

Upgrading Environmental Innovation for the 21st Century

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Introduction

Who gets to be an innovator, and who gets to decide what innovation is? Although the International Organization for Standardization defines innovation broadly— as a “new or changed entity (3.2.5), realizing or redistributing value (3.7.6)” in ISO TC 279—**dominant narratives** about innovation limit it to the domain of the technologically adept, financially backed, and globally recognized engineer or entrepreneur. Well-resourced spaces created for those who refer to themselves as innovators, like **innovation events at elite institutions**, further perpetuate this conception. These perspectives and practices are not only narrow, but perilously exclusive: they neglect the vast tapestry of human ingenuity that operates outside these confines, and especially people who are closest to the issues intentionally or unintentionally created by the innovators in these spaces. As concepts, innovation and entrepreneurship have always been integral to human societies, driving us towards new discoveries and ways of living. However, as we grapple with the polycrisis—a confluence of environmental degradation, social unrest, and economic instability—we need to broaden our societal conception of what innovation is in order to actually be able to rise to the multifaceted challenges of the 21st century.

Tech for bad

Some might argue that projects advancing social and environmental sustainability are covered by “tech for good” initiatives, which are well known

and supported in the tech industry. Consulting firms like Accenture have their **Tech4Good** initiative; McKinsey has published reports on **Tech for Good**; and the **World Economic Forum regularly publishes pieces highlighting** tech for good initiatives. Setting aside for a moment the societal backdrop of consulting companies’ history of broadly unethical work practices and contributions to **economic inequality and structural class issues**, these “tech for good” efforts are both completely voluntary and at the discretion of the entities providing them. A shift in social winds or broader geopolitical factors—as is currently happening with sustainability targets and diversity and inclusion efforts—could lead to their demise.

Further, the very existence of “tech for good” initiatives implies that there is a broad and implicit acknowledgement that the paradigm of mainstream technological development is not “good”. It is an understanding that technology is not being initially developed to achieve greater distribution of human health, environmental safety, or global peace and security. Tech for good initiatives highlight an unpleasant reality: most of our tech development is not “for good” - we wouldn’t need specially named initiatives if this were the case. Instead, we might be largely operating in a “tech for bad” development paradigm, with bright spots like **conservation technology** and **access to online education** proliferating despite this dominant approach to tech development, not because of it.

In the **current plutocracy of the tech world**, rapid, **breathless development of artificial intelligence (AI) systems** is rampant, outpacing regulations or ethical use standards. It is this environment, coupled with a “move fast and break things” ethos, that allows platforms like Leonardo AI, which raised \$31 million in capital, and Lensa AI to be easily used to **generate non-consensual explicit images of real people** – which happens disproportionately to **women and girls**. Other AI systems only serve a very small set of interests—those who benefit from having access to data gathered by ever **more-invasive personal health applications, for example**. These do not advance access to things like **essential healthcare**, and **clean air** - basics for survival that many in the global majority do not have.

The ‘tech for good’ approach is further predicated on the belief that technological projects provide isolated solutions that can address the multifaceted challenges facing society. However, this **values-agnostic perspective** fails to account for the broader social, economic, and ecological contexts in which these technologies are deployed. By focusing predominantly on contextless technological fixes, we risk perpetuating a cycle of false progress, where the inequitable adoption of new technologies leads to negative consequences—including exacerbating existing inequalities and creating new forms of environmental degradation.

The oversimplified narrative of technological salvation is further complicated by the question of access. Who benefits from ‘tech for good’ initiatives, who is involved in their creation, and who is left behind? The current approach often prioritizes solutions that cater to the interests of those furthest from the consequences of their actions, sidelining the voices and concerns of marginalized communities. This exclusion is not merely an oversight, but a systemic issue that reflects the underlying power dynamics within the innovation ecosystem.

In light of these persistent issues—which we see as fundamental design flaws preventing us from realistically harnessing technology to support human and environmental progress at the scale we need—we suggest that a key issue to address is the narrow conception of what constitutes innovation and who is considered an innovator. The prevailing model often overlooks or undervalues the contributions of Indigenous peoples, local communities, and grassroots organizations, whose knowledge and practices offer valuable actionable, implementable insights into sustainable living and environmental stewardship. This exclusion is not only self-sabotaging, as it diminishes the potential for holistic and effective solutions, but also perpetuates a form of epistemic injustice, where certain types of knowledge are privileged elevated over others.

What counts as environmental innovation?

Our critiques of the pedagogy of innovative practice apply equally to environmental innovation – which we define as an area of innovation focused on developing and implementing ideas, tools, practices, and processes that actively enable environmental progress. The current state of the space, while increasingly burgeoning with potential, often falls short of being truly transformative. While there are a plethora of technologies aimed at combating climate change and environmental degradation; like The Ocean Cleanup’s fleet, Climeworks’ Direct Air Capture systems, and well-meaning recycling programs around the world; these initiatives advance approaches that are equivalent to sponging up water on the floor from an overflowing bathtub without turning off the tap first – helpful, necessary, and worthy of support, but in no way addressing the drivers of the issues.

The motivation of environmental innovation today is predominantly shaped by a heavy focus on technological advancements and market-

driven solutions, and marked by an absence of contextual or systems thinking, hindering even otherwise helpful approaches. For example, advancements in AI are often touted as necessary in accelerating the rapid deployment of renewable energy. This is largely true: AI is incredibly helpful for **improving predictions of power supply and demand**, **managing distributed energy sources**, and **proactively monitoring the grid to identify faults before they occur**—all things we absolutely need to keep an eye on if we want to deploy safe, reliable renewable energy to power people’s homes and critical infrastructure like hospitals and public schools. However, as Mél Hogan and Théo Lepage-Richer argue in this essay series, AI **also uses significant amounts of water**, a basic resource that is **becoming increasingly scarce** in different regions of the world and one that **wealthy institutions are beginning to stockpile**. While AI grid monitoring is incredibly important for decarbonizing the energy grid, and an effort we support, by using technical efficiency as our only metric for evaluating environmental innovation, we neglect other outputs like **environmental resource scarcity** and **social harms** that come from rapid deployment of AI.

Defining the innovator

What counts as innovation on a burning planet?

Central to the issues we highlight with environmental innovation is the question of who is doing the environmental innovating. In other words, who is deemed an environmental innovator? As with mainstream cultures of innovation, this title is often reserved for those within the echelons of the tech industry, academia, or those who have the capital to bring their ideas to fruition. The archetype of an innovator in the environmental space is often portrayed as someone with a background in STEM, access to significant funding, and connections within the Silicon Valley ethos, as exemplified by programs like **Activate**. We argue that the innovation approaches that are elevated

on a global stage and in popular discourse—tech events, exclusionary competitions, and startup incubators—could use improvement. This is especially true for those that don’t position problems in an actionable way, don’t build long-term relationships for project implementation, and depend on long-term uncompensated labor for progress. This image of innovators and innovation needs expansion, and our thinking around these terms could use some innovation, especially when we think about who gets access to \$31 million dollars in funding while actively causing harm to living people.

One such example of overlooked innovation is **Rise St. James**, a faith-based grassroots organization fighting for environmental justice in St. James Parish, Louisiana, one of the nine parishes along an 85-mile stretch of land nicknamed “Cancer Alley.” **Cancer Alley** contains more than 200 petrochemical refineries and plants. Rise St. James—founded by Sharon Lavigne, a community organizer, grandmother, and retired special education teacher—uses grassroots activism tactics to actively fight the expansion of petrochemical facilities and preserve the cultural heritage and history of the local Black community. After years of advancing this work, Sharon Lavigne won the **Goldman Environmental Prize** and was featured in TIME Magazine’s **100 most influential people of 2024**.

Why isn’t Sharon Lavigne’s story presented as a case study in innovation workshops as a groundbreaking example of a disruptor, paradigm-shifter or innovator? Even though she is using community organizing to drive environmental progress and address social harms, she has not received the same financial and structural support and resources as scientists seeking to commercialize their research in the hopes it will one day proliferate through society in a helpful way.

Ahistorical framings

One of the reasons people like Sharon Lavigne are sidelined in innovation narratives may come from an ahistorical framing of environmental challenges as purely technical problems that simply lack the current political will to be implemented. As engineering students are encouraged to **scale their hardware ideas into new ventures**, there is no time built into these processes to look backwards and critically engage with the physical reality of what has already occurred. Consider the petrochemical plants in Louisiana: Who made the decision to build the petrochemical facilities in predominantly Black communities? Who designed these facilities? Who carried out their construction? Who operates them today, and who holds the reins at a corporate level? While this may be challenging, uncomfortable work for some, this is exactly **the type of novel work we claim to love tackling in innovation spaces**. We have to spend time answering these questions, deep consideration that maybe our dominant approach to problem-solving isn't cutting it, then move towards an approach that is. Doing so would allow for a more complete analysis of the factors that drive technological innovation—a collective and timely evaluation of not just the 'what' and the 'how', but the 'who' and the 'why' behind technological advancements. Currently, these considerations are, at best, optional addendums to investigate as a way to build a strong narrative for funding or advertising. These oversights point to a profound inadequacy in how we innovate—a huge blunder we must correct to be better scientists, engineers, and marshals of progress.

This current approach to (environmental) innovation is riddled with limitations and biases that hinder its effectiveness in fostering transformative progress. It operates within a framework that values economic growth at the expense of physical reality, often leading to solutions that perpetuate or even exacerbate inequalities. For instance, the desire for quick, uncomplicated tech-driven solutions completely overlooks the need for

systemic changes in consumption patterns, energy use, waste management, and so on —especially in wealthy countries. Innovations that receive the most attention and funding from the tech industry, which, through excessive capital accumulation, is immensely powerful globally, are those that promise profitability and align with the interests of the dominant economic system, rather than those that expand the breathability of air, drinkability of water, and accessibility of nutritious food.

There are real-world consequences when conversations about “environmental innovation” exclude any conception of environmental harm or “environmental justice.” For instance, the push for electric vehicles (EVs) as a green alternative overlooks the **environmental and human costs** associated with lithium mining, essential for EV batteries, and does not address other issues posed by excessive use of personal vehicles, like traffic deaths and walkability of cities. Such examples highlight the trade-offs involved in technological advancements and underscore the need for a common-sense, robust approach that considers the social and environmental impacts of innovation as a mission-critical pillar of the innovation process, rather than an optional add-on.

Shifting the culture of innovation

To meet the challenges of the 21st century and build a world with more access to cleaner air, cleaner water, more nutritious food, and physically safe spaces to live, work, and play, we need a more robust approach to environmental innovation. We urgently need transformative solutions that tackle the root causes of the intertwining issues we face today, rather than foolishly hoping the incremental approaches of yesteryear that caused these issues will be sufficient. The overly narrow conceptualization of what innovation is and who gets to be an innovator is a major limitation to building transformative change in the context of the persistent reality of climate change and environmental injustice. Cultivating these deeper, world-creating

innovations requires a significant expansion of our imaginative boundaries in innovation spaces. We must actively foster (and fund) new approaches, ranging from citizen-driven science to participatory infrastructure planning that allow bold, visionary thinking to flourish, fundamentally reimagining how and why we create and use social, economic, and technological systems.

We cannot recycle our way out of planetary crisis. We instead need a climate-aware innovation framework that actually recognizes and internalizes the true, physically real tradeoffs - not just short-term financial ones - of the decisions we make and the ideas we put out into the world. This cultural transformation requires us to have the courage to question long standing assumptions about progress, success, and who gets to participate in the innovation ecosystem.

Trapping our approaches to innovation inside a system of economic growth for already wealthy nations at all costs fails to create truly useful and transformative solutions for humanity. This model not only reinforces existing power structures but also overlooks the intricate relationships between humans and the natural world. A cultural shift towards justice-centric innovation challenges us to redefine success, not by profit margins or technological novelty, but by the capacity to enhance the well-being of all communities and the planet.

To shift the culture of environmental innovation, we must also confront and dismantle the narratives that perpetuate harm. This includes challenging the glorification of 'disruptive' technologies that disregard social and ecological impacts, questioning narratives that frame certain communities as 'backward' or 'uninnovative,' and exposing greenwashing tactics that mask the environmental damage of corporate practices.

Engineers, business leaders, scientists, policymakers, and educators need to carefully consider how and why we create the technology and infrastructure that we do, and who gets to be

a part of that decision making and implementation process. Innovation spaces that have infrastructure and resources can be extremely exclusive, accessible only to those who have access to higher education opportunities, and those who are made to feel welcome in tech and innovation spaces - or at the very least, not harassed, discouraged, or told that they are in the wrong place.

Environmentally just innovation

At the heart of this redefined approach is the integration of justice as a foundational principle. Environmental innovation must move beyond the creation of "sustainable" technologies to encompass a broader vision that includes the equitable distribution of benefits and burdens, the recognition of traditional and Indigenous knowledge systems, and the active participation of excluded and overburdened communities in the innovation process. We propose the creation of a new framing: environmentally just innovation. Environmentally just innovation focuses on the contextually-aware co-creation of ideas, tools, practices, and processes that actively addresses social and environmental harm, while driving forward social and environmental progress.

Promising directions for justice-led environmental innovation

What does co-creating an environmentally just future look like? While we unfortunately have a large pile of examples to pull from when exploring the intersection of innovation and environmental harm, thankfully, there are also helpful examples that model environmentally just innovation. Justice-centric innovation challenges us to consider not only the outcomes of innovation but also the processes through which these innovations are developed and implemented. We can look to frameworks like [appropriate technology](#) and methods like [participatory action research](#) as a starting point to guide us towards what a new paradigm may be.

To conclude our essay, we offer some instances which exemplify justice-centric environmental innovation. We offer these as starting points for reconceptualizing the principles and protocols that can guide more socially and environmentally just innovation in the 21st century.

At the heart of these initiatives, implicitly or explicitly, is an understanding of and engagement with questions of power, positionality, history, and justice - crucial aspects of the human experience often overshadowed by the pursuit of technological advancement and economic growth. We argue that the journey towards integrating justice into environmental innovation begins with rejecting ahistorical narratives of how and why different kinds of technologies have been developed, and combating the myth of value-neutral science, as well as challenging our perceptions of who is recognized as an innovator and what qualifies as innovation.

Community-led renewable energy projects

One exemplary case of justice-centric innovation comes from community-led renewable energy projects, especially to advance energy sovereignty. Like another essay in this series, written by Naolo Charles, we see great promise in community-led projects that empower people's self-actualization. These projects, often initiated by **Indigenous communities or rural populations**, focus on harnessing local natural resources, such as solar, wind, and hydro power, in ways that respect the environment and benefit the community. While there are still issues in the supply chain of renewables creation, in the current global paradigm, these projects exemplify how environmental innovation that recognizes benefits and burdens can empower communities, preserve cultural values, and contribute to sustainable development. The innovation aspect here lies not in the deployment of renewable energy technology, but rather, in the

process and approach of deployment.

Urban agriculture and food sovereignty initiatives

Urban agriculture initiatives, aimed at enhancing food sovereignty in historically (and presently) exploited and/or overburdened urban communities, represent another form of justice-centric environmental innovation. Projects like the **Detroit Black Community Food Sovereignty Network** not only provide fresh, locally grown produce but ensure that ecologically sound methods are used to create culturally sustainable foods. While there remains a need to redress the factors that led to the overburdening of communities in the first place, DBCFSN provides a phenomenal example of a model of community-led environmental innovation.

Overcoming obstacles to justice-centric innovation

Embracing a justice-centric approach to environmental innovation requires systemic change. It involves shifting the focus from individual technological solutions to collective action and policy reform that addresses the root causes of environmental degradation and social injustice. This shift necessitates a reexamination of our values, a redistribution of resources and opportunities, and the dismantling of structures that perpetuate inequality.

Environmental injustice does not just happen - it is engineered. While the shift towards justice-centric environmental innovation is critical for sustainable and equitable development, it is not without its challenges. These obstacles are present in both the immediate levers of change we need to work with to provide essential support, as well as long-term, systemic issues we must address like the dominant paradigm of neoliberal capitalism.

One of the most formidable obstacles to justice-centric innovation is the existing financial and institutional framework, which often prioritizes short-term gains and conventional metrics of financial success over long-term sustainability and equity. Overcoming this barrier necessitates rethinking how we approach projects, processes, and economic systems in society, as well as the deployment of some sort of **common good framework** or **harmonization with living systems**.

The shift towards a justice-centric approach also involves challenging entrenched cultural norms and societal resistance to change. This includes confronting stereotypes about who can be an innovator and what constitutes innovation, as well as addressing the broader societal reluctance to embrace sustainability and equity as core values. The prevailing paradigm of environmental innovation, with its narrow focus on technosolutionism, is wholly insufficient to meet the demands of our times and will not deliver the transformative scale of change we need.

While working towards building a “better” world has as many interpretations as there are people on this planet, we argue there are some basic metrics we should be working towards, including clean air, clean water, access to nutritious food, and access to shelter. Globally, we have certainly taken some steps forward, with the creation of vaccines, increased access to education, and the like. However, these basic pillars of survival are increasingly threatened by climate change, pollution, and environmental destruction.

We must embrace a new framework for environmental innovation that is justice-centric, one that places the acknowledgement of physical reality at the center and actively pursues the rectification of environmental harm. This requires us to critically examine who is considered an innovator and whose voices and knowledge are prioritized in the process of engineering systems for climate justice. The challenges we face in

scaling this philosophy are huge, but so are the payoffs. By committing to this paradigm shift, we have a chance of creating a future that’s not just livable, but filled with more chances for people to pursue the lives they want.