing sustainable and regenerative worldviews and supported by cooperative worldwide efforts, will allow Earth's diverse societies to create the social, technological, and economic systems that will allow for the regeneration of the planet's rivers and lakes.

Future-Orientated Narratives - Our Opportunity to Create Inspiring Narratives for our Future

Issue

Future-oriented leadership narratives help us to inspire belief in the future. When leaders engage us with such narratives, they help us to feel like we have agency to make a difference for our tomorrows. Such inspirational narratives give us hope, which has been demonstrated to help with such things as "improved coping, well-being, and engagement in healthy behaviors. It also protects against depression and suicide. Among teens, hope is linked with healthy, quality of life, self-esteem, and a sense of purpose."[217]

Background

We're not immortal—at least not yet–so we ourselves won't be around to see the distant future—that time "yet to come"--it is only "likely to exist." We can never know the distant future with certainty, and we probably won't be there to experience it. So, we're prone to focus on the more tangible 'now,' that we live in. But, the choices we make now, shape the future. In the same way our personal choices matter to our future health, our collective choices matter to the health of our environment. And imagining a positive future does matter to our individual wellbeing, in the same way exercising might.[218] This is because we like to aspire to things and to look forward to things. It helps us to feel like we have agency, when we can see a future that inspires us. On the other hand, it is easy to become despondent, when we can't see a future clearly, and especially when we can't understand how we can each make a positive difference about it. So, establishing a future-orientation mindset and narratives that inspires us, matter. This is better not only for us—but for the future generations of us—and the environments all around us that we impact, too.

Recommendations

[217] Stern MD, Adam P., Hope: Why It Matters, Harvard Health Publishing, Harvard Medical School, 2021, July 16, Harvard Health, September 2, 2022

[218] Lindstrom Johnson, Sarah, Blum, Robert W., Cheng, Tina L., Future-Orientation A Construct With Implications for Adolescent Health and Wellbeing, National Library of Medicine, National Center for Biotechnology Information, PubMed Central, 2016, April 11, September 2, 2022.

1. Craft meaningful and trustworthy leadership narratives that invite people to want to imagine, participate in and create a future for Rivers and Lakes.
2. Help individuals to understand how they have agency and how they can each uniquely contribute to positively impact rivers and lakes outcomes. Inspire involvement and action accordingly.
3. Keep hope, compassion, trust and stability as cornerstones for the leadership narrative.[219]
4. Consider how immersive technology can serve as a tool to help people envision the best iterations of our future. Help people see how their lives connect to such technologies.
5. Anticipate fears that people may have about changing technologies and a changing planet, engage with them where they are and help draw the links from there to the future, on their terms and in their language. Build bridges.

Further Resources

1. The Long Now Foundation
2. Keeping Time Into the Great Beyond
3. Future Orientation: A Construct With Implications For Adolescent Health and Wellbeing
4. Why hope matters
5. Back to the Future: Imagining New Planetary Narratives
6. Our Future Shapes Our Present

[219] Brim, Brian, Strengths-Based Leadership: The Four Things Followers Need, Gallup, 2021, October 7, Gallup, Omaha, Nebraska, September 2, 2022.

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It is 2030. Cities have been transformed into positive innovation ecosystems. The twenty-first century marked the transition from the industrial to the digital era; from industrial productivity to sustainability focus; from human competition to cooperation. Human knowledge and its expression in technologies are available to accelerate the positive change we now witness.

We now have Society 6.0,[220,221] where human-centric, urban planning, environmental sustainability concepts and other technological systems and solutions co-exist to provide a more equitable organization of resources within our world, where water and energy are more efficiently utilized, and we have reached sustainable food distribution worldwide. Our climate change and sustainability efforts have led to a new economic, technological, and human perception of values and collective ethical behavior.

Urban technologies have enabled intelligent cities and technology has made them smarter. Public health and education, green mobility, and sustainable growth are now shared values, accessible to most of the world's population. We provide fresh air and clean water in most cities of our planet, notably in the developing world, where clean energy adoption is now the norm. Sustainability is now affordable for everyone.

220 "The Sustainable Socially Responsible Society: Well-Being Society 6.0", Žižek, Simona Šarotar; Mulej, Matjaž, Potočnik, Amna, Sustainability (Basel, Switzerland), 2021, Vol.13 (16), p.9186.
221 "Society 5.0: Aiming for a New Human-centered Society", https://www.hitachi.com/rev/archive/2017/r2017_06/pdf/p08-13_TRENDS.pdf

Issue 1 Positive Innovation Ecosystems

The coordinated action of government, academia, entrepreneurs, and social agents can transform cities and towns into Positive Innovation Ecosystems.[222] These innovative urban spaces demand that we act now, as the majority of the world population will live in cities and towns of the developing world in the 21st century.

Background

The need for Positive Innovation Ecosystems is a unique opportunity and perhaps the ultimate target for leaving a multigenerational legacy to the planet. By 2050, over 70% of the world's population will live in cities.[223] This demands that we positively act now, as most of this human density will be in developing countries.

The twenty-first century marks the transition from the industrial to the digital era; from productivity to sustainability; from competition to cooperation. Such bipolarities — a concept from the past—ideally must cede their place to diverse innovation, that benefits the population in cities and towns worldwide. As information flows freely, at lower and lower costs, knowledge will be available to accelerate positive change in ways not seen until now, but even more so not properly imagined or projected into the future.

The power of technology here can be great leverage to impact the planet positively. AI and computing technologies are key to optimizing the use of renewable energy and reducing CO2 emissions, by leveraging new businesses and organizations that are human-centered and innovation-for-good driven as well as getting existing organizations to act in the public interest instead of supporting reliance on fossil fuels.[224] Public-interest innovation must play a key role and receive prioritized support from governments and funding agencies. Positive i-ecosystems integrate and leverage the knowledge of multiple stakeholders (governments, NGOs, i.e., community leadership and organizations, academia, investors, corporations, and social entrepreneurs) that share common values and seek to build innovation ecosystems in which their coordinated and collaborative action drives cities to a sustainable present and increasingly positive future. Cities and towns are the home of all aspects of human life and all our technologies: water supply,

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[222] "Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges Francesco Paolo Appioa,", Marcos Limab, Sotirios Paroutis in Technological Forecasting and Social Change, Volume 142, May 2019, Pages 1-14

[223] UNDP Sustainable Cities and Communities

[224] "Oil is the new data", Zero Cool, *Nature,* Issue 9, Dec 7, 2019, https://logicmag.io/nature/oil-is-the-new-data/.

energy, education, health, transportation, and all other public services and private activities. The need for changing the supply and adding sustainability to the value chain of all these technologies significantly affects the way we live on a frail yet resilient planet.

Key recommendations:

1. Technology must be applied and deployed for the benefit of the urban environment and humankind, always respecting the diversity and rights of the people's historic and harmonic connections to their lands and environment and treating cities as living complexities.
2. Although all technology is dual (or even multimodal), we shall always find ways to prioritize the positive use of our knowledge and technologies. Thus, positive actions shall be the vectors that accelerate innovation and sustainable change in developed and developing countries - more importantly, in the cities that invite most of us to live in them.

3. Defining an agenda, a strategy, and actions for positive innovative Ecosystems (positive - i-ecosystems). Drawing inspiration from the literature on innovation Ecosystems and Sustainable economics, positive innovative ecosystems extend the underlying idea of i-ecosystems to respond to the challenges of building sustainable, cooperative, diverse, equal, inclusive cities and metropolitan areas where socio-economic development is truly focused on constructing and preserving the planet and raising sustainable living standards, especially in the developing world.

4. A positive innovation ecosystem agenda demands a change in our innovation culture: from building the most effective business or political models to building positive innovation ecosystems, in which we all seek to preserve, recover, and leverage our accumulated, distributed scientific knowledge and resulting technologies (e.g., AI, clean energies, blockchain, new materials, sustainable supply chain optimization) for the true benefit of our planet and future generations.

Issue 2 Livable shared spaces enabled by technology

How to leverage technologies of smart cities[225] and circular economy[226] in practice to provide more livable shared spaces prioritizing community and mental health. Cities should aspire to develop systems that can reuse waste as a resource to help manufacture new materials and products, essentially doing away with the concept of waste altogether.[227]

Background

By 2030, we will have introduced a society 6.0, where AI and environmental sustainability concepts co-exist to provide a more equitable organization of resources within our world, where water and energy are more efficiently utilized, and no one goes hungry, and where climate change mitigation efforts are shared and realized with global ethical consideration. Technologies that enable smart cities and circular economies are applied in practice to provide more livable shared spaces prioritizing community and mental health, green mobility, smart utility systems, knowledge and ethics, and sustainable societal growth over monetary benefits.

Key Recommendations

1. To allow for data sources and methodologies that vary depending on geographic scope and regionality both vertically and horizontally, approaches that allow for sustainability need to be synchronized.
2. To develop applicable standards to big data that is being produced constantly, but its swift materialization into beneficial action is so far delayed due to a lack of such standards.
3. To resolve the challenge that both developing and developed countries face regarding –first with reaching equity, and second with systematic pressure within ecosystems, resources, and space (urban sprawl).
4. Knowledge, while widely accessible via digital means, needs to be centered around the conscious introduction of terms such as “Green AI”, “Knowledge City”, “Smart Utilities” etc. to ensure the synced comprehension between wider groups of stakeholders and the actualization of society 6.0 – technologically sound and environmentally conscious.
5. Improving the practice of Ethical AI systems and mitigation of AI misuse, where we avoid leaving people behind as we transition to a better world.

[225] US Department of Transportation, "Putting People First: Smart Cities and Communities", June 2021.
[226] “The circular economy”, Stahel, Walter R, Nature (London), 2016, Vol.531 (7595), p.435-438.
[227] William McDonough, *Cradle to Cradle,* North Point Press; 1st edition (March 1, 2010).

Issue 3 Rebuild legacy fossil-fuel based urban infrastructure

We must rebuild and plan the urban space from the legacy of the fossil fuel driven industrial era and allow for the transition into sustainable cities and towns.

Background

In towns and cities worldwide, citizens everywhere must rebuild the legacy from the first fossil fuel-powered phase of the industrial revolution into sustainable communities that provide a good life for all people. It is urgent to get CO2 emissions down to net zero to avoid further climate warming far beyond the pre-industrial temperature levels that are safe for agriculture and earth ecosystems.[228] "If emissions of CO2 stopped altogether, it would take many thousands of years for atmospheric CO2 to return to 'pre-industrial' levels."[229] Meeting the climate crisis requires bringing people together to care about each other and all life on the planet.

We have to achieve net 50% of 2005 emissions by 2030, reengineering our power grids with cheap solar and wind energy and our transportation with electric vehicles – cars, trams, scooters and bikes. "Estimates suggest that cities are responsible for 75 percent of global CO2 emissions, with transport and buildings being among the largest contributors," according to UNEP. [230] Older Industrial cities need to be rebuilt for energy efficiency, with walkable neighborhoods. The megacities have to be rebuilt from the ground up with energy efficient housing, including both heating and cooling systems, and well-designed parks that connect us with nature.

Buildings already account for a significant share of emissions, and new construction for expanding urban areas could increase this. "Commercial and institutional buildings account for approximately one eighth of the energy used in Canada."[231] Building heating systems are estimated to emit 2.5 billion metric tons of CO2 (out of a global total of 40 billion) from fossil fuel boilers; global cement and steel production accounts for about 6 billion metric tons combined.[232]

Other estimates show "mobility" as accounting for about 60 percent of about 12 billion metric tons of global CO2 emissions due to petroleum in 2019, out of over 42 billion metric tons from all sources.[233] To

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228 McKinsey & Co, The Net Zero Transition, January 2020.
229 The Royal Society, "Climate change: evidence and causes, question 20."
230 UNEP Cities and Climate Change
231
232
233

minimize travel emissions, commuter suburbs with low density housing must be redesigned to have town centers with jobs, conservation areas with natural habitats, and organic agriculture.

Opportunities for reducing greenhouse gas emissions vary widely depending on existing transportation and other infrastructure. Removing or not introducing gas guzzling vehicles is essential, but we must still improve quality of life for all citizens. A mix of electrical vehicles (including trucks and scooters as well as passenger vehicles) bikes, trains, buses, and possibly automated vehicles can be combined with urban planning that ensures that the megacities of the future allow all people to find jobs near their homes.[234]

To achieve all this, we have to engage citizen groups to actively support the return to net zero.[235] Reuse and reduce groups advocate for local circular economy waste control[236], including e-waste[237], thus avoiding pollution, and saving energy used in manufacturing. All kinds of groups sponsor nature education clubs for children as well as protecting and regenerating green space in and near towns and cities. Neighbors working together in community gardens combine with food waste reclamation groups to eliminate hunger. Clean air monitoring groups chart overall emission reduction progress and make sure all neighborhoods have clean air.[238] Housing groups improve heating and cooling systems in existing buildings and provide energy efficient housing for all.

Key Recommendations

1. To reduce and optimize urban transportation to limit CO2 emission and commuting times.
2. To improve building construction, operation, heating, and cooling that produce a large share of greenhouse gas emissions. Use heat pumps, district heating and biomass boilers for heating, and innovative building methods like carbon-sucking concrete.[239] [240]
3. To plan and construct energy grids that are efficient and reliable as well as based on renewable sources.
4. To significantly reduce waste disposal and treatment systems that are a source of methane and N2O emissions.

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[234] What is the Most Sustainable City in the World? YouTube video
[235] The Nature Conservancy: Goals for 2030 -- Build Healthy Cities.
[236] To Promote and Develop Sustainable and Professional Waste Management Worldwide and the transition to a Circular Economy", International Solid Waste Association
[237] "International cooperation", US Environmental Protection Agency.
[238] AirNow Partners, airnow.gov
[239] Klammer, Pless, Podder, Rothgeb, "Integrating Energy Efficiency into the Permanent Modular Construction Industry," NREL Buildings Integration Research.
[240] “Carbon-sucking concrete is capturing attention and funding,” Heather Clancy, May 6, 2021, https://www.greenbiz.com/article/carbon-sucking-concrete-capturing-attention-and-funding

5. To offer urban populations that are vulnerable to sea level rise and extreme weather events – drought, floods, wildfires, hurricanes, tornadoes urban housing alternatives that are safe and not vulnerable to climate change consequences.
6. Information, knowledge, communication, and shared planning about urban environmental problems, standards, and solutions are needed between different levels of government, non-governmental organizations, and the public, and between people in different parts of the world.
7. Housing: retrofit into carbon-positive houses including renewable energy decentralized to local districts/suburbs. Insulation and design cater for an energy consumption reduced to a strict minimum.
8. Food is produced and consumed locally, including exotic food (e.g., coffee). This increases the resilience of the food supply chain, creating deeper connections between producers and consumers of food in cities and towns, improving logistics, transportation and reducing CO2 emissions.
9. Smart charging and advanced energy storage are needed to ensure wide spread of electric vehicles, in addition to appropriate network planning to balance renewable energy supply and demand.
10. To provide R&D and funding support to research on electric planes that need technological advancements.
11. To significantly reduce noise pollution from vehicles (planes, cars, buses).[241]

[241] Community Noise Lab studies urban pollution, environmental injustice - The Brown Daily Herald, 2/26/22

Issue 4 Food waste and distribution

In the 21st century, we produce enough food to avoid hunger in the cities and towns of every country.[242] However, we have been unable to solve hunger in developing nations and underdeveloped regions of developed nations[243], due to distribution inefficiencies and income inequality, which results in food waste. Moreover, the transport of food and agricultural processes such as manure management, liming and urea application, rice cultivation, and burning crop residue, result in emissions of carbon dioxide, methane, and other greenhouse gasses. Meeting the climate crisis sustainably requires solving the hunger problem at the same time that we reduce GHG emissions due to agricultural production. Food systems must be made resilient to water shortage, drought, heat wave and other consequences of climate change as well as political conflict and income inequality.[244]

Background

Recommendations for reducing GHG emissions in agriculture that affect land use and production, like avoiding deforestation caused by clearing land for soy and beef, are in the scope of the chapter written by the Farmlands and Grasslands, Mountains and Peatlands committee. In this section, we consider how feeding urban populations can avoid food waste and use land within cities, towns and suburbs for gardens and local food production. This can reduce the pressure on land use and agricultural production outside of cities while at the same time improving the quality of life for everyone in urban areas.

Citizens are already working to help with urban food production and avoid food waste. Grass roots efforts like Food Shift provide job training and food for the needy using donated food that would otherwise go to waste[245]. Over 14,000 Climate Victory Gardens decrease carbon in the atmosphere now, while hoping to establish a movement for significant vegetable production like the Victory Gardens in the USA during World War II.[246]

At the municipal rather than individual level, we need community fridges where low-income and homeless community members could pick up excess food from the grocery store. We need municipal composting

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242 "Reducing food loss: What grocery retailers and manufacturers can do", Moira Borens, Sebastian Gatzer, Clarisse Magnin, and Björn Timelin, McKinsey & Co, Sep 7, 2022.

243 "Environmental Justice and the Food Environment in Prince George's County, Maryland: Assessment of Three Communities". Lucy Kavi et. al., *Front. Built Environ.*, 18 October 2019.

244 "Amid Climate change and conflict, more resilient food systems a must", Kelsey Simpkins, CU Boulder Today, July 15, 2022.

245 "Food Shift: Reducing Waste. Nourishing Neighbors. Creating Jobs", https://foodshift.net/our-approach/

246 "Climate Victory Gardens", https://greenamerica.org/climate-victory-gardens

services in every city, with compost collection bins in every public building, and every large business. Food waste breaking down in landfills emits lots of greenhouse gases, whereas composting does not and instead provide nutritious soil for use in gardens[247].

Community groups that sponsor nature education clubs and gardens[248] for children as well as protect and regenerate green space in and near towns and cities are critical to sustainable, local food production. We see a potential for neighbors working together in community gardens combine with food waste reclamation groups to contribute to eliminating hunger.

Key Recommendations:

1. Food should be produced and consumed locally where feasible. Moving farm production closer to cities may reduce CO2 emissions from food transportation and logistics.
2. Efforts should be made to reduce food waste from production through transportation and retail.
3. No one should go hungry, whether in towns and cities or in agricultural areas.
4. Some areas formerly used as farmland, now part of suburban sprawl, should be made available again for agriculture as cities are made more walkable and livable.
5. Moving farm production from farmlands that have been dominating rural areas, closer to cities (e.g., via vertical urban farming, or industrially grown and produced meat) would spread true and wild nature to the doorsteps of cities and revive wildlife.
6. Research on technological advances for sustainable food production and on consumer acceptance of sustainable foods, e.g., sustainable protein production, should be supported.

[247] "Composting Food Waste: Keeping a Good Thing Going", United States Environmental Protection Agency, October 2020, https://www.epa.gov/snep/composting-food-waste-keeping-good-thing-going
[248] "Oakland Community Gardening Program", https://www.oaklandca.gov/topics/oakland-community-gardening-program

Issue 5 Fresh air and clean water

We must provide fresh air and clean water to the population of cities and towns for sustainable human health and well-being. We must do this while coping with the challenges that extreme weather events due to climate change, like more frequent and damaging floods[249,250] and wildfires[251], place on our existing water treatment and air quality infrastructure.

Background

"Air pollution is the greatest environmental threat to public health globally and accounts for an estimated 7 million premature deaths every year. Air pollution and climate change are closely linked as all major pollutants have an impact on the climate and most share common sources with greenhouse gases," according to the UN Environment Programme.[252] Clean water and sanitation is UN Sustainable Development Goal 6.[253]
The sustainable use of natural resources can avoid the scenario where people are deprived of clear air and have limited or no access to clean water. Cities are already making their own Climate Action Plans in support of the Paris agreement for clean air. [254]

Sustainable urban life depends on an effective health system. Clear water and fresh air are key to improving public health. They depend upon clean public and private transportation systems, efficient water supply, and energy efficiency. We also need to rebuild watersheds and help in water availability, maybe even by restoring natural systems like beaver colonies[255]. The book on Beavers I read is called: Eager: The Surprising, Secret Life of Beavers and Why They Matter, by Ben Goldfarb.

In order to build a healthy world for the future generation to be more self-reliant and achieve their basic goals, we need to focus on our natural resources, conserve them, and aid those facing economic

249 https://www.nytimes.com/2022/08/30/climate/pakistan-floods.html
250 https://www.nytimes.com/2022/09/01/us/mississippi-water-climate-change.html
251 "Climate change and forest fires", M.D. Flannigan, B.J. Stocks, B.M. Wotton, The Science of the Total Environment , Elsevier, 262(2000), pp 221-229.
252 "Pollution Action Note: Data you need to know", 30 Aug 2022, https://www.unep.org/interactive/air-pollution-note/
253 "GOAL 6: Clean water and sanitation", UN Environmental Programme.
254 C40 Cities, "Clean Air Accelerator", February 2022, https://www.c40.org/accelerators/clean-air-cities/
255 Ben Goldfarb, *Eager: The Surprising, Secret Life of Beavers and Why They Matter*, Chelsea Green Publishing, 2018.

challenges with guidance to reversing environmental degradation. The idea of being deprived of fresh air or drinking water should be a thing of the past. What we seek is a world with freedom and empathy, where every life is valued, and we choose life over death as our starting point. Actions to immediately address air quality in urban areas are around addressing cars, trucks and buses - one of the largest sources of bad air quality in urban areas globally is TRAP (traffic related air pollution).

We must value nature[256] and truly see what it means to us and how it has shaped, structured, and conditioned human life. We need to effectively reconnect people to the modern world and nature being embraced. Humans must be free to think independently and have no fear of institutions, violence, or others. As we evolve, we continue to seek harmonious interaction with humans and machines. We owe it to ourselves.

Key Recommendations:

1. We must increase the ability to retain water in the soil and the instance of flooding in cities.
2. Tackle inequalities in cities and see water supply as a public health policy.
3. To provide clean air and water to all in cities and towns in the developed and developing world.
4. Humans must take responsibility for nature and for the impact we have caused upon it.

[256] "More than dollars: mega-review finds 50 ways to value nature", Ehsan Masood, *Nature*, July 15, 2022.

Issue 6 Sustainable and regenerative communities

Sedentary, exclusive, and extractive city models prevent. integrated ecosystems in which humans, animals and machines co-exist and live harmoniously in nature.

Background

Sustainable development on a global scale is possible through the multilevel and interdisciplinary efforts of many people. While projects dedicated to building Smart Cities have expanded exponentially in the past few years, we still live in places with fragmented infrastructures, poor value accounting, low-quality services, and artificial barriers between people and their basic needs.

By 2030 we need the complete transformation of human settlements to inclusive, sustainable and regenerative city models in which humans, animals and machines co-exist and live harmoniously with nature. Regenerating forests[257] and creating wildlife corridors[258] can help to reconnect ourselves and our children with nature and motivate further social change.

Today we have greed and corruption at every level of human society and the lack of incentive mechanisms to promote a sustainable social architecture is very apparent. This leads to social impacts of a dysfunctional social hierarchy. The monopolist pricing structure and artificial scarcity mechanisms are causing unnecessary search and competition despite the technology for production and the sufficient capacity for sharing resources and the economic production output. Finally, the absence of an education system to teach people how to live and maintain a sustainable lifestyle.

According to a recent report on the future of cities in Europe, "Urban segregation is the unequal distribution of different social groups in the urban space, based mainly on occupation, income and education, as well as on gender and ethnicity. The quality of life and number of healthy life years differ among these groups, too ... Socio-spatial segregation is not negative per se, since it can entail a high sense of local identity and cultural and social capital within a community. However, it can have a detrimental effect on cities' social stability and augment social fragmentation."[259]

Key recommendations

[257] The Miyawaki Method: a better way to build forests", Lela Nargi, JSTOR Daily, July 24, 2019.
[258] *How Sussex farmers plan to create a wildlife rich green corridor to the sea", The Guardian, 2022 July 22.*
[259] Social segregation: how can cities become more inclusive, European Commission report *The Future of Cities.*

1. Cities should be architected based on sustainable social architecture, zoned based on sustainable development and organized based on social cohesion.
2. We must include gender considerations in our plans for remaking infrastructure and transportation to adapt to climate change.[260]
3. We must ensure that urban segregation does not result in unequal outcomes for different groups in areas such as climate resilient housing, air quality and education.
4. We must work to create a homogeneous society that functions as a unified collective intelligence to promote peace, compassion, altruism, and justice and shows zero tolerance towards supremacy, violence, inequity, colonialism, expansionism, and oppressive behavior.
5. We must listen to environmental justice groups, such as West Harlem Environmental Action[261] and Deep South Center for Environmental Justice.[262]

[260] "Gender, Climate, and Transport in the United States", Women's Environment and Development Organization (WEDO), July 2021.
[261] https://weact.org
[262] https://www.dscej.org/

Issue 7 Optimized clean energy solutions

We must provide affordable and easy access to carbon-free energy in our towns and cities, deploying sustainable smart monitoring systems to enable real-time monitoring of emissions to track our progress. We must also use smart energy systems and internet of things to protect vulnerable populations from power outages[263] and provide them with heating and cooling.

Background

Access to clean energies in our towns and cities remains a challenge faced by cities and towns in the developed[264] and developing world. Technologies allowing for smart monitoring systems[265] are crucial to providing solutions applied across countries and continents. The affordability of wind and solar power plants compared to fossil fuel powered plants makes them an easy choice for energy grid expansion.[266]

We aim at a planet where our use of energy including buildings, transportation, manufacturing, etc. are all carbon neutral. The progression to electrification requires addressing our current grid system, eliminating wasted energy.

We also require our cities to be healthy environments for all of their citizens, which heat waves combined with power outages due to climate change make difficult to manage. Cities have already begun to hire heat response and mitigation officers.[267]

Key Recommendations

1. Transnational funding of solutions in research and development (e.g., batteries, material) to support community centers that provide clean energy solutions to local cities and towns worldwide.
2. Governments in developing nations should prioritize funding schemes for research and development of renewable energies, harnessing the potential of clean energy sources.

263 A grassroots coalition turns to solar and batteries to help New Orleans cope with disasters , Canary Media, July 2022.
264 Nationalize the U.S. Fossil Fuel Industry to Save the Planet - The American Prospect, Robert Pollin, April 8, 2022
265 M.A. Ramirez-Moreno, “Sensors for Sustainable Smart Cities: A Review,” MDPI Applied Sciences, Aug. 2021, https://doi.org/10.3390/app11178198
266 "Renewable power costs rise, just not as much as fossil fuels," Bloomberg News, 2022-06-03.
267“ Phoenix names a heat officer, with a goal of easing the risk of rising temperatures”, Brandon Loomis ,*Arizona Republic*, Oct 7 2021

3. We must improve the organization, planning, and infrastructure related to energy policies in developing countries (although developed nations face similar challenges[268]).
4. We must create incentives to drive change in the current behavior of most citizens in developed and developing nations towards the use of clean, renewable energy sources[269].
5. We must plan and build carbon neutral heating/cooling of buildings and the movement of transportation vehicles.[270] Heat pump adoption should be encouraged and incentivized to save energy.[271] Emphasis in the global north overall with respect to energy is reducing excess energy use and especially focusing on sustainability.[272]
6. Key technologies to focus on include heat pumps,[273] refrigeration, microgrids, community solar,[274] grid-enhancing technologies, [275] energy storage and demand side management.[276]
7. Key policies to focus on include racial/gender/disability justice, economic incentives to first make cost of living affordable (e.g., rent control), and then do away with the concept of cost of living overall (should not have to pay to be alive and have necessities like food and shelter in a planet positive world).[277]
8. Smart charging[278] and advanced energy storage[279] are needed to ensure a wide spread of electric vehicles[280] and harness the power of parked EVs,[281] in addition to appropriate network planning to balance renewable energy supply and demand.

[268] 2050 long-term strategy, European Commission.

[269] D. Crow, et al., "Behaviour Change: Strategies and Case Studies for reaching net-zero by 2050," Nov. 2021, https://energypost.eu/behaviour-change-strategies-and-case-studies-for-reaching-net-zero-by-2050/

[270] "€2 billion underground 'water battery' turns on in Switzerland: Swiss plant has power output large enough to power as many as 900,000 homes", Anthony Cuthbertson Tuesday 05 July 2022

[271] "Combating High Fuel Prices with Hybrid Heating", Matt Malinowski, Max Dupuy, David Farnsworth, Dara Torre, CLASP (Cooperative Labeling and Appliance Standards Program) report.

[272] "Existing climate mitigation scenarios perpetuate colonial inequalities", J. Hickel, A. Slamersak, The Lancet Planetary Health, Volume 6, Issue 7, July 2022, Pages e628-e631.

[273] Clean Energy 101: Heat Pumps - RMI, John Matson, Rocky Mountain Institute, July 2022.

[274] "What is community solar?", Alison F. Takemura, Canary Media, July 8, 2022.

[275] "FERC Could Slash Inflation and Double Renewables with These Grid Upgrades", Russell Mendell, Mathias Einberger, Katie Siegner, July 2022, RMI (Rocky Mountain Institute).

[276] "The future of urban housing is energy efficient refrigerators", Technology Review, 2022-02-23.

[277] "Policies for the People: The Chisholm Legacy Project"

[278] J. Burger et al, "The time is now: Smart Charging of Electric Vehicles," Regulatory Assistance Project, April 2022.

[279] G. Kamiya et al., "Energy Storage" IEA Technical Report, https://www.iea.org/reports/energy-storage

[280] "This Dutch city is road-testing vehicle-to grid tech", Michael Dumiak, IEEE Spectrum, June 2022, https://spectrum.ieee.org/vehicle-to-grid

[281] Harnessing the power of parked EVs, Kevin Delaney, *Cisco Newsroom*, June 27. 2022.

9. To plan and build healthy cities - active transportation, clean air, clean water, safe food, minimize criminal activities, how we deal with garbage & waste and make sustainable use of clean energy sources.

Issue 8 Urban redesign for walkability and local employment

Cities and towns must be planned or redesigned to allow for most people to work from a 20-minute walk from home or less. Long commutes and suburban sprawl enabled by automobiles should become a thing of the past. Air quality will improve, creating a healthier environment for everyone.[282]

Background

The ability to create and nourish relationships in localized settings is key to several aspects of urban planning. However, transforming cities into walkable urban spaces[283] remains challenging these days. Providing the possibility of working from home or allowing for citizens to work close to their houses requires new forms of thinking and planning the urban space.

National, state, and local governments can implement land use regulations globally which require communities to develop in ways that each town and city is built where work. Food and services are provided within a 20-minute walk or cycling radius or paired with carbon-neutral public transport

Key recommendations

1. Cities should offer common infrastructures allowing for networks, security, desks, and other needs available for locals to use as their working spaces. This would increase the possibility of working from home or from nearby common office spaces.
2. Increase and incentivize the use of public transport, powered by renewable fuel, making it readily available in cities and towns, mostly free, and connecting hubs of urban activities: e.g., offices, schools, and government services. Add greenery to public transit stations to mitigate climate change-induced heatwaves.[284] Public transit must be run so often (e.g., every 7 minutes) that it seems silly to take a car if you are able-bodied. Ride/taxi services should be available for the elderly, disabled and those with small children. Public transit should also be made more affordable to increase its use.[285]
3. Work, schools, parks, and health hubs should be available within a 20 mins radius (walking distance).

[282] Air pollution, epigenetics, and asthma Hong Ji, Jocelyn M. Biagini Myers, Eric B. Brandt, Cole Brokamp, Patrick H. Ryan & Gurjit K. Khurana Hershey Allergy, Asthma & Clinical Immunology volume 12, Article number: 51 (2016)

[283] Jeff Speck, *Walkable City Rules*, Island Press, October 2018.

[284] All Aboard for Nature: Improving Outdoor Access Through Public Transportation, Emma Johnson, EESI(Environmental and Energy Study Institute), July 29, 2021

[285] Less traffic jams with a 9-euro ticket - Analysis of TomTom data - Economy - News in Germany, July 2022.

4. Once we have a walkable city, foods, clothing, and other consumer goods purchased from local businesses can be expected to require less transport than ordering from remote locations.
5. Community: towns and cities are developed to bring people together whether meeting up at our central mail drop, on the porch of the general store, at the public library or at community event – we come together not only in times of need but in everyday interactions which allows us to feel part of something which we nourish but also nourishes ourselves.

Issue 9 Promote community solidarity and social responsibility

How to incentivize, harness, and leverage technologies that allow for close-knit communities in towns and cities that engage locally and mutually understand and respect self and others.

Background

Living in a world where we live as close-knit communities, in towns and cities that engage on a face-to-face level, where mutual understanding and respect flourish as a result of real relationships and communication remains a challenge to today's society. Personal anxiety and isolation no longer have a place in our society, even at the beginning of the 21st century.

We need to treat and respect our neighbors, and not see them as strangers but as supporting friends. Human happiness can be sought in the real company of others, and we need to understand that security is not achieved by sacrificing our privacy, but instead, through being part of a proactive strong community that, as a whole, cares for each of us, and welcomes outsiders.

Key Recommendations

1. Social media needs to adapt to stimulate and support "local" face-to-face connectivity. An incredible example of what this can look like is Buy-Nothing Groups flourishing on Facebook. [286]
2. To create a new value system for rewarding people for "good"[287] rather than for superficiality and economic gain, e.g., the "followers" syndrome.
3. Local economies need to be safeguarded – they are the bastion of community life and sustainability.
4. Social responsibility needs to be incentivized as a common goal for all of us living in towns & cities: for community members, respecting fauna and flora.

[286] How 'Buy Nothing' Facebook Groups Are Emerging as Sites for Mutual Aid, Tilde Herrera, *Eater*, Jul 1, 2022.
[287] Volunteer Spotlight: When Tech Is the Last Piece of the Puzzle, Cecilia Fischer-Benitez, *Code For America, 2020-08-25.*

Issue 10 Reduce datacenter energy consumption

Computing infrastructure has increased the quality of human activity in public, private, and non-government sectors. However, data center energy consumption consumes about 1% of worldwide power distribution. Reducing data center energy consumption demands innovations in cooling in the data center such as better separation of hot and cool air and liquid cooling of hot components, reducing data movement, moving to photonic from current driven communication and moving from volatile to non-volatile memory. We must also consider the trend for distributed computing to add energy use at the edge and endpoints.

Background

Data center energy consumption consumes about 1% of worldwide power distribution. It has been a pretty consistent percentage since at least 2010. However, there are changes in the amount of data collected due to IoT (such as connected sensors for city infrastructure, industrial, agricultural and consumer applications) as well as training and inference of large AI/ML models that could drive data center energy consumption (including processing at the network edge) to much higher levels (up to 8% of WW power generation has been projected) in a few years' time unless new computer/network/storage/memory architectures are introduced.

However, there are changes in the amount of data collected due to IoT (such as connected sensors for city infrastructure, industrial, agricultural and consumer applications) as well as training and inference of large AI/ML models that could drive data center energy consumption (including processing at the network edge) to much higher levels. These include moving photonic communication into servers and especially making this part of chip integration in order to reduce the generation of resistive heat from data transport.

In addition, moving to domain specific accelerators that offload CPUs and process data much closer to where it lives, reducing data movement, could help reduce energy consumption--this would likely include the use of accelerators on NVMe-oF and CXL networks. Another trend would be moving from volatile to non-volatile memory technologies (in particular if a non-volatile memory that could approach DRAM performance and price were used, the energy used to refresh DRAM data would be reduced, this refresh can account for up to 60% of server energy consumption).

In addition, at the network edge, and for endpoint devices, using non-volatile rather than volatile memory would allow more frequent low power states, which can extend use in power-constrained situations (such as in consumer battery-powered devices). In addition to these developments, many data centers are moving to increase their use of renewable energy sources such as wind or solar power.

Because these energy sources are often intermittent, concepts such as pausable computing could be used for certain applications that want to do inexpensive processing but where the demand for results can be deferred to when the power comes back up. Some other ways to reduce energy consumption are innovations in cooling in the data center such as better separation of hot and cool air and liquid cooling of hot components (e.g., the latest NVIDIA GPU consumes about 800W and 1KW chips are coming) may help in reducing the HVAC energy load of data centers.

Key Recommendations

1. We must develop of these technologies and establishing them commercially as well as standardize around how these technologies can be used between various vendors equipment and systems.

2. Sustainability has become a big factor in modern data center design. The challenge is to make many of these approaches to control data center and edge energy consumption applicable to real-world solutions. One good resource is Climate Change AI, a global initiative to catalyze impactful work at the intersection of climate change and machine learning.[288]

[288] https://www.climatechange.ai/

Issue 11 Open platforms, machine intelligence and resource use

We must create an Open, Intelligent and Resourceful Planet based into three main technology building blocks. We should encourage efforts like Public Lab[289], the Wilson Center [290]to involve everyone in creating solutions.

Background

By 2030, Planet Earth is an Open, Intelligent and Resourceful Planet. A key component of building sustainable cities and towns is technological diversification. We see three main major building blocks, and this is how our Towns and Cities can be formulated in the future.

Key recommendations:

1. Open: having open backend platforms that communities can use, and re-use is one of the core concepts of sustainable advancement, building on our knowledge is a dream that currently Open-Source Platforms are achieving. Human knowledge should be transferable and accessible. Open-Sourced information and knowledge will help this world to be a better place. See related articles.[291]

2. Intelligent: Human intelligence is uncanny, that's why transferring the human powerful brain capabilities to a machine is the greatest idea a man had imagined. By 2030 the power of AI and Machine Learning can exceed the human brain's capabilities, which will lead to an intelligent world, helping humans to accelerate in lives, and help the world to be a better place.

3. Resourceful: by 2030, our planet is full of resources helping Human beings to perform better. Resources are not infinite, but the intelligent world will help humans to make use of everything around us, this includes generating energy from clean sources and reusing all our waste. See the GOSH Manifesto[292] for ideas on how to open up these resources.

4. Predictable: by 2030, our planet can be visualized and AI along with XR technologies and the Metaverse will accommodate the visualization of the future through prediction algorithms to assist with decision making at town/city level.

[289] Public Lab
[290]"Low-cost and Open Tools for Environmental Decision-making, Alison Parker, Shannon Dosemagen & Ashley Schuett, The Wilson Center blog post, April 5, 2022.
[291] https://www.shannondosemagen.com/writing
[292] https://openhardware.science/gosh-manifesto/

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Ocean and Coasts

> The ocean plays a crucial role in the achievement of the Sustainable Development Goals and the livelihoods of billions of people. We urgently need to change how we interact with it.
> —United Nations Secretary General António Guterres

Future Vision

It has been an incredible decade. The fact that the ocean produces half of the world's oxygen has evolved from obscure science trivia to common knowledge. The world has been educated about the ocean's influence on people and their influence on the ocean, inspiring grassroots groups of citizen scientists to organize globally, collecting data on ocean and coastal change, resilience, diversity, population, and economy. Society has met the 30x30 (30% of oceans protected by 2030) goal. The definitive map of the ocean floor is complete.

Circular economy practices have moved from an emerging field to a central principle in both the private and public sector. Broad investments in process improvements and waste stream mining have resulted in 100% reuse and recycling of plastic, and nearly every jurisdiction has eliminated the use of single-use disposable plastic items. Notable progress has also been made with mining and removal of plastic waste from the ocean and freshwater bodies.

Wind, wave, and current-driven renewable energy projects along the coastline now produce and store a substantial fraction of the electricity to power society day and night without relying on carbon-based fuels during peak and dark hours.

Ocean and coastal-based carbon dioxide (CO_2) removal strategies have been proven and are being built on a scale that will soon be able to remove carbon dioxide at rates comparable to the residual carbon output from human activities. There is now a clear economic and technological path to removing the human contribution to the rate of change in Earth's climate.

Coastal desalination plants powered by salinity gradient energy technology provide abundant clean water and clean energy to areas where freshwater is scarce. Sustainable aquaculture provides an important food source for global populations.

As impressive as these technological achievements are, what is most meaningful to the average person is that the ocean is visibly healthier. Their favorite beaches no longer have garbage washed up from offshore. Ocean economies are booming as biodiversity has rebounded, leading to increases in everything from whale watching to sport fishing. Protected coastal wetlands and mangrove forests both make coastal communities safer and provide beautiful recreational spaces.

Issue 1

It will be nearly impossible for society to reach our sustainable development goals without a healthy ocean, and the largest threat to the ocean is the absorption of excess heat and atmospheric CO_2.

Background

The ocean has until now been the signal largest climate buffer, absorbing 90% of excess heat and 25% of excess CO_2[293]. This has broadly affected physical, chemical, and biological processes in the ocean, adversely affecting many ocean ecosystems and ocean health. In particular, ocean acidification is directly linked to absorption of atmospheric CO_2.

Do we understand the strata of heat in the ocean? Yes, climate is a heat engine. Heat is most abundant at the equator, and the rest of the climate system is designed to remove heat from the equator. There are three parts of the system: land, water, atmosphere; the ocean is 72%. The high heat capacity of the ocean has saved us (until now) by smoothing the variations in heat input/output. This ocean heat uptake comes at a cost, including the thermal expansion of ocean water and resulting sea level rise and the intensification of storms.

If we do not slow the rate of ocean acidification or mitigate its effects, we risk significant impacts to biodiversity, especially in coral reefs and shellfish, but there is a significant knowledge gap about the full impacts of acidification. Increased ocean heat combined with nutrient discharge (in this chapter, this topic is discussed in the issue covering pollutants) also reduces the capacity of the ocean to hold oxygen. Declining oxygen contributes to a loss of biodiversity and shifting species distributions; it also threatens to disrupt the ocean's food provisioning services. These changes make effective management of ocean resources extremely difficult.

We need a solid understanding of a system in order to design good technologies for it. With the ocean, not only do we have a poor understanding of the baseline, but because of human-

[293] WMO. 2021. WMO Greenhouse Gas Bulletin (GHG Bulletin) – No.17: The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2020. Available at: https://library.wmo.int/index.php?lvl=notice_display&id=21975#.YnzbifPMJQI

induced climate change, the baseline is moving while we try to measure, understand, and responsibly manage vast ocean resources. This complex, interconnected problem calls for urgent, revolutionary increases in ocean observations to inform both technology development and management policy.

Recommendations

- We need massively-increased observations of ocean systems. This includes everything from scientific measurements of the carbon cycle to improve the understanding of how the ocean acts as a buffer to the climate system, to physical measurements to support safety and energy transformation (bathymetry, currents, weather, hazards), and to biological assessments to inform good management from both civil society and government policy. The UN Decade of Ocean Science for Sustainable Development 2021-2030 was recently launched with the goal of "The Science We Need for the Ocean We Want". Achieving the goals of the Ocean Decade will require significant technology development in sensors, platforms, and autonomous vehicles in parallel with coordination of public, private, and philanthropic science funding.

- Studies to inform strategies for adaptation and mitigation.
- Restoration of coastal (tidal marshes, wetlands and mangroves) and ocean (seagrass meadows and kelp forests) could substantially contribute to carbon sequestration.
- As it stands, slowing anthropogenic CO_2 release will not meet 1.5 °C targets. Carbon dioxide removal (CDR) technology may provide a path to limit net-carbon emissions. The ocean could provide up to 20% of global carbon sequestration [ref].
- In order to responsibly evaluate CDR technologies relative to the economic and ecological costs of other carbon solutions, we need immediate work to understand the costs and ecological impacts of various CDR approaches in order to have the information at the time it is needed for massive investment in carbon solutions.

Case Studies

1. The OSPAR 2017 Intermediate Assessment confirms acidification in the northeast Atlantic Ocean. A full ocean acidification quality status report is expected before publication of this work.

2. The UN Intergovernmental Panel on Climate Change (IPCC), and its latest status report (IPCC — Intergovernmental Panel on Climate Change).

Further Resources

1. UN World Ocean Assessment - probably lots of useful information for other issues as well
2. 2022 State of the Ocean Report
3. Observing carbon uptake within major ocean basis, e.g. North Atlantic Carbon Observatory proposal.
4. Better understanding of the air-sea exchanges in important climate cycles. Observing Air-Sea Interaction Strategy (OASIS)
5. Ocean-based CDR Roadmaps from Ocean Visions.
6. Global Ocean Acidification Observing Network (GOA-ON)
7. Blueprint for Ocean Climate Action The Blueprint recommendations are backed by 93 organizations, ranging from environmental groups, ocean advocates, think tanks, aquariums, and outdoor recreation brands, who came together to develop these comprehensive recommendations. The recommendations focus on 12 key policy areas identified by Ocean experts to improve sustainability, resilience, conservation, equity, and justice and demonstrate the broad solutions offered by the ocean.

Issue 2

If left unchecked, sea level rise will threaten coastal communities, cause increased economic losses, and increase coastal erosion and destruction to ecosystems such as wetlands and mangroves.

Background

Since 1880, sea level has risen from 21 cm to 24 cm, and the rate of sea level rise is accelerating[294]. Even with reduced greenhouse gas emissions (GHG), coastal communities are facing an additional rise of at least 0.3 m above 2000 levels by 2100, and sea level will continue to rise for centuries[2]. The main drivers of sea level rise are thermal expansion of seawater due to excess heat being absorbed into and heating the ocean and increasing seawater mass from melting glaciers and ice sheets.

There are high population densities near the coast, and rising sea levels are threatening infrastructure and water supplies. Higher sea levels allow storm surge and high tides to travel further inshore and result in increased high-tide flooding of coastal communities. Sea level rise threatens the habitability and very existence of small island nations. Ecosystems protecting the shoreline in many areas are unable to evolve and migrate due to the impacts of humans, so the rate of erosion of these ecosystems increases as sea level rises.

Communities will require storm protection, coastal impact assessments/response plans, and better ways to measure direct local impact of climate change. The modeling and prediction of climate change is needed to determine coastal communities' vulnerability to storm surge, increasingly common flood inundation, saltwater intrusion, and natural disasters. Perhaps much of the real damage goes unmeasured in the areas where less technology is available for monitoring and measurement. Sharing knowledge is also important, especially for developing countries that may be disproportionately affected by climate change—both its acute hazards and long-term effects.

The modeling and technical data are especially important to identify the sovereignty of each coastal state over it´s sovereignty area. The Maritime Boundaries are set from the baseline, which is the low-water line along the coast as marked on large-scale charts officially recognized

[294] Climate.gov Climate Change: Global Sea Level

by the coastal State.[295] Since the international treaty UNCLOS does not explicitly provide that the maritime boundaries shall shift with a change in baselines, it can be said that the UNCLOS does not decidedly exclude the possibility of States resorting to either of the two approaches. One is to fix the baseline and the other is to shift it according to the rising sea level. Therefore it is important to constantly measure how far the baseline has shifted.[296]

Recommendations

1. The equitable distribution of low-cost, easy-to-use monitoring equipment and satellite data and products helps to track sea level and erosion and provide early warning systems.
2. Definitive mapping of the global seafloor is necessary for modeling, see recommendation 3.
3. Modeling sea-level rise, storm surge dynamics, and erosion locally and globally can help develop smart maps to inform the placement and protection of critical infrastructure or the relocation, ecosystem-based adaptation, and planned shoreline retreat of coastal communities to prevent loss.
4. Adaptation should focus on local drivers of exposure and vulnerability, dependent on regional sediment sources and budgets.
5. Use of bio-coastal restoration in addition to / in place of infrastructure protection. Restoration should target key coastal ecosystems, such as saltmarshes, mangroves, vegetated dunes, and sandy beaches that provide important services, including coastal protection and habitat for diverse biota.

Case Studies

1. CoastSnap - a global citizen science project to capture changing coastlines
2. Land change assessment, monitoring and prediction using Landsat

[295] UNCLOS, Article 4, https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

[296] http://climate.org/wp-content/uploads/2019/01/Has-Climate-Change-Rendered-the-Concept-of-Sovereignty-Obsolete.pdf

3. Environment | Mangroves for the Future - Investing in coastal ecosystems
4. National Oceanic and Atmospheric Administration's Sea Level Rise viewer and NASA's Sea Level Change Portal

Further Resources

1. Seabed 2030 will produce the definitive map of the global seafloor by 2030.
2. Chapter 4: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities
3. National Oceanic and Atmospheric Administration 2022 Sea Level Rise Technical Report

Issue 3

Without intervention, we may continue to see increases in coral reef bleaching and die-offs, which will threaten large ecosystems that provide many services, from ecotourism to food security.

Background

Over half a billion people depend on coral reefs for resources and protection. Coral reefs protect coastlines from storms and erosion and provide economic opportunities and ecosystem services. Coral reefs are threatened by pollution, harmful fishing practices, and climate change impacts such as increased ocean temperatures and acidification.

Many of these threats can stress reef ecosystems leading to bleaching and possible death. Bleaching is when stressed corals may expel the symbiotic algae—their main food source—living within them, thus putting the coral at risk of dying. There have been many bleaching or mass mortality events; however, the largest was the 2014 to 2017 global coral bleaching event, in which warm waters affected about 70% of coral reefs worldwide.

Recommendations

- Technology solutions to regrow reefs
    - Bioengineering of heat-resistant corals
    - Improved techniques to grow new coral
    - Drones and other technologies for seeding new reefs
- There are more than 7,500 oil and gas platforms around the world. As fossil fuels are phased out, massive decommissioned offshore rigs can be converted into living substrates or artificial reefs. However, this comes with a caveat: some believe this will provide oil conglomerates a loophole to dump unwanted debris as a cost-saving measure.

Case Studies

Further Resources

1. https://www.rig2reefexploration.org/read-me
   https://icriforum.org/coralrestoration/

Issue 4

Wide scale changes in the methods, regulation, and social awareness of ocean-based food production are necessary in order to ensure equity and food security and prevent the destruction of marine habitats.

Background

Fisheries and aquaculture provide food and livelihoods for billions of people, while simultaneously being the largest threat to marine biodiversity through both direct fishing impacts combined with bycatch and habitat destruction.[297,298]

About 60% of fish stocks are currently harvested at the maximally-sustainable level, 33% are harvested beyond sustainable levels[299].

Fisheries' 2017 annual value was estimated at $127 billion; the World Bank also estimated that $88 billion of net loss occurred due to impacts of overfishing.[300] Additionally, illegal, unregulated, and unreported (IUU) fisheries threaten the livelihoods of small-scale fisheries, which primarily support local food consumption and are vital to food security, particularly in developing states.

Challenges to sustainable ocean food production are many, including: difficulty in identifying and tracking IUU fisheries, harmful subsidies, lack of political will to address the problem, and a lack of transparency and control against transnational criminal networks.

In addition to the obvious economic, social and food security impacts, unsustainable and particularly IUU fisheries are likely to present greater risk to the environment due to destructive fishing practices and improper waste management.

Recommendations

[297] Maxwell, S. L., Fuller, R. A., Brooks, T. M. and Watson, J. E. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature, Vol. 536, no. 7615, pp. 143–45. doi:10.1038/536143a
[298] O'Hara, C. C., Frazier, M. and Halpern, B. S. 2021. At-risk marine biodiversity faces extensive, expanding, and intensifying human impacts. Science, Vol. 372, No. 6537, pp. 84–87. doi:10.1126/science.abe6731
[299] Source?
[300] 2021 World Ocean Assessment Vol II Ch15

1. Better ocean observations can prioritize areas and species for most urgent action.
2. Coordinated policy regulation
    a. International bodies must become more effective
    b. MSC ASC requirements - they exist, not adopted rapidly enough
3. Non-destructive fishing gears
4. Better fisheries management through understanding of habitats and food chains, better monitoring of stocks
5. Improved remote sensing and monitoring technologies can enable enforcement of existing regulations and inform creation of new regulations.
6. Ocean literacy and awareness is especially important here.
7. Transfer techniques and best practices
8. Citizen science to support compliance
9. Digital Traceability

Case Studies

1. Calculation Model Of Economic Losses Due To Illegal Fishing Activities In Indonesian Territorial Waters[301]

Further Resources

1. International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
2. Illegal fishing
3. Strengthening the Role of Ports in Combating Illegal, Unreported and Unregulated Fishing in Indonesia

[301] Farhan, Aulia Riza, R. Bambang Aditya, Dendi Mahabror, Romy Ardianto, and Kalu Nicolaus Naibaho. "Calculation model of economic losses due to illegal fishing activities in Indonesian territorial waters." Indonesia Marine Fellows Program Report (2018).

Issue 5

Changes are needed in development and resource extraction in order to reduce or prevent destruction of key habitats such as seagrass meadows, kelp forests, tidal marshes and mangroves, causing a loss of marine biodiversity, coastal erosion, flooding, and ocean warming.

Background

From seagrass meadows to kelp forests to tidal marshes and mangroves, to deep sea ecosystems, our oceans and coasts provide key habitats for a variety of plants, animals, and other organisms all over the world. Biodiverse environments are more resilient to climate fluctuations; therefore, the protection and restoration of these areas is crucial to maintaining a livable planet. These important habitats are being damaged by resource extraction, coastal urbanization, introduction of invasive species, storm surges, and sea level rise.

The loss of biodiversity in our oceans is causing major reductions in available fishery stock, affecting livelihoods and increasing food insecurity globally.

These habitats also play an important role in ocean-atmosphere interaction. Seagrass meadows are estimated to capture upwards of 10% of the carbon absorbed by the ocean each year, and kelp forests capture 20 times more carbon per acre than land forests. The continued loss of seagrass meadows and kelp forests will further increase atmospheric levels of GHG.

The destruction of tidal marshes and mangroves are destabilizing coastlines by increasing erosion and flooding, causing governments and coastal communities millions of dollars a year. Deep Sea ecosystems are poorly understood yet could be threatened by increased fishing and future deep sea mining.

There has been a rapid increase in the establishment of marine conservation areas (MCAs) globally. However, the lack of ecological monitoring and enforcement has called into question the effectiveness of many of these areas in meeting conservation goals.

Recommendations

1. Balancing man-made structures versus using natural approaches to resilience.

2. Implement more MPAs and MCAs with robust monitoring programs and adaptive-management practices that meet the 30x30 goals (30% of oceans protected by 2030) and include key habitats and prioritize biodiversity. However, localized impacts on stakeholders must be taken in consideration, especially in the case of "no take" zones where all fishing activities are prohibited. This would also include the development of an open-access database allowing for MPA/MCA managers, researchers, and stakeholders to access and share best practices and *any* data (from oceanographic to economic and everything in between relating to these areas).
3. Establish sophisticated monitoring and noninvasive technology (moorings, buoys, eDNA, underwater remote-operated vehicles, autonomous underwater vehicles, and sensors) to better understand the overall dynamics and detect changes. Understanding the ecology and processes of these habitats will provide valuable information on their integral importance and further inform evidence-based decision-making for management needs.
4. Implement the widespread use and accessibility of mechanical restoration technologies such as seeding buoys and vessels designed to mechanically plant seagrass and kelp seedlings.
5. Establish *living seawalls* with 3D-printed structures. Designed to mimic naturally occurring substrates, these seawalls allow for a variety of invertebrates, fish, and seaweeds to live or grow on them, while simultaneously protecting coastlines from storm surges and erosion.

Case Studies

1. " Sydney Harbour has shown that after 1-2 years Living Seawalls already support at least 36% more species than plain, unmodified seawalls, with as many as 85 species of invertebrates, seaweeds and fish living and growing on the panels. " [ofhttps://www.livingseawalls.com.au/overview-science](https://www.livingseawalls.com.au/overview-science)
2. "eDNA as a metabarcoding tool for monitoring marine protected areas"[302]

Further Resources

[302] Gold, Zachary & Sprague, Joshua & Kushner, David & Zerecero, Erick & Barber, Paul. (2020). eDNA metabarcoding as a biomonitoring tool for marine protected areas. 10.1101/2020.08.20.258889.

Issue 6

We will not be able to maintain food security, biodiversity, and the safe management of coastal and ocean ecosystems without better monitoring and more effective control of pollutants: nitrates and phosphates cause eutrophication, fish die-offs, and ecosystem changes and also may increase harmful algal blooms (HABs) in coastal waters.

Background

The presence of pollution in the ocean, particularly in the form of nitrates and phosphates, is becoming ubiquitous, with significant effects on marine life and human health. The complete picture of pollutants is complex and we do not have sufficient data to fully characterize all sources and effects, but there are well-established major causes. These causes include agricultural run-off, impacts of inefficient aquaculture practices, effluent discharges from urban and industrial areas, and the modification of natural river flows, which disrupts sediment transfer processes.

Pollutants cause a change in the ratio of important nutrients and temporarily stimulate plant growth, causing or exacerbating localized *dead zones* where decaying organic matter consumes oxygen faster than is exchanged with the oxygen-rich sea surface. These hypoxic conditions directly affect commercial fish stocks, alter food webs, and also may be a major contributor to habitat and biodiversity loss (see issues elsewhere in this chapter on coral reefs, seagrass meadows, and coastal wetlands).

The changes in nutrient ratios due to human activities may also contribute to the sudden, rapid growth of certain phytoplankton species—known as harmful *algal bloom*s—which present health risks to food chains, commercial fisheries, and humans as well as related economic effects.

Recommendations

- More ocean observations are needed, in general. The fit-for-purpose ocean observation system is a cross-cutting theme, but for this issue specifically, we need to monitor pollution outflows from rivers and cities, including submarine groundwater discharge. This requires development and widespread adoption of low cost technology for real-time monitoring of temperature, nutrients, pollutants and suspended sediment in all waterways.

- Direct measurements of water movement and chemical composition (for example, with gliders equipped with dissolved CO_2 and nitrous oxide sensors) are necessary to validate detailed computer models, which can then help predict hazards and conduct what-if testing of various technical or policy mechanisms. These could include a wide range of actions, from changing regulations on farming and aquaculture practices to timing the operation of dams and spillways to minimize harmful effects on ocean chemistry.
- Improved remote sensing methods can help monitor and provide timely warnings to mitigate the immediate effects of harmful algae blooms. Improvements could be new sensors on new satellites but more likely will include improved machine-learning algorithms to automate the processing and analysis of existing remote-sensing data.
- A long-term solution would see the establishment of more regenerative agriculture practices and better urban wastewater management, including biofiltration systems and blue-green roof technology for stormwater runoff.
- Corrective measures mirroring those linked to land - this also impacts seafood production. STPP is used in laundry detergents and on farmed shrimp and fish to retain water to add weight (not banned in most places). STPP contains phosphate and can cause eutrophication and algae bloom if wastewater merges into water bodies without the right treatment.
- Citizen scientists can provide cost-effective water quality data on temporal and spatial scales that would otherwise not be possible.

Case Studies

- Use of Biochar to remove toxins from different harmful algal blooms
- Nanobubble ozone technology (NBOT) to control cyanobacteria and their toxins
- Case studies of Biofiltration systems from the Minnesota stormwater manual
- Blue-Green Roof technology
- The development of smartphone applications (Apps) which can be used by citizen scientists to cost-effectively measure and record surface reflectance, water color and water quality parameters.

- Environmental Protection Agency Participatory Science Water Projects

Further Resources

1. 2022 State of the Ocean Report
2. World Water Report
3. Feikai Yang, Dafang Fu, Chris Zevenbergen, Eldon R. Rene, A comprehensive review on the long-term performance of stormwater biofiltration systems (SBS): Operational challenges and future directions, Journal of Environmental Management, Volume 302, Part A, 2022, 113956, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2021.113956.
4. Metcalfe, A. N., Kennedy, T. A., Mendez, G. A., & Muehlbauer, J. D. (2022). Applied citizen science in freshwater research. *Wiley Interdisciplinary Reviews: Water*, 9(2), e1578. https://doi.org/10.1002/wat2.1578
5. Anna San Llorente Capdevila, Ainur Kokimova, Saunak Sinha Ray, Tamara Avellán, Jiwon Kim, Sabrina Kirschke, Success factors for citizen science projects in water quality monitoring, Science of The Total Environment, Volume 728, 2020, 137843, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2020.137843.
6. Tim Busker, Hans de Moel, Toon Haer, Maurice Schmeits, Bart van den Hurk, Kira Myers, Dirk Gijsbert Cirkel, Jeroen Aerts, Blue-green roofs with forecast-based operation to reduce the impact of weather extremes, Journal of Environmental Management, Volume 301, 2022, 113750, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2021.113750.

Issue 7

Widespread change in the use of plastics and management of waste is needed to reduce the prevalence of macro- and micro marine plastics, which directly threaten marine life, affects biodiversity and food security.

Background

One of the biggest issues within ocean conservation is plastic pollution. We can see it in our daily lives walking by the sea: plastic waste on beaches.

According to the UN Environment Programme (UNEP), 8 million tonnes of plastic waste end up in our oceans every year and this could double by the year 2025 if we don't take drastic action.[303]Plastic is floating in rivers and we can even catch plastic when out on the ocean. But there is more than just the visible plastic waste. There is macro- and microplastic. Macroplastics are objects and are visible to our eyes. Microplastics, however, are particles smaller than 5 mm. They come either from clothing fibers or are a result of larger plastic breaking down. These tiny particles are floating throughout the ocean and are even found in the ocean´s tiniest creatures, like plankton.

Plastic makes up 80% of marine debris, and is caused by mismanaged plastics. One source is land based, typically from areas with poor waste management without a recycling system.[304] Single-use plastic items make up half of all plastics produced annually and likely form the largest part of the plastic pollution problem. The largest pollution coming from marine sources are from fisheries (ghost-gear), aquaculture, and nautical activities.[305] A recent study in the Great Garbage Patch shows that more around 80 % of plastic waste actually originates from fishing activities.[306]

[303] https://www.weforum.org/agenda/2022/02/plastic-pollution-rivers-innovative-solutions/
[304] https://tontoton.com
[305] P.15, ECO Special Issue UN Ocean Decade
http://digital.ecomagazine.com/publication/frame.php?i=707374&p=1&pn=&ver=html5
[306] https://theoceancleanup.com/updates/the-other-source-where-does-plastic-in-the-great-pacific-garbage-patch-come-from/

Marine plastic debris is a direct threat to animal health, and, therefore, impacts biodiversity, food safety and quality, human health, and coastal tourism. Plastic waste also contributes to climate change through the potential release of carbon dioxide when incinerated.

Recommendations

- Ocean literacy. Facing the problem through the empowerment of individuals by promoting ocean literacy. Beach cleanup can help, so every single individual should help and start collecting plastic.
- Urban waste management. A key issue for preventing plastic waste reaching the ocean is proper waste management to keep garbage from entering rivers to be carried to the ocean. Plastic-eating bacteria may be able to decrease the microplastic waste (https://www.science.org/content/article/could-plastic-eating-microbes-take-bite-out-recycling-problem)
- Modeling pollution drifting to determine where to focus both mitigation and cleanup efforts. Modeling to understand impacts of plastics to human health and planetary health.
- Tracking fish gear: monitoring the fish gear will help limiting the loss of equipment and will save costs and fuel while searching for it
- Lifecycle analyses for products and services. It is difficult for an individual to understand the impact of their decision on the ocean/environment. Considering the full life cycle of a product can help measure the benefits of big changes that might appear too expensive without a full understanding of the cost of the status quo. This should be captured in two ways: by making companies responsible for the full life-cycle cost or products / materials they produce and profit from, and by ensuring consumers are aware of the impact of their products and participate in appropriate reuse/recycling programmes.
- Joint forces across countries: there are so many different organizations promoting ocean literacy. There must be a way to combine and interchange the knowledge of technologies to accelerate and make the process more efficient.
- Biodegradable fishing lines/gear paired with stronger policy
- Better understanding of impact of microplastics, especially related to food chain (human health vs planetary health)

- Global Plastics Ban Treaty
- Encourage research into alternative plastics e.g., Biodegradable 'plastic' solutions such as this one made from seaweed: https://www.canplastics.com/features/researchers-develop-non-toxic-biodegradable-plastic-film-based-on-seaweed/
- Intercepting, collecting and removing plastic pollution carried in runoff, ditches, streams and rivers using low-cost, low-tech solutions.
- Standardize recycling, collection and composting of plastics across communities, states and countries; Develop data collection methodologies (like block chain) to report on plastic waste reduction, composting, and recycling rates; and require producers to share responsibility for supporting effective recycling programs.

Case Studies

- https://thegreatbubblebarrier.com: We create a bubble curtain by pumping air through a perforated tube on the bottom of the waterway. The bubble curtain creates an upward current which directs plastic to the surface. By placing the Bubble Barrier diagonally across the river, the natural flow of the water will push the plastic waste to the side and into the catchment system. The catchment system is designed to work in harmony with the bubble curtain to collect and retain plastics. Following collection, it will be removed for processing and reuse. The Bubble Barrier comprises three main components: the bubble curtain, the compressor, and the catchment system. The three components are designed to work together to create the optimum solution for each location.
- https://plasticfischer.com/opensource Installing Plastic Fischer's Trashboom in rivers is up to 300 times more cost-effective than fishing plastic out of the ocean. Plastic Fischer decided to make it as easy as possible for everyone to take action against plastic pollution by themselves. They have created a detailed construction manual, including lessons and ideas.
- https://www.lonelywhale.org/ Lonely Whale has trained 2,400 young leaders, ages 8 through 23, across 90 countries and engaged tens of thousands more through the OH-WAKE Media Network at ohwake.org . Lonely Whale is leading the movement to ensure plastic is no longer considered waste but a valuable raw material for the circular economy – not the ocean. Learn more: nextwaveplastics.org

- Global Plastic Innovation Network: an innovative network to crowdsource innovations of high potential innovators to tackle plastic pollution. https://uplink.weforum.org/uplink/s/uplink-issue/a002o0000133Un1AAE/global-plastic-innovation-network?activeTab=Discover
- Mi Terro: sustainable and durable bio-based materials for packaging, textile, contact lenses, and many more. Using biomaterials that can be returned back to nature after it is used, leaving no harm to our environment; home compostable, water degradable or water-resistant, and 20-40% cheaper than other bio-based materials.

Further Resources:

1. Ocean literacy: http://oceanliteracy.wp2.coexploration.org
2. The Global Plastic Action Partnership (GPAP): a multistakeholder platform dedicated to translating commitments to reduce plastic pollution and waste into concrete action. Together, we believe it is possible to stop plastic pollution from source to sea and achieve the transition to a global circular economy.
3. The Alliance to End Plastic Waste: Ending plastic waste is ambitious. But it is through collaboration and collective action that this complex problem can be solved. Together with policy makers, nongovernmental organizations, and local communities, we are driving and delivering transformational change: to end plastic waste in the environment and protect the planet.
4. The Incubation Network : The Incubation Network sources, supports, and scales innovative solutions that tackle plastic pollution. Together with our diverse network of key partners, we work to optimize land-based plastic waste management and advance a circular economy in South and Southeast Asia. We are an initiative by The Circulate Initiative and SecondMuse.
5. World Economic Forum article on technologies for plastic pollution in rivers.
6. Blueprint for Ocean Climate Action:

Issue 8

The exploration and processing along with the spills and everyday use of petroleum products has led to widespread and long-term pollution of the marine environment. Society's decision to continue exploring for, extracting, processing and using petroleum products is unsustainable in the long term, and results in spills that hinder the resilience of ocean ecosystems in the short term.

Background

Petroleum pollution of the marine environment is well-known and documented across decades. The most visible impact is that of oil spills, notably the *Deepwater Horizon* oil spill in the Gulf of Mexico in April 2010. One of the key issues making fingerprinting oil spills intractable, even major ones like the Deepwater Horizon spill, is the prevalence of natural oil seeps within the same region. This makes it challenging to detect small or early leakage of oil spills and to hold petroleum companies accountable for the long-term effects of major oil spills. Furthermore, a related issue is the difficulty of assessing effective long-term remediation for petroleum and petroleum-derived products in the ocean. Petroleum being a complex mixture, marine pollution must be studied in the context of the environmental interaction of hundreds, sometimes thousands, of hydrocarbons that make up petroleum. This requires some energy transition: all the technical, economic, and human issues related to decommissioning existing offshore infrastructure, building new infrastructure, and meeting society needs for energy while reducing CO_2 emissions and other environmental impacts

Recommendations

- Limited interfaces between existing offshore oil and gas practitioners and newer offshore wind developers. Existing knowledge could accelerate development, and infrastructure may be repurposed for clean energy solutions. Require all platforms to develop plans to modify their existing offshore infrastructure towards sustainable energy alternatives - wind, wave, solar - within the next 20 years.
- Assess effective remediation strategies e.g., oil booms, skimmers, sorbents. Bioremediation is also of interest i.e., using algaes and bacterias to break down oils.

- Prevent the development and construction of new offshore petroleum extraction platforms and work to stop the cycle of petroleum reliance across society.

- Require all extraction / processing platforms to monitor the natural hydrocarbons in their region to ensure that spills are detected and mitigated early. Require platforms to contribute to a regional management fund that can use tools such as satellite monitoring and tracking to trace the source of natural hydrocarbons and of spills from other sources to ensure accountability.

- Investment in ocean based renewable energy systems using energy from wind, waves, currents, geothermal and ion exchange.

Case Studies

- Satellite Oil Spill detection

Further Resources

- https://illuminem.com/
- Reconversion of offshore oil and gas platforms into renewable energy sites production: Assessment of different scenarios https://www.sciencedirect.com/science/article/abs/pii/S0960148118315209
- Terrestrial oil spill mapping using satellite earth observation and machine learning: A case study in South Sudan https://www.sciencedirect.com/science/article/pii/S0301479721014869
- Monitoring oil spill in Norilsk, Russia using satellite data https://www.nature.com/articles/s41598-021-83260-7
- 10 Methods for Oil Spill Cleanup at Sea https://www.marineinsight.com/environment/10-methods-for-oil-spill-cleanup-at-sea

Issue 9

Commercial shipping emissions will continue to damage Earth's ecosystems as long as the cost of emitting is less than the cost of adopting clean technologies and operations.

Background

Commercial shipping emits harmful pollutants in many forms, including: greenhouse gasses (like CO_2); nitrogen oxide (NOx), sulphur oxide (SOx), and particulate matter; underwater and airborne noise; bilge water, scrubber water, and ballast water; waste water and food; metals from bio- and antifouling coatings; and invasive species. Studies are ongoing to measure the emission levels and their impacts for many of these areas. For instance, 3% of global GHGs (Global Greenhouse Gas) are attributed to shipping, and emissions are expected to rise by 16% by 2030 if there are no changes. Similarly, underwater ambient noise levels have doubled each decade since the 1970s and reductions are unlikely to be achieved by 2030.

There is an ongoing effort to regulate marine pollutants, most notably led by the International Maritime Organization's (IMO) convention for the Prevention of Pollution from Ships (MARPOL). However, these efforts fall short due to issues such as variations in regulations in different flag and port states, the high cost of refitting the large proportion of older vessels to meet modern standards, limited truly clean solutions that can be applied in a huge variety of conditions, and challenges in measuring and tracking the impact of any operational or equipment adaptations at an appropriate scale.

Recommendations

1. Make the cost of emissions higher than the cost of clean technologies. This effort must be supported both through regulation (tracking of emissions and levying of fines) and by subsidizing technology development and adoption.
2. Consolidate localized studies, initiatives, and oversight to capture global trends and expectations. International bodies must work to ensure a consistent regulatory environment across borders to prevent local regulations (e.g., speed limits, green corridors, emissions limits, and clean fuel stands) from being bypassed. The industry as a whole must move together to not force one region to bear the brunt of emissions as others require higher standards.

3. Enable measurement of impact on a smaller and more frequent scale so that change (negative or positive) can be recognized and timely adjustments can be made. This can include emissions monitoring in ports that every ship can use to establish their baseline levels without additional cost. There should also be mechanisms to publicize *wins* and critique *losses* so that reputational factors further drive reduced emissions.
4. Educate the public about the embodied energy of goods and allow customers to choose the right option for their needs. This might include the option of slower shipping in exchange for reduced carbon footprint.
5. Support research in transformative technologies. While incremental improvements like Liquid Natural Gas (LNG) fuels can be considered in the short term, transformative technologies will be needed. This includes: propulsion innovation (hydrogen fuel, wind assist, long-distance-capable electric?), route optimization (data analytics, weather forecasting, and autonomous navigation), noise reduction (cavitation reduction, active and passive noise control in structures and spaces, and maintenance protocols), invasive species mitigation in ballast tanks, and non-leaching antifouling coatings, among others.

Case Studies

1. Green Marine: a voluntary environmental certification program for the North America. (Link is to results of this program- plan to expand here summarizing case study).
2. Marine Protected Areas (Mongabay review of impact, PEW case for MPAs,WWF Effects of MPAs) (Links are to impact of MPAs in particular regions - plan to expand to summarize case studies here)
3. Wind Assist for Shipping (Bureau Veritas' review of early challenges for wind propulsion) (Link is to impact of wind propulsion adoption - plan to expand to summarize here)

Further Resources

1. Projections for future of CO2 in shipping under different policies: IMO CII targets
2. International Transport Forum "Pathways to Zero-carbon shipping by 2035"
3. Canada's road to shipping impact reduction: WWF Impact Report
4. J. Moldanova , I.-M. Hassellov, V. Matthias, et al., Framework for the environmental impact assessment of operational shipping. *Ambio,* vol. 51, pp.754–769, 2021.

5. World Economic Forum: Shipping Emissions Reduction Strategies and Call to Action

6. Hydrogen Fuel for Shipping (Vision for Hydrogen in Commercial Shipping, Lloyd's Register's Decarbonisation Hub)

7. W. J. Richardson, C. R. Greene Jr, C. I. Malme, and D. H. Thomson, Marine Mammals and Noise. Academic press, 2013

8. Readiness of Zero-carbon fuels for shipping industry, LR Findings - zero-carbon shipping fuel assessment (lr.org)

9. Climate impacts of LNG for shipping fuel The climate implications of using LNG as a marine fuel (theicct.org) (including need to address methane leakage)

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Farmlands and Grasslands, Mountains and Peatlands

> We are one with nature. We are not above it or separate from it.
> —Steven Nitah, Chief of Łútsël K'é Dene First Nation

In 2022, society recognized the need to bring all humans together to care for our lands that required immediate collective action. As American environmentalist Paul Hawken said of addressing our climate emergency, "The impotence of individual actions is exactly the reason for everyone to try."

Emboldened by the support from the public, businesses, and governments, now in 2030 we have a world where a third of all farms have transitioned to regenerative agriculture practices. We no longer seek to exploit land for short-term profit, but better understand our role as healers of the land. Forests are seen as life sustaining ecosystems. Rather than cutting them down, we harvest only what we need. As a result, a significant boost in biodiversity has been measured across farmlands, forests, and the adjoining grasslands. People enjoy safe and tasty food that is grown in healthy, naturally regenerated soil. Soil carbon sequestration and the reduction of greenhouse gas (GHG) emissions have increased the overall value of the farms that made the transition. Furthermore, these farms have also avoided the cost of fuel and fertilizers, which has plagued the rest of the agricultural sector in the last decade. In 2030, we have each established ties between our community and land stewards, creating relationships that are co-caring over transactional.

Issue 1 - Agricultural impacts on land

Farming practices that destroy biodiversity undermine human survival

Background

Farmlands and grasslands are vital ecosystems. They supply food, fiber, and fodder and host countless organisms. However, degrading soil and vegetation and excess agrochemicals and other pollutants are depleting their vitality [1].

Intensification of farmland is increasing. Small farms (less than 2 ha) produce roughly 35% of the world's food. The largest 1% of farms (those larger than 50 ha) operate more than 70% of the world's farmland [2].

Grasslands are one of the most widespread of all major vegetation types in the world. They occur in environments conducive to the growth of this plant cover but not that of taller plants [3]. Ongoing degradation and the capacity to support biodiversity, ecosystem services, and human well-being place them under severe threat [4].

- Farmland now counts x% of dead zones, where biodiversity has been exterminated both in the soil and on the ground (citation).
- Tilling has been proven to cause [soil erosion]… (citation)
- Lack of crop rotation causes… (citation)
- Pollution of aquatic and terrestrial systems (nitrogen, phosphate) is a major issue (citation)
- Residue of pollutants, chemicals, and antibiotics in food found … (citation)

Recommendations

1. Provide education to reach farmers and codesign with them a shift from industrial agriculture models to regenerative agricultural models [5].

2. Incentives to allow this transition to happen may include the following:

    a. Increase lands farmed organically by 25%
    b. Reduce pesticide use by 50%
    c. Reduce fertilizer use by 20%
    d. Increase sustainable or biostimulant fertilizer use by x%
    e. Reduce use of antibiotics for livestock use by 50%

   f. Residue-free foods

3. Funding available for regenerative agricultural, conservation, and sustainable farming-related projects:
   a. Secure funding for transition
   b. Set targets for X% spending towards local and sustainable food in schools and hospitals

4. Tools for soil and water regeneration, solutions, frameworks, and markets for farmers:
   a. Set targets for regenerative and organic content in institutional food programs

5. Implement a cross-industry, closed-loop farming system.
   a. Upcycle waste from partnering F&B industries to use leftovers as fertilizer to reduce the need for and costs of chemical fertilizer
   b. Form a direct communication channel between farmers and retailers to exchange information about harvest conditions and market demand

Further Resources

1. UNEP 2022. Ecosystem Restoration Playbook - A practical guide to healing the planet. [online] Available at: https://unenvironment.widen.net/s/ffjvzcfldw/ecosystem-restoration-playbook [Accessed 30 June 2022].
2. Lowder, S., M. Sánchez, and R. Bertini, “Which farms feed the world and has farmland become more concentrated?” *World Development*, vol. 142, p.105455, 2021.
3. Smith, Jeremy M.B., "grassland". *Encyclopedia Britannica*, Mar. 13 2020, https://www.britannica.com/science/grassland. Accessed 30 June 2022.
4. Bardgett, R., J. Bullock, S. Lavorel, P. Manning, U. Schaffner, N. Ostle, M. Chomel, G. Durigan, E. L. Fry, D. Johnson, J. Lavallee, G. Le Provost, S. Luo, K. Png, M. Sankaran, X. Hou, H. Zhou, L. Ma, W. Ren, X. Li, Y. Ding, Y. Li, and H. Shi, “Combatting global grassland degradation,” *Nature Reviews Earth & Environment*, vol. 2, no. 10, pp. 720-735, 2021.
5. Hilimire et al (2014) Food for Thought: Developing Curricula for Sustainable Food Systems Education Programs, Agroecology and Sustainable Food Systems, 38-6, pp722-743
6. https://ourworldindata.org/environmental-impacts-of-food
7. https://www.nrdc.org/stories/industrial-agricultural-pollution-101
8. https://foodprint.org/the-total-footprint-of-our-food-system/issues/food-and-the-environment

Issue 2 - Using ancestral wisdom to sustain land

Voices of Indigenous people and their ancestral wisdom have been sidelined in our relationships with lands, resulting in further exploitation.

Background

- For centuries, Indigenous peoples have stewarded the land, sustainably providing for themselves and their communities for future generations: ranging from the arctic tundra of the Inuit in Canada; the lush rainforest of the Manobo in the south of the Philippines, or the desert of the Maasai in Kenya.
- Presently, Indigenous peoples only make up 5% of the world's population, yet protect 80% of the world's biodiversity in forests, deserts, grasslands, and marine environments.
- Unfortunately, the effects of colonization have largely marginalized Indigenous Peoples, systemically silencing and oppressing these groups from participation in governance and stewardship of the land.
- In extreme cases, this has led to genocide; today, the effects linger as generational trauma through displacement, loss of culture, values, and ultimately a fractured relationship with the land that was once stewarded by their peoples.

Recommendations

1. Learn the history of the lands that you live and work on..
    1. If you are on colonized lands such as the United States, recognize that your country has historically benefitted and continues to benefit from the ongoing colonization of Indigenous peoples.
    2. If you are not on colonized lands, recognize the Indigenous peoples of your country whose traditional livelihoods and stewardship of land may be threatened by the interests of the nation state or corporations.
    3. Consult histories written, spoken, and performed by Indigenous authors.
2. Work towards decolonization, through amplifying and supporting Indigenous peoples
    1. Respect Indigenous leadership and sovereignty
    2. Build meaningful alliances and collaborations with respective Indigenous peoples
3. Implement the United Nations Declaration on the Rights of indigenous People (UNDRIP)

Further Resources

1. https://www.vox.com/22518592/indigenous-people-conserve-nature-icca
2. Native land https://native-land.ca/
3. UNDRIP https://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

4. Allyship https://theantioppressionnetwork.com/allyship/
5. Braiding Sweetgrass, Robin Wall Kimmerer

Issue 3 - Extraction of land resources

Changes in land use—deforestation, land clearing, mining, and depletion of freshwater resources—are a major driver of climate change and are unsustainable.

Background

- Energy production relies on exploitation of resources which has left areas inhabitable. Renewable energy production has similar impacts on the environment [1].
- Progress to safeguard key biodiversity areas has stalled over the last five years with just 43% terrestrial, 42% freshwater, and 41% mountains covered by protected areas [2].
- Invasive alien species negatively affect native biodiversity and cost the global economy billions of dollars annually (citation).
- Progress has been made toward sustainable forest management, but the world has lost 100 million hectares of forest in two decades (citation).
- Climate and ecosystem change has been accelerated by unsustainable practices and has contributed to the increased prevalence and intensity of extreme weather events—such as droughts and floods—and of damaging invasive species—such as locusts—all of which are devastating to land stewards and farmers.

Recommendations

1. Set targets for soil carbon sequestration.
   a. Protect 30% of the land from traditional economy
   b. Work towards valuation of natural capital
2. Support healthy and sustainable diets.
   a. Reduce meat consumption and land clearing and deforestation linked to grazing
3. Manage farms as systems.
   a. Establish nitrogen and phosphate cycles as a system rather than within the boundaries of the farm only
4. Lift the pressure of protein demand from animal raising.
   a. Promote alternative proteins such as cultivated, plant-based, and fermented protein
   b. Encourage protein diversity to ensure health and nutritional balance
   c. Liberate freshwater reservoir and arable pastureland for regenerative agricultural development

5. Support technologies that provide alternatives to traditional farming product in restoration of biodiversity.
    a. Replace animal leathers and wooden products with novel materials (e.g., fermentation-derived materials)
    b. Support research and development (R&D) of cultivated meat in replacement of traditional animal meat

Further Resources:

1. Shamoon et al (2022) Environmental impact of energy production and extraction of materials - a review, Materialstoday proceedings, Vol.57, Part 2, pp. 936-941

2. Sun et al (2022) Global Human Consumption Threatens Key Biodiversity Areas,

Issue 4 - Capital investment in land sustainability

Smallholder farmers lack access to capital, resources, stable markets, and general infrastructure to develop sustainable practices and build agro-economies.

Background:

- *Technology:* 90% of the smallholder farmers do not have access to smartphones, and it makes it difficult to access markets for their agricultural produce.
- *Capital:* Traditional financial institutions do not trust smallholder farmers, which disables their ability to invest in more sustainable agricultural practices.
- *Markets:* Local and smallholder farmers must often walk from 8 km to 10 km to reach the market, and they mostly carry their produce on their heads. They lose up to 40% of their harvest during the postharvest (Norman Mugisha).
- *Capacit*y: Most smallholder farmers across the developing world still practice subsistence farming, whereas sustainable agricultural practices [1].
- As rural poverty increases, young people are driven into cities in search of employment, further deepening poverty cycles in the rural areas and increasing the difficulty of community revitalization.
- In some countries, agriculture continues to be the main source of employment, livelihood, and income for 50% to 90% of the population. Of this percentage, small farmers make up the majority, as much as 70% to 95% of the farming population [2].

Recommendations

1. Mobilize capital more efficiently by using surgical microfinance on subnational and community-based levels.
   a. Research from the *World Development Journal* found agricultural growth to have two to three times more impact on poverty reduction than equivalent growth in other industries.
   b. Community-based capital allocation would remove intermediaries and ensure that more resources go to farmers and land stewards.
   c. More capital in the hands of smallholder farmers de-risks their agribusiness risk and inspires innovation.
2. Concentrate efforts to bridge the digital divide and alleviate energy poverty for smallholder farmers and rural agricultural communities through enabling technologies such as mobile phones, decentralized finance, and microgrids.

   a. Giving smallholder farmers access to information about buyers and sellers through the internet would exponentially increase their revenues and reduce inefficiencies.
   b. Decentralized finance and peer-to-peer lending would decrease smallholder farmers' reliance on external (and sometimes misaligned) actors and unlock new avenues of sustainable agribusiness financing.
   c. Tapping into the abundant clean energy potential for smallholder farmers and providing reliable electricity access can serve as a foundation for other enabling technologies.

3. Invest in human capital development for rural agrarian communities along with skills promotion and technology integration.
   a. Given the opportunity, smallholder farmers can pursue sustainable farming practices and develop their own innovative methods
   b. Increased human capital and training helps smallholder farmers de-risk their subsistence operations and could provide sufficient incentive to adopt more sustainable practices.
   c. Investing in human capital enables knowledge transfer within communities, across subsectors, and between generations.
   d. Helping smallholder farmers adapt to and integrate new technologies further reduces their reliance on external parties and induces exponential and network effects.

Further Resources:

1. https://borgenproject.org/sustainable-farming-in-developing-countries/

2. https://www.iatp.org/sites/default/files/Agriculture_in_Developing_Countries_Which_Way_.htm

Issue 5 - Labor and Land

Plantation models persist in industrialized agriculture, leading to human labor exploitation [1].

Background

There is a high degree of correlation between resource aggregation into the hands of a few (consolidation of land and water rights) and human exploitation in terms of migrant wage labor. This has a direct impact on community health and economy (See Arvind-Dinuba study) [2].

Recommendations

Further resources

1. Examples: Brassero History (California), Africans in Spain, Pacific Islanders in Australia

2. Book, In the Struggle by Daniel O'Connell

Issue 6 - Human consumption overshoots the planetary boundaries

As human consumption grows, there is immense pressure on existing ecological safe heavens, particularly rainforests, to yield to economic pressures.

Background

The need to feed 7 billion people by 2050 is pushing a rethink of the type of diets we should adopt to operate within the capacity of the planet and to support a healthy population [1]. Further, food waste globally represents over 30% representing a waste of a quarter of all the water used by agriculture and 8% of global greenhouse gas emissions [2].

Current models in countries like the USA where sprawling suburbs encroach on arable lands, grasslands and forests are not sustainable.

Recommendations

Food waste and food loss mean that over 25% of all food produced globally is wasted before it reaches the people it needs to feed. Reducing food loss and food waste would help alleviate poverty, generate benefits for women, avoid agricultural expansion into natural ecosystems, help reduce greenhouse gas emissions and would help to not deplete or pollute aquifers [3]

Further resources

1. Willet et al, 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems, The Lancet
2. Target 12.3 | Champions 12.3 (champions123.org)

Issue 7 - Land for all living creatures

Tech approach to facing the challenges is at best human-centered and does not include the voice of non-humans, environment (solutionism)

Background

Digital divides and the choice of ICT non-use, dominant groups versus marginalised groups are important barriers to using technologies (ICTs) which have the potential to support food, land and water systems [1].

Solutions are created and developed not from a place of "context" but from a place of "imagined empathy" [2]. Further, technologies are pushed from the global north in a new form of colonialism which does not respect local viewpoints and reinforces current power structures [3].

Recommendations

Further resources

1. Ng M; de Haan N; King B; Langan S. 2021. Promoting inclusivity and equity in information and communications technology for food, land, and water systems. CGIAR Platform for Big Data in Agriculture, Cali Colombia
2. Morozov (2013) To save everything, click here
3. Mohamed et al (2020) Decolonial AI: Decolonial theory as sociotechnical foresight in artificial intelligence, Philosophy and Technology

Issue 8 - Transition challenges in land management

Transitioning to and scaling sustainable farming is fraught with challenges

Background

Farming (dominated by industrial interests) is incredibly inaccessible to new entrants who may have new ideas/ more sustainable approaches. Smallholder farmers do not have the same level of access to technologies that boost productivity and crop resilience.

In many countries, smallholder farmers lack access to capital, resources, stable markets, and general infrastructure to develop sustainable practices, livelihoods and build agro-economies. They face economic challenges which puts their livelihood and existence at risk.

Transitioning farming practices is risky business- how are addressing the immediate cost hurdles? Furthermore, climate change solutions are about scale and smallholder farmers are a fragmented sector. Economic incentives are needed to incentivise the transition to sustainable agriculture.

Food is produced within business models that are incompatible with net positive impacts and meaningful ESGs. There are no incentives for industrialised agriculture and shareholders to change practices leading to a lack of scale in transitions. Consumers have an illusion of choice when in effect 70-80% of grains are produced by 4 companies globally, 60% of agricultural seeds and agricultural chemicals are produced by just three companies [1]. Change among the concentration of suppliers is as or more important as the change made by individual consumers.

Recommendations

Further resources

1. Harvey (2022) Food price rises around the world are result of ‘broken’ system, say experts, The Guardian Environment, https://www.theguardian.com/environment/2022/aug/24/food-price-rises-around-the-world-are-result-of-broken-system-say-experts?amp;amp;amp

Issue 9 - Upstream prevention over downstream mitigation

Consumers are unaware of the impact their decisions have on land sustainability.

Background

The cost of environmental degradation is invisible to consumers and very little knowledge on how their choices impact it. How do we bring that to the center of consumers' everyday decisions? There is an extreme lack of transparency into food systems. We have done a good job of highlighting best in class cases, but the everyday customer has no visibility.

While cleaner production and reduction of waste post-production is increasingly being questioned, levels of consumptions are rarely discussed. For example, we are being told that we need to replace our cars with electric ones without thought of not needing to use cars at all; or, without considering the overall increase in human toxicity of producing such cars versus the lower overall greenhouse gas emissions . Considerations which highly affect land use and human health.

Recommendations

Further resources

1. Shrey Verma, Gaurav Dwivedi, Puneet Verma, Life cycle assessment of electric vehicles in comparison to combustion engine vehicles: A review, Materials Today: Proceedings, Volume 49, Part 2, 2022, Pages 217-222

Issue 10 Pollution affecting food supply security and safety

Pollution – including from farming itself – reduces yields and food safety.

Background

[Climate change is generally bad for food security] Effects of climate change, such as extreme temperatures, droughts, rains, and weather events negatively affect the security of the food supply chain.[2,3]

[Pollution, is bad for both security and safety] Pollution is a specific

Affecting supply yield, security:

- Ammonia, nitrogen (affecting soil) [1]
- Ozone (reducing plants' ability to develop)[1,2]
- Black carbon in fine particulate matter PM2.5 (covers leaves - heats up plant, prevents photosynthesis)[2]

Affecting safety:

- "Forever chemicals"/"everywhere chemicals"
- Microplastics[5]
- Pesticides
- Herbicides[4]
- Fertilizers
- Runoff from animal waste
- Machinery (eg. oil, gas, diesel, industrial lubricants, coolants, etc.)

Recommendations

Further resources

1. Air pollution and food production
https://unece.org/air-pollution-and-food-production
"[Ammonia and nitrogen compounds] affects soil quality and thus the very capacity of the soil to sustain plant and animal productivity."
"Ozone precursor emissions (nitrogen oxides and volatile organic compounds) are of particular concern for global food security as these compounds react to form ground-level ozone. This, in

turn, penetrates into the plant structure and impairs its ability to develop. Ozone was estimated to cause relative global crop losses for soy 6-16%, wheat 7-12% and maize 3-5%. At a European level, a study in 2000 of the economic losses due to the impact of ozone on 23 crops amounted to 6.7 billion Euros."

2. Short-lived climate pollutants and food security

https://www.ccacoalition.org/en/content/short-lived-climate-pollutants-and-food-security
"A warmer climate adds many challenges to food production. There is an increase in pests and diseases, and more frequent and extreme droughts and floods. Heat-stress causes poor yields, or worse, crop failures. Together these impacts put pressure on domestic and global food systems, and increase the likelihood of supply chain disruptions and competition for increasingly limited resources."
"Air pollution stunts crop growth by weakening photosynthesis. Tropospheric ozone alone causes annual losses of approximately 110 million tonnes of major staple crops: wheat, rice, maize and soybean. This represents around 4% of the total annual global crop production, and up to 15% in some regions."
"Black carbon (a component of fine particulate matter or PM2.5) also harms crops when it covers their leaves, where it absorbs more sunlight and increases the plant's temperature. While in the atmosphere, black carbon affects plants by reducing the amount of sunlight that reaches the earth and disrupting rainfall patterns."

3. Special Report - Climate Change and Land

https://www.ipcc.ch/srccl
"four pillars of food security: availability, access, utilisation, and stability"
"Observed climate change is already affecting food security through increasing temperatures, changing precipitation patterns, and greater frequency of some extreme events"

4. Roundup Lawsuit Update August 2022

https://www.forbes.com/advisor/legal/product-liability/roundup-lawsuit-update
"Studies have shown that the chemical might cause illness to humans and cause damage to the environment. The International Agency for Research on Cancer categorizes glyphosate as possibly carcinogenic to humans—essentially, the IARC is saying this toxin may cause cancer."
"A study from the University of Washington found that exposure to glyphosate increased an individual's risk of non-Hodgkin's lymphoma by 41%."

"The CDC recently released findings that up to 80% of Americans may have traces of Roundup in their urine, showing they have been exposed to it. Considering that 200 million pounds of Roundup are sprayed annually on U.S. crops, it is not surprising most of the population has been exposed to it."

5. What do we know about microplastics in food?

https://www.medicalnewstoday.com/articles/what-do-we-know-about-microplastics-in-food
"The microplastic chemicals present in food are a mixture of those that manufacturers deliberately add, such as fillers and stabilizers, and those that accumulate as byproducts, such as residues and impurities."
"Using eco-friendly packaging reducesTrusted Source the exposure to and migration of microplastics in the food supply." ← Food producers (farmers) must invest $$ to do this

Committee Members:

David, Elliot (Chapel Hill, North Carolina)
Kirtland, Colleen (Santa Ana, California)
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Liu, Ran (Palo Alto, CA)
Mugisha, Norman (Rwanda)

While he is not on our committee, members would like to extend a special thanks to Steven Nitah, tribal chieftain to the Lutsel K'e Dene first nation for providing a compass of the heart

Human Wisdom and Culture

It is 2030. While human wisdom and culture have been instrumental in transforming collective consciousness for millennia, in 2022 a worldwide cultural evolution took place where humans universally took a holistic and embodied shift to become stewards and caretakers of life and nature. All concepts, designs, and implementations of sustainable and regenerative efforts are now prioritized as being in service to life, not simply humans.

We need to prioritize the focus for any sustainable initiatives in the transformation of the mindset, culture, and society before any technological and infrastructure transformations are developed and implemented. The culture and mindset of any society has a major impact on the society's infrastructure and governance.

The current prevalent culture in 2022 appeared to be largely informed by the illusion of control and separation. The by-product of this illusion led many in the global society to adopt self-interest, competition, exploitation, infinite growth through the extraction of natural resources, and consumerism which focused mainly on the interests of human comfort and lifespan.

But humans are at once creators and destroyers of the realities they choose to live in. Many parts of the world, especially financially wealthy nations, promoted materialism, competition, and separation in the past. Advances in scientific discovery helped better understand the physical environment, leading to improved standards of living for a portion of humanity. This leads financially wealthy civilizations to use these advancements to accelerate and support belief systems that were not sustainable, were destructive and used to manipulate.

The shift in consciousness that took place in 2022 was not about canceling or erasing scientific discoveries over the previous centuries. Rather, the aim was to seek and situate scientific materialism in alignment with non-materialism and healthier ecosystems. These ecosystems include dimensions that can open humanity's eyes, scientific instruments and future thinking.

While honoring the insatiable quest to learn, discover, and grow, society recognized it would be well served to summon humanity's inner wisdom and learn to trust what might be too expensive and resource extractive to even measure and visualize using instruments outside of human senses.

There are limitations in relying solely on the material/physical realm to give answers[307]. Scientists explain that we understand just 5% of everything that exists (the material world)[308]

Society recognized the need to answer some key questions from the non-material and non-physical realms such as: just because humanity might be able to build a spaceship to try and find another planet to live on, should they? Just because humanity can build an amazing AI to monitor the thoughts and actions of people, how does all this advanced computation serve the human collective, especially if millions lack basic necessities?

Human wisdom mindset is not gained through calculation as much as it is received through insight, where for brief glimmers, humanity is open to the connection people share with all living beings around them. It takes much work and skill to de-program and quiet people's chattering minds. A part of humanity has diminished in cultural beliefs and now values things like unlimited economic growth, unhealthy competition, and the exercise of individual will.

On the other hand, when everything is interconnected, for better or for worse, everything and everyone matters. People are intrinsically interconnected to all living species that came before us and evolved over 4.5 billion years for humans (Homo Sapiens) to come into existence in the last 200,000 years, as demonstrated in this graphic below:

[307] NASA (N/A) Dark Energy, Dark Matter , NASA Science https://science.nasa.gov/astrophysics/focus-areas/what-is-dark-energy
[308] Noor Al-Sibar (2022) Inside NASA's Bold Proposal to Probe the Mysteries of Dark Matter, Futurism, https://futurism.com/scientists-dark-matter-probe

4.5bn Evolution of Earth in 24-hours

Most images are free Creative Commons images from Pexel.com. The images for the Moon, Life Origin and Reproduction are respectively credited to Science.org (Tobias Roetsch), News-Medical.net (Christoph Burgstedt) and H.educate.in site.

The deep knowledge of the interconnectedness of all things is held within the ancestral (indigenous) wisdom from generation to generation to this day. This specific human wisdom standard the survival of every human being to the wholeness of nature and its elements that support life.

Ancestral wisdom holds collective knowledge of the land, sea, and sky, and deepens understanding of how life naturally evolves and its impacts (i.e. climate change) for livelihoods, cultures, and ways of life. It provides the concrete situations of communities in relation to the environment and provides practical solutions on how to adapt to ever-changing climates and environments, and how to act sustainably and regeneratively in order to co-create conditions for life to continuously evolve.

Therefore, human wisdom involves integrating ancestral wisdom as well as modern wisdom to protect the planet and all life's existence that humans depend on while advancing into the future of human prosperity and sustainable development. There needs to be an intentional raising of awareness of the wisdom traditions of multiple indigenous communities and first nations around the world; and their relevance in future technology for the benefit of humanity, nature, and life itself.

The intent of this shift of consciousness that happened in 2022 was to evaluate various concepts, perceptions, beliefs, and technical abilities of ancient and current cultures, into sustainable development activities, and educational outreach programs. This effort was and is an attempt to provide general guidance and influence, not to intervene in local policies and/or existing educational programs.

Finally, we recognized that regardless of policy acceptance or not, an effort should be made to preserve and promulgate these advanced skills, applied science, and planet positive initiatives; and to explore how integrating them into our human development cycle(s) could be beneficial in solving technology challenges facing our current and future societies. We recognized that the human element was missing.
.

The invitation in 2022 was a humanity-soul-enhancing journey to transform scientific materialism through humility to surrender and trust unknown spaces, where all is united in its diversity, where a loss of "self" became our greatest teacher and guide, and we collectively shifted humanity's consciousness and culture towards more alignment in how life and nature actually evolves.

Issue 1: Expand Mindset

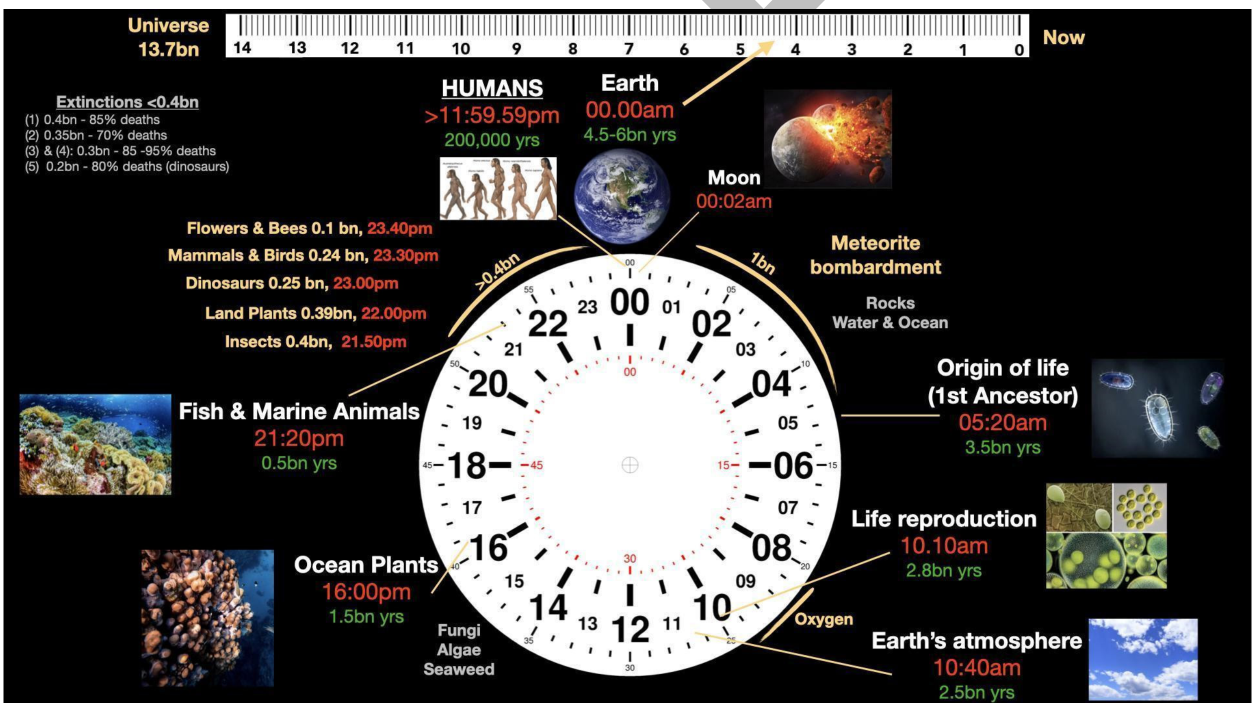
Illusion of the role of humans in the 4.5bn evolution of earth

Background:

Humans evolved from all the living species that existed and evolved during 4.5 bn history of earth. Earth itself evolved within the 13.7 bn years of the Universe's evolution.

In the last 0.4 bn years (400 million years), there have been 5 extinctions that scientists are aware of and at every extinction, about 70 to 95% of all living species died. The last extinction eradicated all the dinosaurs.

This appears to be the regenerative lifecycle of life. It seems that death and life are inherently interconnected within Earth's evolution in which death becomes compost for the new.



4.5bn Evolution of Earth in 24-hours

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Humans (Homo Sapiens) only came into existence 200,000 years ago, only a micro-second before midnight if earth's evolution of 4.5bn years were equal to a 24-hour clock. It took over 4 bn years of our ancestors evolving, all living species, for humans to come into existence.

In the last 200,000 years, it is only in the last 500 years where technology advanced rapidly. The advent of farming and agriculture transformed Earth's natural landscapes, locally and globally. As humans settled down because they were able to produce their own food, more food was available so human civilization flourished and the human population began to increase dramatically.

Indeed, human wisdom is relatively new in the greater scheme of the Earth's 4.5 bn evolution. Yet, there appears to be an illusion that humans are the dominant species on earth with the illusion of control and separation to life and nature.

The traditional ancestral (indigenous) wisdom and life pathways such as the aboriginals of Earth are cognizant of its place in the history of Earth, and as such, live accordingly as caretakers of life and nature.

Recommendation:

To change any ecosystem may require all the ecosystem participants to change consciousness to ensure the new system is not informed by the mindset and culture that created the old system. There is a need to unlearn our illusions that humans are in control or are separate from nature and the evolution of Earth so that human culture consciousness shifts to one of guardians and caretakers of life and nature.

List of recommendations:

- Transform consciousness: One needs to make the system visible unto itself in order for the system and its participants to be response-able in co-creating a new system from a shift in consciousness.
- Learn from the existing caretakers of life and nature: indigenous peoples (aboriginals), their wisdom, and life pathways.
- Humans are nature. Experiment and embrace a culture in all our thinking, being, and doing that is aligned to the flourishing and lifecycle of life and nature.

Further Resources:

- Age of Earth (National Geographic)
- History of Earth (Earth.com)

- P. James E. Peebles, David N. Schramm, Edwin L. Turner, Richard G. Kron (1994)1994. The evolution of the Universe (Scientific American)
- Scott Dutfield (2021). The 5 mass extinction events that shaped the history of Earth — and the 6th that's happening now (Live Science) .
- Leslie A White (1948) Man's Control over Civilization: An Anthropocentric Illusion Vol. 66, No. 3 pages. 235-247 https://www.jstor.org/stable/19284

- Claus-Christian Carbon (2014) Understanding human perception by human-made illusions Front Hum Neurosci. 2014 Jul 31;8:566.
- Tom Oliver (2020) The illusion of individualism helped us succeed as a species – but now the scales are tipping, BBC Science Focus Magazine
- John Gray (2004) An illusion with a future, Dædalus Journal of the American Academy of Arts & Sciences p. 10

Issue 2: Understand Our Story

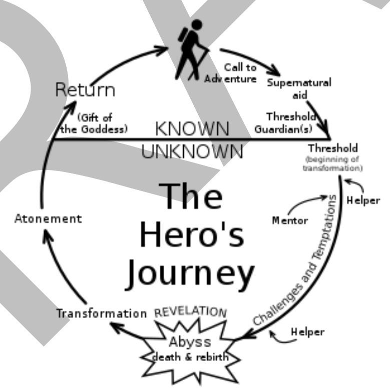
Lack of understanding of our common regenerative and sustainability story

Background:

We as humans love stories. Stories uphold our social systems, help us find common understanding, and support trust. The systems that are destroying our planet are also upheld by a story continually reinforced in our culture, our media.

If we can find a way to change our collective story, we can change our collective consciousness. Joseph Campbell's Hero journey showed the commonalities in our human journey through tracing the commonalities in myths in cultures throughout the world. We can attempt to change our broken system by charting the similarities in the human experience to bring about a changed mindset and a collective consciousness as it relates to our common regenerative sustainability story.

We have a common globalized understanding about our economic system, money, our capitalist system which we all partake in. This can be described as a global story, yet there are other stories that are common to us all, found in all cultures with varying twists.



Campbell, Joseph (1990) - Wikipedia article on MONOMYTH (4/11/2016): unknown publication by an anonymous poster, in a thread, gave permission to use it. Re-drawn by User: Slashme

Recommendation:

Working collectively, we can identify similarities of sustainability issues in varying countries and communities to create a common story that supports a shift in our understanding of our relationships to all life. Doing so may also help to shift our collective story from one that prioritizes unlimited growth and exploitation of life to a story that does not recommend growth at all costs and prioritizes a harmonious ecosystem.

List of recommendations:

- The Hero's journey template/methodology may also be adapted to chart the stages we are going through with a view to a positive sustainable transformation.
- Share and socialize this story with other organizations, while allowing for feedback from others to refine it and help to change mindsets towards collective sustainable change

Further Resources:

- Bernier (2019,) Sustainability Storytelling is Not Just Telling Stories About Sustainability -
- Wedner et al, (2020) Sustainability as Cognitive "Friction": A Narrative Approach to Understand the Moral Dissonance of Sustainability and Harmonization Strategies
- Campbell Joseph (1990) A Hero's Journey
- Children, myth and storytelling: An Indigenous perspective
- State of the World Indigenous Peoples, United Nations
- Robson, D (2018) Our fiction addiction: Why humans need stories, BBC
- Bekhrad, J (2018) The 100 stories that shaped the world, BBC
- Judy Iseke (2013) Indigenous Storytelling as Research, International Review of Qualitative Research, Vol. 6, No. 4 (Winter 2013), pp. 559-577 (19 pages)
- Adrienne S. Chan (2022) Storytelling, Culture, and Indigenous Methodology, In: Discourses, Dialogue and Diversity in Biographical Research, An Ecology of Life and Learning, pg. 170–185
- Sasha Starovoitov (2021) Narrating Landscapes: How Indigenous Storytelling Can Unlock Our Environment's Past, State of the Planet
- World Economic Forum (2021) How can indigenous knowledge help us create sustainable food systems?
- Maria Hofman-Bergholm (2022) Storytelling as an Educational Tool in Sustainable Education Sustainability 2022, 14(5), 2946;
- Fernández-Llamazares Á, Cabeza M. Rediscovering the potential of indigenous storytelling for conservation practice. Conservation Letters.

Issue 3: Anti-Materialistic Worldview

The existence of a materialistic world order devoid of wisdom-centric philosophical worldview has, inter alia, profoundly affected the environment.

Background:

The crisis that has engulfed the present society is the result of human being's continuous desire to 'move forward' at the expense of the nature around them. Hence, there is an urgent need to bring about a radical change in the philosophy underlying the above by putting nature before thinking about 'oneselves'. The harmonious integration between human beings and nature is possible when the entire universe is seen as a one single family, including the ecosystem comprising myriad flora and fauna.

Recommendation:

Provide education at multiple levels and institutions globally, beginning at young ages that demonstrate how caregiving-oriented economics and sustainability lead to a shift in consciousness and action leading to holistic planetary and human health.

List of recommendations:

- While taking a decision that has a bearing on nature, it is imperative to include the latter in the discussions in the initial stages;
- While devising a strategy, it is necessary to look at the world from a broader perspective instead of looking at it through a narrow and hollow 'self-centered' lens; and
- Adopting a holistic approach.

Further Resources:

- Surjya Kamal Borah (January, 2012). Ancient Indian Wisdom and Sustainable Development, Quest-The Journal of UGC-HRDC Nainital, researchgate.net.
- Ali Intezari (November, 2015). Integrating Wisdom and Sustainability: Dealing with Instability, researchgate.net
- Amr Al Madani (March 04, 2022). What can ancient wisdom teach us about sustainability?, World Economic Forum

Issue 4: Human Bias

Bias of Duality (Either/Or) Thinking. (Rethinking what is technology????? Is this a good alternative given what I added? Maybe this can go as a suggestion for guiding principles?)

Background:

There is a consistent bias in decision making processes where most problem-solution efforts must be one or the other, simplifying options to traditional human wisdom vs modern (technological) wisdom. Indeed much of modern technology have as their foundation traditional human wisdom and in varied forms continue to be influenced by it. For, all are interconnected and interdependent of each other as aligned in how life naturally works.

Recommendation:

Work via transdisciplinary means with diverse population representation to identify how communities can endorse, promote, and embrace duality-efforts to implement sustainable solutions for the greater good where both human and technology wisdom can collaborate in sync and human wisdom itself can be viewed as technology in itself.

List of recommendations:

- Promote active participation/workshops in learning and documenting traditional peaceful behaviors by individuals and societies. Particular attention could be given to human responsibilities/roles applied by first nations and indigenous peoples; especially those that could be scalable to other communities and processes.
- Implement history and human wisdom educational and recovery programs. Knowing what has worked or what hasn't worked in other communities, and/or in different times in history. These programs should help us acquire more experience and skills to resolve our current and future tasks at hand. This concept applies to hard (technical) skills as well as to soft skills, such as human wisdom.
- Outreach educational programs on Human Wisdom, acknowledgement and realization of deeper self-knowledge and our impact on others and the environment.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Morales, Gerardo E. "The Book of the Mamus. Notes on the History, Geography and Wisdom of a Culture of Peace and Ecological Harmony". "El Libro de los Mamus, apuntes sobre la Historia, La Geografía y la Sabiduría de una Cultura de Paz y Armonía Ecológica"

- Ernesto, Janica Vega,. "Pueblo Iku: Science, Nature and Art of the Arhuaco".
- International Telecommunications Union (2021) Indigenous-led tech solutions for a better planet
- R. A, Hodgkin,. "Techne, Technology and Inventiveness." Oxford Review of Education 16, no. 2 (1990): 207–17.

Issue 5: "I Am Because We Are"

Incorporate Ubuntu philosophy to map connectivity and show links between actions

Background:

Ubuntu, a Nguni word means 'I am because you are' and originates from South Africa. A person's identity is linked to others, to community. This concept resonates with the sustainability crisis. However, there is not enough emphasis on just how much this is so. Someone in charge of a big corporation that ravages poorer communities may have thwarted through their business and their decisions someone from a vulnerable group that may have under different circumstances been the missing link helping to find a cure for the disease that plagued their loved family member. This holds true for sustainability in general. The actions of a corporate head may cause them and their family tremendous pain. Yet these dots are not usually connected. Indeed, this is also physics because for every action there is an equal and opposite reaction.

Recommendation:

Design a methodology that incorporates Ubuntu for sustainability.

List of recommendations:

- Explain through a type of system thinking how those who perpetuate the most harm will also be severely affected.
- Move beyond the Western human centric perspective to illustrate this at the ecosystem level

References:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Sabelo, Mhlambi, (2020) From Rationality to Relationality: Ubuntu as an Ethical and Human Rights Framework for Artificial Intelligence Governance, Carr Center Discussion Paper Series, Harvard Kennedy School.

- TC. Danford (2016) Ubuntu is Not Only about the Human! An Analysis of the Role of African Philosophy and Ethics in Environment Management, Journal of Human Ecology, 53:2, 157-166,
- Edwin, Etieyibo (2017) Ubuntu and the Environment. In: Afolayan A., Falola T. The Palgrave Handbook of African Philosophy. Palgrave Macmillan, New York.
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- Archbishop Emeritus Desmond Tutu Eco-Ubuntu
- Jacqueline Church (2012) Sustainable Development and the culture of uBuntu
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- Ephraim Gwaravanda, (2019). Ubuntu Environmental Ethics: Conceptions and Misconceptions. In: Chemhuru, M. (eds) African Environmental Ethics. The International Library of Environmental, Agricultural and Food Ethics, vol 29. Springer, Cham.
- Shumba Overson (2011) Commons thinking, ecological intelligence and the ethical and moral framework of Ubuntu: An imperative for sustainable development Journal of Media and Communication Studies Vol. 3(3), pp. 84-96, March 2011.

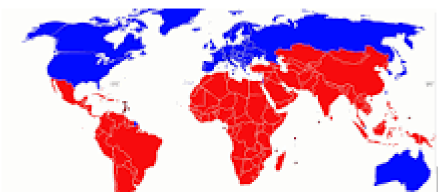
Issue 6: Global North Dominance

Human Wisdom from the Global North is often dominant in policy and technology efforts where inclusion efforts are needed for holistic planetary health.

Background:

As native communities and first nations have been the earth's takers for the longest time, their vast knowledge and expertise is crucial for a sustainable future. However, there can be a bias towards "human wisdom" being defined by global or developed nations. The language of many indigenous or marginalized populations are often not even acknowledged by these bodies, thereby immediately ostracizing them from any efforts towards sustainability and the applicability of their valued experience. For instance, most efforts regarding sustainability do not recognize or are aware of the seminal knowledge First Nations stewards can bring as noted in documents like the [6th Assessment report of the UN IPCC].

What is the dominance of the Global North?



It was generally agreed that the Global North would include the United States, Canada, England, nations of the European Union, as well as Singapore, Japan, South Korea, and even some countries in the southern hemisphere: Australia, and New Zealand.

Recommendation:

Prioritize the inclusion of wisdom from regions outside of the Global North in all "global" efforts, including the teaching of philosophy, ethics, and economics, including these areas in any "global" institution.

List of recommendations:

- A conscious effort should be made to include the active participation of first nations and indigenous communities when defining "human wisdom" guidance/manuals/concepts.
- Promote active participation/workshops in learning and documenting traditional peaceful behaviors by individuals and societies. Particular attention could be given to human responsibilities/roles applied by first nations and indigenous peoples; especially those that could be scalable to other communities and processes.
- Implement history and human wisdom educational and recovery programs. Knowing what has worked or what hasn't worked in other communities, and/or in different times in history. These

programs should help us acquire more experience and skills to resolve our current and future tasks at hand. This concept applies to hard (technical) skills as well as to soft skills, such as human wisdom.

- Outreach educational programs on Human Wisdom, acknowledgement and realization of deeper self-knowledge and our impact on others and the environment.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- 6th Assessment report of the UN IPCC.
- Gerardo E Morales,. "The Book of the Mamus. Notes on the History, Geography and Wisdom of a Culture of Peace and Ecological Harmony". "El Libro de los Mamus, apuntes sobre la Historia, La Geografía y la Sabiduría de una Cultura de Paz y Armonía Ecológica"
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- Azar, B (2010) Are your findings 'WEIRD'? Vol 41 No. 5 American Psychological Association
- Sabzalieva, Emma, Magdalena Martinez, and Creso Sá. "Moving Beyond 'North' and 'South': Global Perspectives on International Research Collaborations." Journal of Studies in International Education 24, no. 1 (February 2020): 3–8.
- Daniel, D Reidpath and Pascale, Allotey (2019) The problem of 'trickle-down science' from the Global North to the Global South, BMJ Global Health 2019;4:e001719

Issue 7: Conscious Resource Extraction

There is a mindset/consciousness of extraction and growth prevalent in global policy and technology design without an awareness or prioritization of proper replenishment efforts and consequences on Earth's resources.

Background:

"Resource extraction has more than tripled since 1970, including a fivefold increase in the use of non-metallic minerals and a 45 per cent increase in fossil fuel use. By 2060, global material use could double to 190 billion tons (from 92 billion), while greenhouse gas emissions could increase by 43 per cent. The extraction and processing of materials, fuels and food contribute half of total global greenhouse gas emissions and over 90 percent of biodiversity loss and water stress."[309]

Recommendation:

Urgent transition is needed in multiple technical fields, including energy production, metrics, and global methodologies, as well as in many other fields to shift from a mindset and practices of extraction towards giving back more than what we take.

However, the technical recommendations will have minimal effect if a conscious human behavior change doesn't occur, and such change must occur from within each individual and collectivity (social groups). Having a deep auto-evaluation of our acts, the consequences on the environment and other generations, as well as our own tolerance for the uncertainties, is our path to wisdom, and so it will be needed/a must for the survivability of our human species.

The time to act is now (or probably 30-50 years ago); nature will continue its evolution process with or without humans. It is our responsibility to extend our positive impact and tenure in this land.

List of recommendations:

- Outreach educational programs on Human Wisdom, acknowledgement and realization of deeper self-knowledge and our impact on others and the environment.
- Implement land/natural resources recovery programs; hopefully in underserved communities and natural biodiversity protected areas.

[309] UNEP (2019) We're gobbling up the Earth's resources at an unsustainable rate https://www.unep.org/news-and-stories/story/were-gobbling-earths-resources-unsustainable-rate

- Rural, simple applications with scalable potential should be considered, promoted and preferred over more technological "advanced" options that may take longer time to be implemented.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Gerardo E Morales,. "The Book of the Mamus. Notes on the History, Geography and Wisdom of a Culture of Peace and Ecological Harmony". "El Libro de los Mamus, apuntes sobre la Historia, La Geografía y la Sabiduría de una Cultura de Paz y Armonía Ecológica" Gerardo Morales Domínguez; 1st edition (January 24, 2016)
- Ernesto Janica, Vega. "Pueblo Iku: Science, Nature and Art of the Arhuaco". Ernesto Vega Janica (July 22, 2020)
- Giorgos Kallis (2011) , In defence of degrowth, Ecological Economics, Vol 70, Issue 5: 873-880

Issue 8: Creativity and Culture

There is wisdom beyond technology via the inclusion of arts & culture in representing planetary themes and inspiring sustainability-oriented action but these areas are often ignored to prioritize economics or technology in isolation.

Background:

Human/social wisdom should extend beyond "technical" solutions to include the arts, culture and social pillars including, but going beyond, STEM (Science, Technology, Engineering and Math). Unfortunately, on top of limited exposure and promotion, arts, culture, and other soft skills, like languages, natural sustainable vision, etc., are complex concepts and practices with contested definitions and multiple histories across different geographical regions; therefore, a considerable effort should be made to recognize these disciplines and their potential add-value when trying to solve local community and global issues, as those intended by PP2030 Initiative.

Recommendation:

As Art, Culture, Languages, and other soft skills could improve pathways to proper implementation of STEM projects/applications in diverse communities worldwide, the following recommendations should be considered.

List of recommendations:

- Promote the inclusion of arts, humanities and culture in general, as equal partners and co-creators in the development of goals and solutions.
- Identify, document, and promote existing STEM + Arts and Culture (STEaM) programs and/or applications.
- Learn from past sustainable innovations that would not exist without being led by, involving the arts, humanities and culture.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Taylor-Wesselink, Wallace (2021). Draft System of Preconditions for Successful Arts, Humanities and Social Sciences Integration, SHAPE-ID
- Marie Clarke, (Ed.) (2019). STEM to STEAM: Policy and Practice. Cham: Springer
- Katri, Huutoniemi, Julie Thompson Klein, Bruun, Henrik, and Hukkinen, Janne. (2010). Analyzing interdisciplinarity: Typology and indicators. Research Policy, 39(1), 79-88. doi

- Kania, Krzysztof, Lemaire, Catherine, Swinnen, Lenna (2019). Integration of social sciences and humanities in Horizon 2020: Participants, budget and disciplines : 4th monitoring report on SSH flagged projects funded in 2017 under the societal challenges and industrial leadership priorities
- Anders, Karlqvist (1999). Going beyond Disciplines: The Meanings of Interdisciplinarity. Policy Sciences, 32(4), 379-383. Retrieved from
- Bianca, Vienni Baptista (2021) Reconfiguring interdisciplinary and transdisciplinary spaces for Arts, Humanities and Social Sciences integration

Issue 9: Expand Knowledge with Respect

Avoid conflict while highlighting the added value of other cultures and their wisdom.

Background:

Copying others is a powerful way to honor others' people culture, skills, and overall wisdom. This practice also establishes a close and harmonious relationship in which people or communities are in "sync" with each other, and even with the environment, if the proper guidance is given or copied.

Unfortunately, this is not always an altruist goal; and in many cases conflict and violence erupts when parties appropriate or don't respect each other's cultural roots and differences. Therefore, an effort is to be made to avoid conflict and simply focus on the added value that others can have in processes and thoughts. After all, we are all humans and as such, we are just one. There are no "others" and "us", there is just "all of us".

Recommendation:

A continuous effort needs to be made to promote well-rounded skills, techniques, and social interactions based on peace and ecological harmony. The intent should be to promote local soft skills with a regional, well founded, and proven basis, that could have a global scalable potential.

The key premises should be doing this (copying the add value of other cultures and their wisdom) in peace, with respect to others, avoiding conflict and looking towards humans' future direction and survivability.

List of recommendations:

- Implement history and human wisdom educational and recovery programs. Knowing what has worked or what hasn't worked in other communities, and/or in different times in history. These programs should help us acquire more experience and skills to resolve our current and future tasks at hand. In other words, having more "tools" in your "tool bag" will make your work easier. This concept applies to hard (technical) skills as well as to soft skills, such as human wisdom.
- Outreach educational programs on Human Wisdom, acknowledgement and realization of deeper self-knowledge and our impact on others and the environment.
- Create avenues for keepers of indigenous wisdom to be leaders and owners of processes and their outcomes in ways which allow for non-exploitative communal benefit.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Gerardo E Morales, G. “The Book of the Mamus. Notes on the History, Geography and Wisdom of a Culture of Peace and Ecological Harmony”. “El Libro de los Mamus, apuntes sobre la Historia, La Geografía y la Sabiduría de una Cultura de Paz y Armonía Ecológica”
- Ernesto, Janica Vega,. “Pueblo Iku: Science, Nature and Art of the Arhuaco”.

Issue 10: Productivity over Purpose

Exponential growth thinking deeply influences human focus or priority on productivity over purpose.

Background:

Having a purpose in life, according to the science of Positive Psychology provides a great foundation for a productive, meaningful impact in our societies. Individuals and societies with deeper ethical or moral values and self-conscious discipline of serving others while supporting sustainable growth have the proven ability to maintain healthy social communities in harmony with others and with less damaging effects in the environment. Recent ideas in Net Positive Thinking have been published by Paul Polman and Andrew Winston in their book “Net Positive” They encourage leaders to embark on a journey of long term thinking that focuses attention on the whole system being impacted by decisions being made. They challenge leaders to work in ecosystems of purpose to regenerated and give back to the ecosystems that have sustained life on this planet. They map a way forward for us all to engage in the world around us, applying patterns of decision, and taking that “give back more than you take” from the world around you.

Recommendation:

A conscious effort should be made to identify and promote role models in lieu of the “greater good;” focus on higher standards of peaceful living, collaboration, and respect of each other’s point of view. Current diversity and inclusion initiatives can gain guidance from native and first nations’ wisdom, most of them based on cultures of peace and ecological harmony. These efforts can be coupled with a focus on the science of positive psychology that has proven how practices of meditation, kindness, and “flow” (living to your purpose).
In addition, a Net Positive Context should be applied to every organization. Designing and taking action for the long term, holistic well being of all parts of the systems impacted by the human managed organizations of our world.

List of recommendations:

- Promote active participation/workshops in learning and documenting traditional peaceful behaviors by individuals and societies. Particular attention could be given to human responsibilities/roles applied by first nations and indigenous peoples; especially those that could be scalable to other communities and processes.
- Implement history and human wisdom educational and recovery programs. Knowing what has worked or what hasn’t worked in other communities, and/or in different times in history. These programs should help us acquire more experience and skills to resolve our current and future tasks at hand. This concept applies to hard (technical) skills as well as to soft skills, such as human wisdom.

- Outreach educational programs on Human Wisdom, acknowledgement and realization of deeper self-knowledge and our impact on others and the environment.
- Enlist communities of the willing across public private partnerships to spread human wisdom through models like those described in "Net Positive" ideas that call us all to design with heart, with purpose, with the long term of future generations of all life on Earth, that exhort us to unleash human energy for an inclusive and sustainable future.

Further Resources:

- Gerardo, E. Morales,. "The Book of the Mamus. Notes on the History, Geography and Wisdom of a Culture of Peace and Ecological Harmony". "El Libro de los Mamus, apuntes sobre la Historia, La Geografía y la Sabiduría de una Cultura de Paz y Armonía Ecológica"
- Vega Janica, Ernesto. "Pueblo Iku: Science, Nature and Art of the Arhuaco".
- Wellbeing Chapter of Ethically Aligned Design, IEEE 2019.
- Paul, Polman, and Andrew, Winston, (2021) "Net Positive - How Courageous Companies Thrive by Giving More Than They Take" Harvard Business Review Press
- Matt Taylor, and Gail, Taylor, , "MG Taylor Modeling Language" Untitled Document (mgtaylor.com)

Issue 11: A Commons Approach

Communities (families) have not typically adopted a Commons approach, a shared resources and asset-based approach, to social wellbeing.

Background:

Asset-based community development (ABCD), or asset-based community-driven development is a bottom-up community driven way of working that focuses on community strengths and assets rather than on lack of resources and problems.

Assets are seen as more than just money but can be micro in scale. If someone needs a lift and another person needs help with their taxes they can exchange and barter for a more sustainable outcome for all. These interactions forward a mindset of sustainability with better wellbeing for all and potentially the environment. It is rooted in an asset mindset and not a deficit mindset (not in relation to financial) that everyone lives on this planet with an abundance of assets (not financial) that can support and help others.

Furthermore, the Nobel prize winner, Elinor Ostrom, found that collective action can be effective when using common-pool resource (CPR). This is an open-access resource environment or domain that all may benefit for the social well-being of a particular community.

Recommendation:

Utilize asset-based community development to identify existing resources and strengths versus only what is lacking.

List of recommendations:

- Utilize this methodology of asset-based community for changing mindsets on what are assets and for supporting and developing community and encouraging bartering and exchange of goods and services
- Looking at experimenting a local Commons approach within community-driven initiatives

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- ABCD Institute De Paul University's Resources (Website)
- Nurture Development (N/A Asset Based Community Development (Website)

- Serge Svizzero, Clement Tisdell (2019). Barter and the Origin of Money and Some Insights fromthe Ancient Palatial Economies of Mesopotamia and Egypt HAL Open Science https://hal.archives-ouvertes.fr/hal-02274856/document
- Eric Nordman (2021) Crises of the commons: Elinor Ostrom's legacy of self-governance

Issue 12: Invite Existing Caretakers of the Planet

Today, the primary caretakers of the land/nature are unable to utilize their expert ecosystem regeneration, restoration, and maintenance efforts.

Background:

One of the main purposes of humans is to be caretakers of our planet, and not just the appropriation or exploitation of natural resources for, what is usually seen as a financial short-term gain. The sooner humans realize this purpose, of caretakers of the land/nature, the sooner they will be able to work on the solutions and changes that will be needed for our survival.

Currently, 80% of the natural resources and biodiversity are under the care of 5% of the people, most of them first nations and indigenous peoples. And even though these communities have the expertise, and centuries worth the skills; modern industries, political division, and many other elements, keep these communities marginalized, underestimated and in many cases even under constant pressure of colonization and cultural alienation.

Recommendation:

Consciously listen to and emulate the role of earth caretakers, including the provision of proper scenarios for the first nations and indigenous peoples to play their valuable role in global sustainability.

List of recommendations:

- Promote active participation/workshops in learning and documenting traditional farming methodologies, cultural/social behaviors, and human responsibilities/roles by first nations and indigenous peoples; especially those that could be scalable to other communities and processes.
- Implement history and human wisdom educational and recovery programs. Knowing what has worked or what hasn't worked in other communities, and/or in different times in history. These programs should help us acquire more experience and skills to resolve our current and future tasks at hand. This concept applies to hard (technical) skills as well as to soft skills, such as human wisdom.
- Outreach educational programs on Human Wisdom, acknowledgement and realization of deeper self-knowledge and our impact on others and the environment.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Gerardo E Morales,. “The Book of the Mamus. Notes on the History, Geography and Wisdom of a Culture of Peace and Ecological Harmony”. “El Libro de los Mamus, apuntes sobre la Historia, La Geografía y la Sabiduría de una Cultura de Paz y Armonía Ecológica”
- Ernesto, Janica Vega . “Pueblo Iku: Science, Nature and Art of the Arhuaco”.
- Kanyinke Sena (2020) World Wildlife Fund. Recognizing Indigenous Peoples' Land Interests Is Critical For People And Nature

Issue 13: Create a Stage for new Leaders

Vulnerable/marginalized communities should be positioned as leaders in developing sustainable solutions versus marginalized communities.

Background:

In most cases, vulnerable/marginalized communities have faced basic needs, such as the need of clean water, food, education, clothing, communications and more; and even suffer from natural disasters like earthquakes, volcano eruptions, storms, etc., with a lot less resources and less advanced notice as better developed societies. These specially challenging conditions often require the most creative, simple (from the manufacturing and sourcing point of view), and timely solutions, mainly because of the lack of resources and the urgency to resolve the tasks at hand in a timely fashion.

Recommendation:

As vulnerable/marginalized communities often have to do the most with the least, the following recommendations should be considered.

List of recommendations:

- Involve community groups representatives from vulnerable/marginalized groups in the creation of sustainable solutions as leaders and owners in the process.
- Document scalable projects/solutions and foster such projects in other communities.
- Promote active participation/workshops in learning and documenting traditional farming methodologies, cultural/social behaviors, and human responsibilities/roles by first nations and indigenous peoples; especially those that could be scalable to other communities and processes.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- UNESCO, (2017). Community-based learning for sustainable development
- Taylor-Wesselink, Wallace (2021). Draft System of Preconditions for Successful Arts, Humanities and Social Sciences Integration
- Olayemi Fadahunsi (2015) Climate change on the front line: Why marginalized voices matter in climate change negotiations, Global Witness
- Logan D. A. Williams (2019) Eradicating Blindness, Global Health Innovation from South Asia
- Taka (2018) Map Kibera: Empowering Africa's Biggest Slum with Collective Wisdom, Harvard Business School Digital Initiative
- United Nations Office for Disaster Risk Reduction - Regional Office for Asia and Pacific (2021) Meet the women who stand up for marginalized groups

- Jem Bendell et al (2022) Beyond Unsustainable Leadership: Critical Social Theory for Sustainable Leadership, Sustainability Accounting, Management and Policy Journal 8(4):00-00, DOI: 10.1108/SAMPJ-08-2016-0048
- Elizabeth Stuart and Jessica Woodroffe (2016) Leaving no-one behind: can the Sustainable Development Goals succeed where the Millennium Development Goals lacked?, Gender & Development, 24:1, 69-81, DOI: 10.1080/13552074.2016.1142206
- Chika Ezeanya, and Abel Kennedy. (2017) 'Integrating Clean Energy Use in National Poverty Alleviation Strategies: Opportunities and Challenges in Rwanda's Girinka Program.' In Political Economy of Clean Energy Use. United Nations University World Institute for Development Economics Research edited volume. Oxford University Press: Oxford, England.
- Chika Ezeanya, (2016) "Research, Innovation and Indigenous Knowledge in Sub-Saharan Africa: In Search of a Nexus." In Almas Heshmati (Ed.); Economic Integration, Currency Union, and Sustainable Growth in East Africa (Advances in African Economic, Social and Political Development, AAESP) Springer: Berlin

Issue 14 : Revisit Past Sustainable Technologies

Past civilizations achieved sustainability when designing (architectural, building, agriculture, etc.) systems. However, though many of these past technologies prioritized and respected life in all forms and mutually positive and supportive human relationships they are often neglected in sustainability efforts.

Background:

There is often a bias towards “modern” or “emerging” technology as the key drivers towards ecological sustainability, when in fact various traditional practices could produce as much nourished land, water, or air regeneration as any modern technology.

Emerging technologies can positively and negatively impact the environment. For example, while they can be used to monitor water levels or air quality in a disaster zone and improve city mobility by using optimization and sensors, simultaneously the manufacturing processes involved in their components, testing, shipping, etc., and the energy needed to power these sensors and systems can also greatly impact the environment in a negative way. Hence, the use of emerging technologies should be considered carefully before being applied to mitigate environmental issues. There is no guarantee they will work as expected or surpass well-established natural approaches.

In addition, any potential benefits will be diminished when the environmental requirements associated with emerging technologies are taken into account. This trade-off about use of emerging technologies and their impact on the environment should be analyzed to determine if the pros are higher than the cons.

Yet as far as earth’s millions of years of evolution goes, there is no better “machine” to clean air, produce oxygen, reduce global warming, and provide soil/land management than a healthy forest and/or natural reservoirs, including oceans. In our forests and oceans there is no battery storage, or solar panels or wastewater treatment plants, except for what nature engineered or created since time began.

Lasting change will only be possible through the collective actions of many in the industrial, commercial, and legislative fields, so support from multiple stakeholders will be needed where a recognition and utilization of traditional practices can be considered in partnership with emerging technologies. This means supply chains will need to be evaluated to identify potential opportunities to involve traditional farming methods, sustainable processes, and systematic change. Transparency and accountability while avoiding a bias towards new or emerging technology in isolation will allow for more pragmatically innovative solutions to be utilized for positive effect.

Recommendation:

Innovation in manufacturing, agriculture and other product production technologies need to be evaluated based on traditional and indigenous sustainable applications to identify how these processes performed and improved through centuries of evolution.

List of recommendations:

- Existing approaches should be replaced by state-of-the-art technology only if the rate of gains and losses is positive and greater than 10%. Losses must consider energy cost and carbon footprint to create the technology, technology maturity, etc.
- Evaluation of applications needs to be considered in light of equity for all people in a community, region, or country including where the rights of the indigenous or marginalized residents and planetary ecosystems are prioritized above exponential growth. Having these insights should help identify the applicability of sustainable technologies. Traditional practices related to land, water, and air regeneration are often ignored in lieu of favoring modern or emerging technology. concepts in current times.
- Identify, document and promote traditional methodologies, i.e., experiences from indigenous communities in various regions of the world.
- The use of technology improving transparency and traceability (e.g., blockchain, vessel monitoring) can help, but adoption takes time and further innovation is necessary to meet these challenges.
- Pandemics, weather-related events, and political/social unrest can create supply/demand volatility and interrupt supply chains; therefore, local/regional sustainable produce and supplies should be encouraged.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Jonathan Foley (2021) Occams Razor for the Planet, Medium
- Walmart (2022), Regeneration of Natural Resources: Forests, Land, Oceans
- Walmart Sustainability Hub (N/A) THESIS index

Issue 15: Transparent Tracking of Human RIghts

Lack of ethical-based trackable measurability and accountability, especially when dealing with indigenous or marginalized cultures and communities which results in lack of equity and human rights protections in association with the development and deployment of technology and policy related to sustainability.

Background:

Many multinational corporations/companies (MNCs) and NGOs/GOs every year put tremendous amounts of efforts and investments trying to address global or regional issues through impact driven initiatives, especially in rural and underdeveloped areas. However, due to lack of evidence-based measurability and accountability information that can be readily shared with all stakeholders, the public only gets a glimpse of what's taken place in an organization's deeply embedded annual Corporate Social Responsibility (CSR) reports or anecdotal stories on social media.

After being "discovered", human wisdoms and the best sustainable practices are not adequately and widespreadly shared to inspire more efficient resource allocations and inclusive involvement from all walks of life. Since there are vast amounts of available empirical data and inputs from both the past and on-ongoing Sustainable Development Goals (SDGs) and ESG efforts, technologies such as AI and blockchain etc. should be able to help unleash waves of aspired and inspired ideas and actions.

Recommendation:

Incorporate Ubuntu philosophy to map connectivity and show links between actions and impacts. Creating a framework unifying IoT, AI and blockchain technology across all countries/regions would help put an end to issues of data availability. Humans can't reduce what cannot be measured, hence the need for real time data for us to monitor our progress together as a planet.

List of recommendations

- Work with leading AI experts and representative stakeholders to develop an AI+Blockchain platform to better discover, assimilate, and share human wisdom and sustainable development and deployment practices worldwide;
- Promote and educate NGOs/GOs and MNCs to use this AI data driven platform to guide and monitor their SDGs/ESG efforts and impacts;
- Use this open platform to track and monitor issues associated with PP 2030 and SDGs implementations and give indigenous or marginalized communities a better chance of letting their voices be heard and getting the best help from other stakeholders;
- Promote the use of home/household sensors able to detect the presence of individuals, and turn off unnecessary energy usage, so energy is not wasted when people are not using them.

Further Resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Project Drawdown (N/A) Table of Solutions | Project Drawdown
- Nasdaq (N/A) CSR ESG Reporting: ESG Reporting Software & ESG Data Tools | Nasdaq OneReportBridget Lane
- Anne, Lane and Bree Devin (2017) Operationalizing Stakeholder Engagement in CSR: A process Approach, Vol 25 Issue 3, Pages 267-280
- Participatory Methods Participatory Engagement Methods

Issue 16: The Natural technology

The technology we often leave unnoticed, but one that does transcend over others, due to its tremendous experience in scientific research.

Background:

The general purpose of human life is often innovation, with a main goal to make our lives more comfortable. Wherever we step, we want the place to turn into a technological oasis, launching us into everything unknown and unseen before. We try to warp the universe around us as supermassive black holes do, yet indulgence in this activity makes us more and more distant from reality…

People frequently do not take notice of sights around us—the beauty of nature, emerging pandemics—until they boom and change our lives drastically. We are too busy to look since we spend our time warping reality to our standards. Interestingly, this plays a dirty trick with us.

Humanity has achieved great things: we have power over our genome code, we have been building intelligence like us for over 300 years, and we can get energy from mere sun rays. We declare there is something more—for millennia our ancestors were exploring intricacies of science, they went a path from simple mechanisms to ones that could measure light years with ultimate precision, and only in the last century we got enough of measurement power to explore a world beyond atoms: the Quantum world.

With the help of Quantum physics humanity made a step in the era of electronics and modern technologies: it brought to us Solar energy, computers and quantum chemistry. And as it often happens to people, by accident we found Quantum effects in natural processes that gave us life as we know it now: genome crossover, photosynthesis, thermonuclear fusion on sun and plausibly quantum nature of our consciousness. That truly means something, if a technology that brought us a breakthrough was already incorporated in every living cell and made it strive: the common process of natural selection made such a great job for 13.7 billion years, that our best technologies are nothing but mere copies and modifications of what was already there.

Recommendation:

Learn to collaborate with nature, since practically what we had already discovered can be a tiny drop in the ocean of secrets that we have yet to discover.

List of recommendations:

- Bring changes to educational systems, which will inspire students and pupils to view monumental discoveries on the edge of life sciences and STEM subjects (E.g explain biological effects using physics and math, elaborate modern views upon ecology);
- Introduce regular open air classes for school and kindergarten students;
- Simplify scientific language in school books and make them more colorful, so that children can really fall in love with discovering;
- Rising the level of STEM and Ecology education in developing countries;
- Giving more opportunities to people from ingenious communities to cooperate in adjacent to Nature scientific areas, thus introducing new perspectives upon scientific investigations.

Further resources:

When involving indigenous communities, please consider the rights of Indigenous Peoples such as the idea of Free, Prior and Informed Consent.

- Betony Adams and Francesco Petruccione, (2019) Quantum effects in the brain: A review.
- IBM. What is quantum computing?
- Marco Sacilotti, Euclides Almeida, Claudia C. B. O. Mota, Frederico Dias Nunes, Anderson S. L. Gomes , (2010) Can the photosynthesis first step quantum mechanism be explained?
- LiveScience. Nicoletta Lanese (2021) .Why does DNA spontaneously mutate? Quantum physics might explain.
- Wikipedia. Quantum biology.
- Britanicca. Thermonuclear reactions.

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Sustainability Commons

It's 2030. The sustainability commons is now the go-to platform for all things climatech. It is always up-to-date thanks to an engaged contributors base and easily accessible by all stakeholders around the world facilitating discovery and adoption of climate solutions and enabling climate action related decisions. Content is easily verifiable and information about its quality is well captured making the platform trustworthy.

People have access to valued contextualized sustainability knowledge that they understand and may adopt to enable the planet to thrive over the long term

Sustainability knowledge is only of importance as long as it is put into use. Having and sharing knowledge is a foundation of influence, and, therefore, power to lead change. The progress in achieving Positive Planet 2030 Vision has been possible by deploying effective models of knowledge and expertise sharing that empowered communities to benefit from the collective know-how worldwide.

Technology itself enabled an effective governance and organization model for the sustainability commons - a dynamic, ever-changing, contextualized sustainability data, information, knowledge and solutions tool available online for the communities to access, share and adopt to enable the planet to thrive in the long term horizon.

Definition of Sustainability Commons:

A Sustainability Commons refers to a dynamic mapping of who is doing what and where, in all climate technologies[310]. These commons will be made available to all to enable and increase visibility of solutions, ultimately allowing governments, businesses, civil society organizations as well as individuals to make the best decisions fit for their circumstances toward effective climate action.

Elinor Ostrom described commons as "long-enduring, self-organized, and self-governed"[311], part of this exercise will be to highlight the sustainability over time of these commons as well as its organization and governance mechanisms. These commons would be expert-vetted and organized with proper contextualization on relevant climate technologies and how they could be leveraged for the query at hand to help various stakeholders get to Net Zero.

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[310] See the Ten Families of Climate Technologies: "Most climate technologies are viable only if other climate technologies are also implemented at the level of facilities, enterprises, regions, or value chains." https://www.mckinsey.com/business-functions/sustainability/our-insights/delivering-the-climate-technologies-needed-for-net-zero

[311] E. Ostrom (1990: 58)

Beyond the sharing of knowledge, this commons could be a platform to help gather information, whether or not this information is readability available (open source).

The sustainability ecosystem consists of a number of academics, corporates, policy makers, regulators, activist groups, and others who might have differing agendas, follow different frameworks and methodologies and make claims/counterclaims that are difficult to verify. Sustainability Commons will create a framework, methodology, catalog of models, tools, and platforms, and an appropriate governance for the different stakeholders to contribute, build upon, and verify the claims. As part of this initiative the Sustainability Commons initiative will evaluate metrics, rewards, business models, ownership, funding, resourcing, curation, and governance using other similar examples (e.g., Wikipedia, Open Source communities, DAO models).

Thinking in Silos: Currently, sustainability knowledge and information is spread over a large number of stakeholders, each of them thinking and acting in their own ecosystems and disciplines. Information flow between these thematic and geographic areas can be largely enhanced, helping with the faster uptake of sustainability solutions. This, however, is not only limited to scientific disciplines, but issues like gender-balance, inclusion of local/indigenous groups, as well as a consideration for the big picture of environmental, social and governance issues within the sustainability fields.

Long-term viability: Lots of commons-aligned projects, especially with a heavy focus on knowledge commons, tend to have a model of grants- or subsidy-funded operations. This model, however, can become a challenge in the long-term, as the projects are dependent on a constant funding stream from public entities, philanthropies and other well-intentioned donors. Along those lines, the platform and overall project will have to prove its worth in the long run, be it through strong and coherent metrics, an innovative business model, shared ownership between all members of the commons, and other specific proof of the efficient use of resources.

Free flow of knowledge and expertise: There needs to be a trade-off between content moderation/curation content hosting and the amount of free flowing, potentially harmful information within a knowledge commons ecosystem. How can the sustainability commons allow different points of views and various solutions to one problem but make sure that the content and platform is not hijacked to greenwashing, marketing or other doubtful activities?

Common language: Potential contributors to the commons will come from a variety of disciplines and geographies, each with their own language and terminology. The more different fields are gathered in one shared information space, the more important will be a coherent and agreed set of concepts, definitions and terms, representing the same idea in different areas of work. Setting up a commons-wide ontology will be crucial to support this issue.

Shareable and verifiable data and models: Currently a number of sustainability models are built for specific domains and specific countries at different levels of granularity. These sustainability models are built with different sets of assumptions and different types of datasets making verifiability of claims and the modular development of models a significant challenge. Having a hyper-catalog of datasets, a modular model architecture and a repository for contributing, sharing, and building sustainability models will be a critical component of Sustainability Commons.

Governance: As a public good, the commons need to adopt a governance model that respects voices from a variety of contributors and supporters - both, in terms of the strategic direction of the overall commons, but also the curation and related decisions. Existing governance models might not even fit this type of activity, giving this effort the chance to invent or deploy new, innovative models instead.

Recommendations:

The following are the initial set of recommendations for moving forward with building a sustainability commons initiative as envisioned in this chapter. These are partially process recommendations and partially design principles.

Map existing initiatives: A key starting point will be to understand existing initiatives and commons around climate technology. This includes examples from universities, research centers, corporations, governments, start -up accelerators and others. This is a key step to understand gaps in the existing landscape, lessons learned from prior attempts to address this need, and identify partners for implementation.

Build a global repository with multi-language support: A true sustainability commons should be global by design, this means building in support for different languages from the beginning. But this commitment to be truly global should be reflected beyond multi lingual support through building tools and an architecture that can be customized for various contexts by communities.

Design to empower distributed communities: The governance and ownership of such a commons should strike a balance to be both as inclusive as possible yet retain effective decision making. This means especially empowering all stakeholders, whether individuals or communities and not centralizing control. Various organizational and technological designs can be tested to achieve these objectives. For example, this could explore new technologies such as setting up a

Distributed Autonomous Organization (DAO) or work with more established legal structures such as trusts.

Accessible to maximize engagement: The design of a sustainability commons should encourage the growth of a network of contributors, and incentive engagement by both contributors and consumers. This means simplifying the tools for 2 way interaction with the commons for access and contribution of content.

Optimizing for discoverability of relevant content: Facilitating the discovery of relevant content has to be critical to ensure the commons will be useful (and adopted) by potential users (customers). This should build on best practice to increase discoverability of data and content, and could build on ideas of gamification.

Feedback loops and pathways for adoption: A sustainability commons is only as useful as the solutions it helps deploy. It is critical to consider building simple pathways for adoption (how can content be linked to problem solving) and the right feedback loops (has content helped solve problems).

Build on what already exists: The sustainability commons itself should leverage existing efforts, not reinvent a new solution. Likewise, when it is operational, it should facilitate sustainability innovation - enabling more reuse and rediscovery of existing solutions, rather than reinvention and duplication.

Start with a focus: The organization(s) building a sustainability commons should focus on a specific area or problem sets as a starting point to build out a pilot and iterate, before scaling it up further. This could be determined by the organization launching such efforts, in collaboration with first clients. The starting point should be carefully selected to showcase the potential for a technology commons, by identifying an area that has both sufficient resources and demand for this. This could be areas such as carbon removal or renewable energy.

Incentives are key for uptake: A sustainability commons should be designed in a way that it encourages discovery, deployment, and documentation of content for re-use. This applies to the design of products, processes, and incentives through the commons.

Quality control and content review: Users need to be able to trust the content is genuine, and ideally have value added data that provides information or a rating on technologies, data, and documents in the sustainability content. This means finding ways to either provide existing metadata or collect reviews and value added assessments of content and reflect this back to users.

References/Case Studies + Additional Resources:

Oxford Climate Tech Initiative https://kumu.io/Cocosavie/oxford-climate-tech-initiative-rd-crowdsource-systems-mapping-launching-april-8-skoll-world-forum-ecosystem-day#oxford-climate-tech-initiative-rd-crowdsource-mapping-challenge-opportunity-solutions-mapping-april-8-skoll-ecosystem-day-launch

Future Earth Knowledge Action Networks
https://futureearth.org/networks/knowledge-action-networks/

WWF Climate Crowd
https://wwfclimatecrowd.org/

Crowdsourcing Sustainability
https://crowdsourcingsustainability.org/

UNEP Publication and Data
https://www.unep.org/publications-data

Global Climate Action
https://climateaction.unfccc.int/

California Climate Commons
http://climate.calcommons.org/

Climate Jobs / startups + corporations
https://www.climatejobslist.com/companies

Climate Initiatives Platform UNEP
https://www.climatejobslist.com/companies

Earth Journalism Network, Climate Commons
https://earthjournalism.net/projects/climate-commons

Wikipedia list of climate action initiative (page only started it seems)
https://en.wikipedia.org/wiki/List_of_climate_change_initiatives

International Carbon Action Partnership
https://icapcarbonaction.com/en/ets

Climate Action 100+
https://www.climateaction100.org/

Carbon Disclosure Project
https://www.cdp.net/en

IPCC links
https://www.ipcc.ch/links/

White House: Climate Mapping for Resilience and Adaptation
https://resilience.climate.gov/

Crane 2021 User Report
https://www.primecoalition.org/library/crane-2021-user-report

Market Intelligence on Climate Tech Startups
https://netzeroinsights.com/