SPOT ON

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AI for Sustainable Societies: A Global Governance Roadmap

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A devastating climate crisis, increasing economic distress, and societal polarization – societies around the world are facing enormous challenges. The advent of Artificial Intelligence (AI) promises transformative capabilities in climate change mitigation and environmental conservation as well as the potential to boost global economic growth and raise incomes across the world. However, questions about the resource intensity and environmental impact of AI as well as concerns about the displacement of workers raise new questions. Ethical guardrails must ensure that AI serves the long-term health of the planet as well as the welfare of future generations, and serves as a lever for rectifying, rather than exacerbating, existing inequalities. To harness the positive impact of AI on sustainability, a robust framework of international governance is necessary – a concerted effort spanning countries and sectors to bring to fruition the sustainable development, deployment, and adoption of AI.

"Success in creating effective AI could be the biggest event in the history of our civilization. Or the worst. We just don't know. So, we cannot know if we will be infinitely helped by AI, or ignored by it and side-lined, or conceivably destroyed by it," Stephen Hawking once projected – a stark reminder of the transformative power of artificial intelligence (AI). In recent years, AI has surged from the peripheries of innovation to become a central force in the modern "zeitgeist", transforming industries, societies, and daily life. AI is not only redefining the boundaries of what machines can do but also reshaping human potential, challenging the collective consciousness to reimagine the future of work, the planet, ethics, and governance. Its ability to harness data and optimize processes promises to catalyze a new era of innovation, yet it is this same potential that underscores the dire need for AI to be deployed for the betterment of humanity (human centric AI).

AI and Sustainability

In a world grappling with war, democratic backsliding, a devastating climate crisis, and pervasive poverty, the deployment of AI intersects crucially with the efforts to meet the Sustainable Development Goals (SDGs). In the case that AI is utilized efficiently and managed with accountability, it holds the promise of catalyzing inclusive and future-oriented growth – diminishing poverty and inequality, fostering environmental sustainability, enhancing the quality of life, and empowering people within all societies at every level of development. This junction presents new vistas for the global community to act decisively.

The objective remains unequivocal: to position AI as a force for good

Yet, AI is no panacea; without ethical guardrails, it holds the capacity to entrench divides, amplify inequalities (within countries and between countries), and imperil the core tenets of justice, trust, and fairness. As Gabriela Ramos, the Assistant Director-General for the Social and Human Sciences of UNESCO, underscored in 2021, the ethical dimension of AI is unparalleled in its relevance, for these technologies are reshaping human existence at a pace unrivaled since the inception of the printing press. Ethics in AI, therefore, is not a peripheral concern but a foundational one that governs behavior and the conduct of AI-related activities. The ethical considerations of AI span the entirety of its lifecycle – from research and design to development, deployment, and beyond.

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The objective remains unequivocal: to position AI as a force for good, propelling it to serve all humanity and averting its potential to become a progenitor of disparity. From an ethical perspective, AI systems should embody a systematic, normative reflection grounded in a comprehensive and evolving set of values, principles, and actions as UNESCO also highlighted in 2021. Sustainability emerges as an ethical pillar in the governance of AI because it encapsulates the equilibrium between progress and equity that modern society strives for. Ecological sustainability ensures that the advancement and application of AI are aligned with the long-term health of the planet and the welfare of future generations, affirming the environmental and social responsibilities incumbent upon today's innovation. Social sustainability, on the other hand, demands that the benefits of AI are distributed fairly, protecting against the deepening of societal fissures and ensuring that AI serves as a lever for rectifying, rather than exacerbating, existing inequalities. Together, these pillars form the bedrock of an ethical approach to AI governance, one that seeks harmony between innovation and its consequences, and between technological capabilities and the intrinsic value of human and ecological well-being.

AI for Ecologically Sustainable Societies

As the world stands on the brink of profound environmental and technological shifts, the urgency to address the climate and sustainability crisis has never been more pronounced. The UN Intergovernmental Panel on Climate Change (IPCC) forecasts that a 43 percent reduction in emissions by 2030 is necessary to reach the 1.5-degree goal anchored in the Paris Agreement and avert catastrophic climate change. This epoch is defined by two dominant megatrends: digitalization and decarbonization. These trends interlace the threads of technological advancement with environmental stewardship, underpinned by U.S. Special Presidential Envoy for Climate John Kerry's observation that "50% of the carbon reductions needed to get to net zero will come from technologies that have not yet been invented."

When deployed responsibly and with the necessary safeguards, AI's transformative potential to enhance sustainable development is immense. A recent peer-reviewed analysis of AI in global environmental governance showed that the EU, the UN, and the WEF each expect AI to contribute to sustainability and a prosperous future with better data analysis, greater amounts of quantitative knowledge, and by making economic and social activities less wasteful and more energy efficient. In 2021, Boston Consulting Group projected that in 2030, using AI for climate control could help reduce five to ten percent of total greenhouse gas emissions. Specific sectors such as energy and transport could see significant emissions reductions through AI applications, with Microsoft and PwC UK highlighting potential decreases of up to 2.2 percent and 1.7 percent respectively.

AI's transformative potential to enhance sustainable development is immense

Google and BCG identify three critical functions where AI can significantly address climate-related challenges: 1. by enhancing the quality of information available to individuals and organizations, thus facilitating more environmentally conscious decisions; 2. by offering more accurate forecasts to adapt to climatic changes, such as supplying instantaneous flood data that allows communities and individuals to prepare and react effectively; and 3. by generating insightful recommendations to refine climate action strategies in areas that can yield significant impacts. AI-based methods are applied for environmental management across a number of domains, some of which include:

- *Agricultural Efficiency:* AI-driven approaches in agriculture can optimize resource use, enhance crop yields, and decrease emissions.

- *Sustainable Energy:* AI can optimize energy use across systems, contributing to more sustainable consumption patterns.

- *Environmental Monitoring:* From satellite data analysis for deforestation monitoring to AI in pollution detection, the technology offers new ways to protect and manage the environment.

From an economic perspective, the deployment of sustainable AI applications provides great upside. Microsoft and PwC UK estimate that using AI for environmental applications could contribute up to USD 5.2 trilli-

on to the global economy in 2030, a 4.4 percent increase relative to business as usual.

The environmental impact of AI could extend well beyond the carbon footprint

However, the deployment of AI is not without significant environmental costs that could undermine these efforts. This dichotomy presents a critical challenge: while AI holds immense innovative potential for driving sustainability, the resources required for its operation could conversely heighten environmental stress. The energy consumption required by the extensive infrastructure of specialized computer chips and data centers could impose significant burdens on power grids and further strain environmental resources. Large-scale generative models like GPT-4 not only require immense computational power but also extensive cooling systems, which consume significant quantities of water. This demand for energy and water contributes heavily to the hidden carbon footprint of AI technologies, complicating their integration into a sustainable future. As AI systems become more complex and widespread, their energy consumption is predicted to escalate dramatically: A peer-reviewed analysis from October 2023 suggests that by 2027, AI servers could consume between 85 to 134 terawatt hours annually – comparable to the annual energy usage of countries like Argentina, the Netherlands, and Sweden, and constituting about 0.5 percent of the world's current electricity usage. The environmental sustainability of AI is therefore closely tied to the sources of this power; reliance on fossil fuels greatly exacerbates AI's environmental impact, whereas renewable sources could mitigate some of the adverse effects. The same holds true for water consumption and companies' efforts in reducing their water footprint, some of them having set themselves ambitious targets until 2030.

The environmental impact of AI could extend well beyond the carbon footprint of the technology's training and operation. This includes the intensive extraction of raw materials required for manufacturing AI hardware, such as specialized processors and data storage devices. The mining and refining of these materials often lead to significant environmental degradation, including habitat destruction, water pollution, and increased greenhouse gas emissions. AI also contributes to the rapid turnover of electronic devices, potentially worsening the e-waste crisis. This waste often contains harmful substances like heavy metals that pose environmental risks if not properly managed. The infrastructure necessary to support AI, including the construction of data centers and network systems, can also lead to habitat loss and fragmentation, thereby impacting biodiversity. Finally, AI can indirectly impact the environment through its applications. For example, AI-driven optimization in industries such as agriculture, mining, and logging can lead to increased exploitation of natural resources unless managed with environmental considerations in mind.

Navigating the multifaceted challenges of achieving sustainability in AI technologies is daunting yet essential. The obstacles are numerous and varied, ranging from insufficient awareness and prioritization of environmental goals within the AI sector to technical and financial constraints that hinder innovative progress. Governments, corporations, and academia have yet to fully focus on leveraging AI for environmental applications, often overshadowed by more immediate economic concerns. This lack of focus is compounded by a scarcity of interdisciplinary collaboration, which is critical for developing holistic AI solutions that can address complex environmental challenges effectively. Research and development are often constrained by limited access to data and funding, as well as a shortage of technical expertise. Moreover, the current investment landscape is not always structured to support the unique needs of sustainable AI development, which requires patient capital and a willingness to embrace novel, untested technologies.

AI for Socially Sustainable Societies

As societies navigate the fourth industrial revolution powered by AI, a socially sustainable society, characterized by fairness and equality, ensures that the fruits of technological advancements, such as AI, are equitably shared among all segments of the population. This is particularly critical in the domains of economy and labor, where AI's transformative potential is matched by its capacity to disrupt traditional employment patterns and economic structures.

Managing AI in a socially sustainable way hinges on the fundamental question of how this technology intersects with the broader goals of economic justice and social equity. As AI reshapes the landscape of work and productivity, it brings forth challenges and opportunities that could significantly influence societal structures. The integration of AI into various sectors and the ensuing transformation of the labor market marks a profound socioeconomic change that requires careful management, raising questions about the distribution of jobs, the nature of work, and the skills required in the future.

The impact of AI on jobs has garnered significant attention, reflecting widespread concern about the displacement of workers and the skills challenge that lies ahead. According to the IMF (2024), AI could affect almost 40 percent of jobs globally, with some being replaced and others complemented. The economic implications of AI are profound, with the potential to boost global growth and raise incomes across the world. However, this same technology could replace jobs at an unprecedented scale and deepen existing income and wealth inequalities. The consequence might be polarization within income brackets, with workers who can harness AI seeing an increase in their productivity and wages – and those who cannot, falling behind.

AI has the potential to augment human capabilities and create new kinds of jobs

The duality of AI's impact – its ability to generate economic prosperity alongside potential risks of increased disparity – places a significant burden on policymakers to craft strategies that harness AI's benefits while mitigating its adverse effects, ensuring that workers are not left behind as the economy evolves.

Historically, technological advancements have been met with both anticipation and anxiety. As early as 1930, John Maynard Keynes speculated about the potential for technological unemployment, suggesting that innovation could lead to significant job displacement. AI's potential to automate tasks – especially those involving routine or repetitive activities – can lead to significant productivity enhancements but also raises the specter of widespread job losses across diverse sectors, particularly in roles that do not require high skill levels. However, AI also has the potential to augment human capabilities and create new kinds of jobs, particularly in sectors where it acts as a tool for expansion rather than replacement.

The dichotomy of AI presenting opportunities to enhance productivity and economic growth but also posing significant risks of exacerbating income disparities and economic inequality is particularly pronounced in how the technology can impact different segments of the workforce. For higher-income roles, where AI can perform complex tasks such as data analysis or decision-making, there may be significant productivity gains. Conversely, in lower-wage roles, AI may not only replace jobs but also suppress wage growth due to the diminished bargaining power of displaced workers. In terms of experience, research shows that younger workers may find it easier to exploit AI opportunities, while older workers could struggle to adapt.

In terms of labor demand, technological innovations related to AI are believed to stimulate job creation in new sectors and industries while potentially reducing the number of jobs in traditional sectors. The net effect on employment will depend significantly on the nature of AI innovations – whether they are predominantly radical, leading to new industries and job categories, or incremental, focusing mainly on efficiency improvements within existing frameworks.

The impact of AI on labor markets also varies by economic status of countries. Advanced economies, with their high integration of technology and digital infrastructure, might face more significant disruptions stotions from AI. These economies have a higher proportion of jobs involving cognitive and analytical skills that AI can replicate or augment. The IMF highlights that while advanced economies could see nearly 60 percent of jobs affected by AI, the proportion is lower in emerging markets and significantly less in low-income countries. Emerging markets and developing countries, which may lack the financial capabilities to invest or the infrastructure to fully integrate AI, face different challenges, including fewer disruptions but also slower adoption of AI's benefits and potentially a technological dependency of economically stronger nations. This discrepancy suggests that while advan-

ced economies need to manage transition and adaptation, developing economies must focus on building capabilities and infrastructure to leverage AI effectively.

Finally, the transformative impact of AI extends well beyond the workforce, deeply influencing social cohesion. As AI drives advancements in connectivity and service access, if not managed carefully, it also risks widening social divisions, particularly if job displacement occurs without adequate support structures. Retaining social sustainability in the age of AI demands helping to manage transitions to automated economies and mitigate risks of unemployment and social fragmentation. Disparities in access to AI technologies can exacerbate existing inequalities, leaving certain groups less equipped to thrive in a digital-first society. In both professional and social realms, new skills, and life-long learning become critical to fostering resilient communities capable of withstanding the societal shifts brought about by technological change.

Global Governance of AI and Sustainability

The complexity of the AI governance landscape mirrors the technology itself—diverse, dynamic, and burgeoning, with social, economic and political influences. Today's governance landscape is populated by an array of guides, frameworks, and principles drafted by a broad spectrum of actors including the private sector, civil society, and multilateral bodies. Accenture and the WEF's AI Governance Alliance highlight two key benchmarks for assessing these AI governance strategies on the national level: firstly, the choice of governance approach, which can prioritize risks, rules, principles, or outcomes, and includes whether a comprehensive national AI strategy exists; secondly, the choice of regulatory tools, which ranges from reliance on established regulations and authorities to the crafting of new regulatory frameworks.

Amidst this diversity, the provisional agreement on the European Union's (EU) AI Act stands out as a pioneering attempt at comprehensive, binding regulation within a risk-based structure. Simultaneously, other nations, each with their own distinctive societal context, embark on their regulatory journeys – be it through India's non-regulatory approach that emphasizes innovation, China's centralized control under its New Generation Artificial Intelligence Development Plan with state-driven directives and substantial investments, or the United States' more limited approach to direct regulation under Executive Order 14110 – each reflecting unique strategies and degrees of impact.

Regarding national or regional governance approaches to the ecological sustainability of AI, the EU AI Act has introduced initial provisions to assess and mitigate the environmental impacts of AI systems. However, these provisions are seen as preliminary steps and have been criticized for not being comprehensive enough. In the United States, the introduction of the Federal Artificial Intelligence Environmental Impacts Act of 2024 signifies a growing legislative focus on the environmental consequences of AI technologies, promoting a more thorough examination of both the positive and negative effects AI has on the environment. Despite these efforts, more robust and detailed regulations are necessary.

Values-based regulation is necessary to ensure that AI is harnessed to promote sustainable societies

The national regulatory landscape to manage AI's socioeconomic impact is also still in formation, with various countries at different stages of addressing these challenges. The overarching goal is to create a balanced governance framework that integrates economic, educational and social policies to manage the transition towards an AI-integrated economy effectively.

The EU leads with a comprehensive approach, focusing on ethical guidelines and robust legal frameworks to manage AI's integration into the workforce. Legislation such as the AI Act, the General Data Protection Regulation, or the Platform Work Directive have implications for AI usage in employment contexts, safety, and adherence to fundamental rights. In contrast, the United States adopts a more sector-specific and less centralized approach: Federal agencies provide guidelines on implementing AI in ways that comply with existing employment laws, focusing on preventing discrimination and ensuring fair labor practices. Japan's Society 5.0 Initiative integrates technological advancement with social improvement, focusing on how AI can be harnessed to balance eco-

nomic advancement with resolving social problems, including employment and social cohesion. Singapore's AI Governance Framework aims to build public trust and encourage responsible AI adoption, with guidelines that indirectly affect labor, such as ensuring fairness and human oversight in AI decisions.

International governance on AI and sustainability is just in its infancy.

These diverse approaches illustrate the complexity of regulating AI's impact on sustainability on a national level alone. Relying solely on national regulation risks creating disjointed regulations that lack the necessary coherence to address the worldwide implications of AI. This can lead to gaps in legal protections and inconsistencies in standards, exacerbating environmental degradation and global inequalities. Furthermore, the transnational capabilities of AI systems make it difficult for single nations to monitor and enforce regulations effectively without international collaboration. Finally, as the pace of AI innovation increases, it magnifies the disparity between those creating AI technologies, the diverse entities implementing AI across sectors, and the regulators overseeing its progress. Consequently, AI governance in numerous regions has veered towards a model of self-regulation by the very entities that develop, deploy, and operate AI systems. Such a model, even presuming the responsible conduct of these parties, falls short in fostering a vision for addressing long-term risks or engaging a broad spectrum of stakeholders. Therefore, effective and values-based regulation at the global level is necessary to ensure that AI technologies are harnessed to promote sustainable societies worldwide. Global governance bodies can facilitate the harmonization of policies, ensuring that AI developments promote sustainability uniformly across the globe, aligning technological advances with the broader goals of environmental preservation and global justice.

Global Governance, AI, and Ecological Sustainability

The global governance of AI's environmental sustainability is still evolving, with international organizations exploring ways to leverage AI for ecological benefits. United Nations agencies are integrating AI into sustainability efforts: For instance, the UN Environment Programme has begun to examine how AI can support environmental initiatives. Additionally, UNESCO includes ethical guidelines on AI that touch on sustainable practices. The OECD has established principles advocating for AI's contribution to sustainable development, which serve as a guide for national policies. The Global Partnership on AI (GPAI), an international initiative first developed within the G7 and now hosted at the OECD, also focuses on responsible AI development and encourages international collaboration to ensure AI aligns with global environmental goals. Tasking regulators to develop a comprehensive AI policy framework in cooperation with the GPAI and the OECD, the G7 Hiroshima AI Process initiated in 2023 could play a crucial role in shaping the global governance framework for sustainable AI that is integrated with broader economic, environmental, and social policies. The initiative's main contribution lies in aligning international efforts towards the sustainable governance of AI, emphasizing the need for harmonized standards and enhanced cooperation among major industrial nations. The recent G7 meeting in June 2024 reaffirmed commitments to harmonize AI governance with sustainability goals, particularly through advancing the Hiroshima AI Process. G7 leaders stressed the need for interoperable frameworks that integrate human rights and sustainability in AI practices. They highlighted a risk-based approach to foster innovation and sustainable growth, including a new OECD-cooperated reporting framework for the International Code of Conduct for Organizations Developing Advanced AI Systems, aiming to enhance transparency, accountability, and sustainable practices in AI development. Collectively, these initiatives indicate a recognition of AI's potential impact on the environment, but the absence of binding regulations and standards underlines that the approach is currently more about encouragement and less about enforcement.

Global Governance, AI, and Social Sustainability

To ensure the social sustainability of AI through global governance, the UN actively engages with the global implications of AI on labor and education: The International Labour Organization's Global Commission on the Future of Work delivers reports and guidelines to ensure AI advancements are

inclusive and human-centered, benefiting all workers. Similarly, UNESCO's broad ethics of AI recommendations stress the importance of education and lifelong learning for adapting to AI-induced economic shifts. They advocate for member states to enrich education systems with a diverse array of core and interdisciplinary skills, preparing both current and future workforces for AI's evolving demands. Beyond the UN system, the GPAI fosters collaboration to guide the responsible development and use of AI, with working groups addressing AI's impact on labor and equitable economic outcomes. Similarly, the OECD AI Principles, adopted by over 40 countries, provide a framework for AI design and use that respects human rights and democratic values, including impacts on the labor market. Looking ahead, the expected adoption of the UN Global Digital Compact at the Summit of the Future in September could significantly impact global AI governance. After nearly two years of intergovernmental negotiations and stakeholder consultations, the current draft emphasizes inclusive and equitable AI governance to harness AI's potential for sustainable development across all SDGs. The Compact proposes creating an International Scientific Panel on AI to assess risks and opportunities and issue regular governance reports. It also calls for annual global dialogues to promote interoperability of AI safety and governance frameworks and stresses harmonizing AI standards that prioritize safety, environmental sustainability, and human rights. To bolster global AI capabilities, the Compact advocates enhanced AI capacity-building, particularly in underrepresented regions, and suggests pooling resources to increase public and private investment in AI for sustainable development. While not sufficient to address and act upon challenges holistically, the Compact has the potential to accelerate the creation of a promising multilateral regime complex for AI governance.

Overall, while significant developments in the governance of AI for ecologically and socially sustainable societies are underway, existing global frameworks are still insufficient due to several limitations that hinder their effectiveness in managing the broad impacts of AI. For instance, many existing frameworks focus narrowly on specific issues like data privacy or safety, neglecting broader environmental concerns or social impacts. Moreover, international policies frequently fail to keep pace with rapid technological advancements, resulting in outdated or inadequate protections against emerging challenges. Additionally, global governance efforts often insufficiently consider varying economic contexts and investment capabilities of countries, disadvantaging low-income countries and exacerbating global inequalities. Finally, significant concerns remain about the real-world effectiveness of these regulations, as many are either voluntary or lack robust mechanisms for enforcement, undermining their potential to mitigate AI's adverse effects on sustainability. Significant efforts are necessary to establish a robust global governance framework – a concerted effort spanning countries and sectors to bring to fruition the sustainable development, deployment, and adoption of AI.

Towards a Global Governance Roadmap

The governance of AI is a global endeavor that must aim to foster trust in technology and facilitate societal transformation in ways that uphold human dignity. Such governance should serve the common good, ensuring fairness, social responsibility, and diversity. Collaborative international governance is required to anchor the principles of sustainability at the heart of artificial intelligence moving forward.

To guide the international governance of AI towards promoting sustainable societies, the following recommendations are proposed:

1. **Establish Comprehensive Regulatory Frameworks: Work towards a global regime complex of AI governance frameworks that comprehensively address environmental, social, and economic sustainability.** These frameworks should integrate concerns beyond privacy and safety to include AI's impact on climate change, resource depletion, labor displacement, and social inequality. Guidelines should be crafted to ensure AI development is in line with the SDGs and should incorporate mechanisms for assessing environmental impacts and social equity outcomes of AI deployments.

2. **Adopt Adaptive Regulatory Frameworks: Create adaptive regulatory frameworks that respond swiftly to AI's technological advancements.** The-

se mechanisms, such as regulatory sandboxes, which allow for the experimentation and safe testing of AI technologies within controlled environments, should evolve in real-time to tackle new challenges, ensuring governance stays relevant and effective. They must remain adaptable and include provisions for periodic review and adjustment, aligning with societal values and ethical standards while accommodating the rapid pace of innovation.

3. **Promote Inclusive Governance: Enhance inclusive governance in global AI frameworks by involving all nations to reflect the global community, ensuring that AI resources and benefits are equitably accessible worldwide.** Actively engage underrepresented regions, especially low-income and emerging economies. Initiate programs to develop capacities, facilitate knowledge sharing, and provide resources to these areas to enable fair participation in AI developments.

4. **Implement Global Standards and Enforcement Mechanisms: Develop and enforce comprehensive global standards for AI that ensure ethical usage and sustainability.** These standards should be clearly defined, actionable, and grounded in international law to facilitate uniform application across all nations. Key organizations such as the International Organization for Standardization and the IEEE Standards Association should lead in drafting these standards, focusing on promoting human dignity, rights, and environmental sustainability. Furthermore, establish an international regulatory body similar to the International Atomic Energy Agency, tasked with overseeing compliance. This agency would focus on the ethical deployment of AI and its environmental impacts, working in collaboration with national regulatory bodies to harmonize and ensure consistent enforcement of these standards worldwide.

5. **Foster Multistakeholder Collaboration: Encourage and facilitate more extensive collaboration among various stakeholders, including governments, industry, civil society, and academia.** A permanent international forum for continuous dialogue, best practices exchange, and joint initiatives focused on advancing the global governance of sustainable AI should be established to facilitate the integration of diverse perspectives into AI policy-making, ensuring that policies are informed by a wide range of cultural, economic, and social contexts.

International governance on AI and sustainability is just in its infancy. Thus, much more needs to be done to ensure that international governance fully harnesses AI's potential to foster sustainable development and safeguard social justice.

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