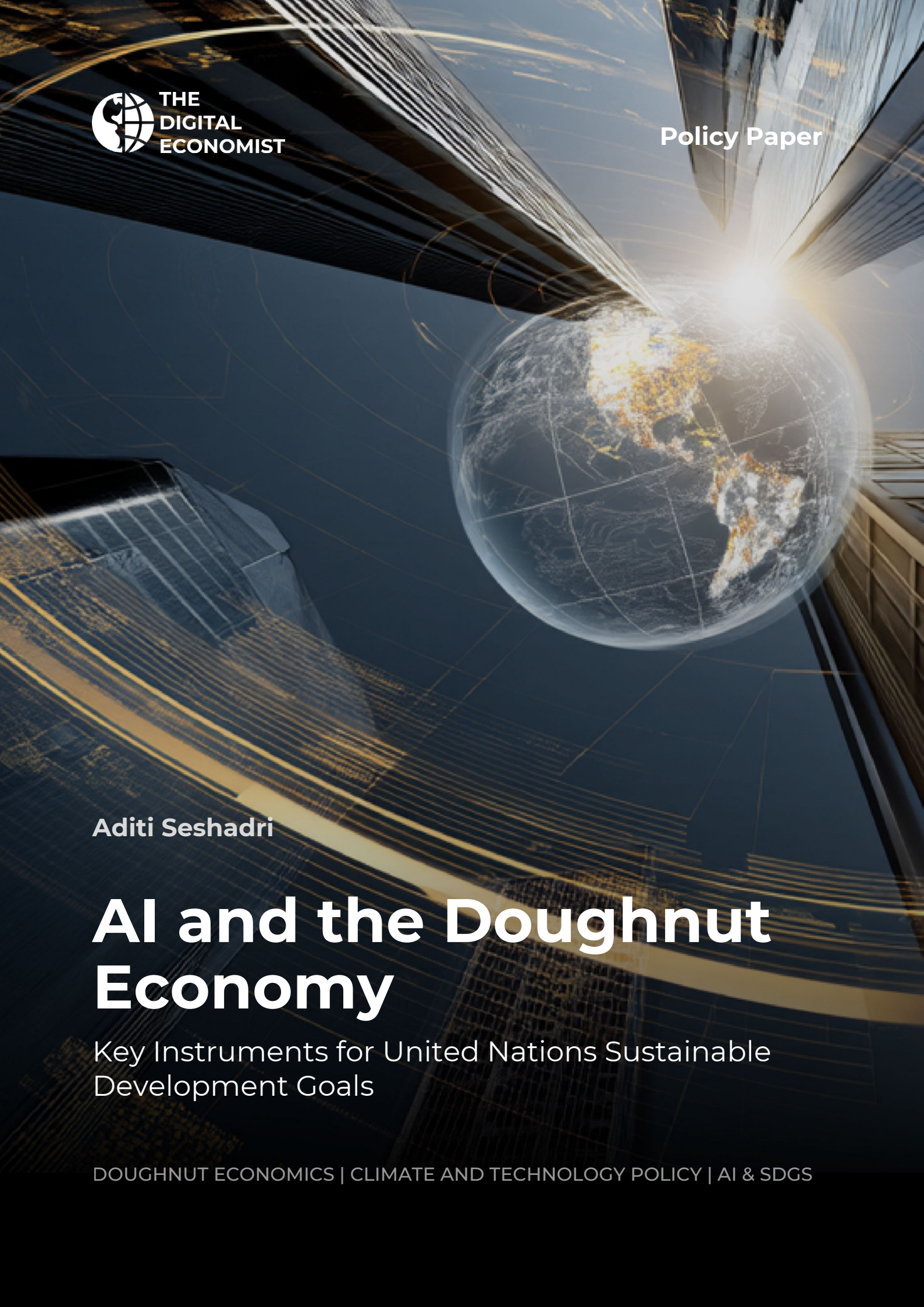

THE DIGITAL ECONOMIST

Policy Paper

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AI and the Doughnut Economy

Key Instruments for United Nations Sustainable Development Goals

DOUGHNUT ECONOMICS | CLIMATE AND TECHNOLOGY POLICY | AI & SDGS

Executive Summary

Humanity and all life on Earth face hitherto unprecedented challenges in the twenty-first century, especially the looming threat of climate change. In 2012, the United Nations created a set of 17 Sustainable Development Goals (SDGs) to address urgent environmental, political, and economic issues facing our planet (United Nations, "The 17 Goals"). Also, in 2012, British Economist Kate Raworth introduced the world to Doughnut Economics, which presents a new model for sustainable economic development that aims to meet humanity's needs without overshooting Earth's ecological limits (Raworth 2012).

This policy brief explores how AI Systems and doughnut economics intersect to advance the United Nations' Sustainable Development Goals (SDGs). Central to this analysis is the role of artificial intelligence (AI), which offers powerful tools capable of revolutionizing our approach to solving these multifaceted issues. AI's capacity to process vast data, identify patterns, and generate predictive models opens new possibilities for anticipating and mitigating global crises. Its applications in optimizing renewable energy systems, enhancing climate modeling, and improving health care resource allocation already demonstrate significant value. However, deploying AI in these crucial areas requires careful consideration of ethical concerns, potential economic implications, and disastrous environmental impacts. Without sufficient safeguards, AI could exacerbate the very problems it is assigned to solve.

This brief first reviews the Doughnut Economy model and its interconnection with the UN's SDGs. It then examines the scope and size of the challenges arising from this relationship and the urgent need for AI–driven solutions. It considers the current AI policy landscape and any potential gaps in addressing these issues at scale. Additionally, it highlights the need for a community-based strategy, global partnerships, and equitable distribution of AI benefits. Finally, it emphasizes the importance of establishing adequate policy and legislative frameworks

to guide AI system design and deployment, ensuring maximum benefits for individuals and the environment while also addressing risks such as energy consumption, data privacy, and security threats.

A holistic approach is required to harness the full potential of AI to achieve the SDGs. This approach must consider technological, environmental, social, and ethical implications. The Doughnut Economy model provides a good roadmap and metrics framework to help bind the problems and measure progress. The proposed framework aims to harmonize the Doughnut Economy model with AI–driven strategies, ultimately driving sustainable development aligned with the SDGs.

The intended audience for this paper includes economists, technologists, and government administrators responsible for policymaking at the city, state, and country levels, shaping global progress toward the UN's SDGs.

Introduction and Background

To address the global development challenges facing humanity, the United Nations has laid out a framework of 17 Sustainable Development Goals for the world to meet by the year 2030. Broadly, these break down into the following six areas of development (Gericke 2021):

1. Human well-being and capabilities
2. Sustainable and just economies
3. Food systems and nutrition patterns
4. Energy decarbonization with universal access
5. Urban and peri-urban development
6. Global environmental commons

A significant number of these relate to environmental, social, and governance factors that are key metrics for global investors. Kate Raworth's doughnut economics model offers a template for sustainable development that can be adopted locally and globally. In this dynamic landscape, AI serves as a transformative force, offering innovative solutions to complex challenges.

While all systems have demonstrated significant potential in advancing sustainable development goals, it is crucial to acknowledge and address the associated challenges. The implementation of AI in critical sectors demands a thorough examination of ethical and environmental considerations and potential economic ramifications.

1. The Doughnut Economy

Kate Raworth's doughnut economics presents a sustainable economic model that balances human needs with the planet's ecological limits (Raworth 2012). Figure 1 illustrates this framework, which visualizes a safe and just space for humanity, with the inner ring representing social foundations and the outer ring signifying ecological ceilings. Raworth advocates for economies that thrive within this balanced space, challenging traditional economic paradigms that prioritize endless GDP growth. She emphasizes the importance of viewing the economy as embedded within society and the environment, promoting cooperative human nature, systems thinking, and the design of economies that are both distributive and regenerative. Regenerative is distinct from sustainable: It involves practices that actively improve and renew systems, whereas sustainability focuses on maintaining the current state and preventing further degradation. The model has gained international traction, influencing city planning and business strategies while sparking discussions on shifting societal values regarding wealth and income. In 2020, Amsterdam became the first city in the world to officially adopt the Doughnut Economics model, incorporating it into urban development by constructing energy-efficient buildings using recycled and sustainable materials. Overall, Doughnut Economics provides a comprehensive approach to reimagining economic progress within environmental and social boundaries.

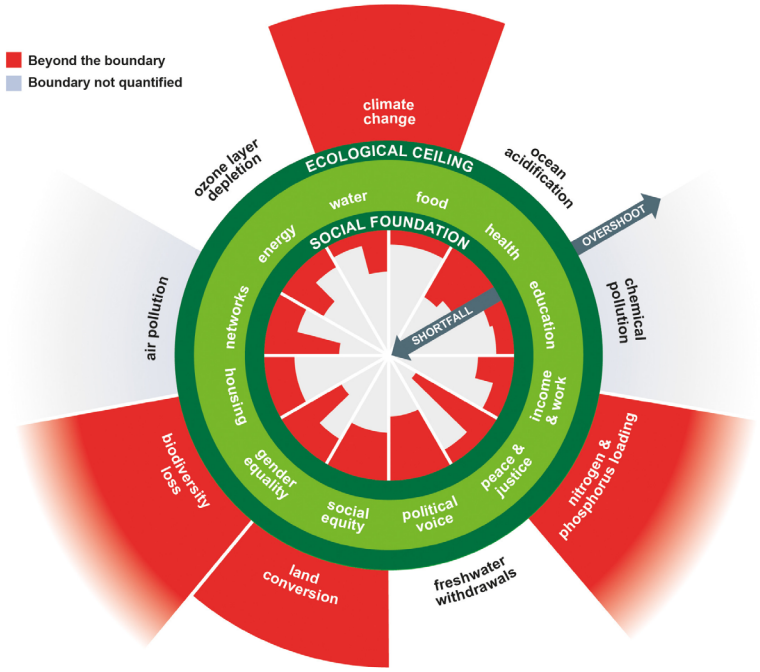

Figure 1: World Economic Forum

1.1 Benefits of the Doughnut Economy

Today's world sees an economy impacted by multifaceted inequities that have existed for centuries. Millions worldwide continue to suffer due to a lack of adequate housing, food security, and access to quality education (Raworth 2017). The Doughnut Economy offers several key benefits for fostering a more sustainable and equitable world. This innovative model aims to balance social and environmental needs within planetary boundaries. One of its primary advantages is its focus on addressing inequality by prioritizing the fulfillment of basic human needs for all while simultaneously promoting environmental sustainability through an ecological ceiling for economic activities (Peluso 2023).

The doughnut model also provides a holistic approach that integrates social and environmental concerns, encouraging long-term thinking in policymaking and business practices. Its adaptable framework applies across various scales, from local to global economies, making it versatile for different contexts (Siu 2023). Additionally, the Doughnut Economy promotes regenerative practices that reduce waste, extend product life cycles, and minimize overconsumption (Wagner 2022). By challenging traditional economic thinking and emphasizing the importance of operating within both social and planetary boundaries, the Doughnut Economy offers a promising pathway toward a more sustainable and equitable future.

1.2 Shifting Toward a Doughnut Economy

Transitioning to a Doughnut Economy framework requires a fundamental shift in how we approach economic development and measure success. This transformation is essential to addressing social inequality and environmental degradation—issues that current economic models often exacerbate (Stockholm Resilience Centre 2017).

Several key steps need to be taken in sequence to begin this shift:

1. Redefine economic goals to prioritize social and environmental well-being.
2. Implement policies that support regenerative and distributive practices.
3. Develop new metrics for measuring economic success beyond GDP.
4. Encourage businesses to adopt Doughnut Economy principles.

5. Invest in education and skills training for a sustainable economy.
6. Foster collaboration between government, business, and civil society.
7. Create incentives for sustainable innovation and green technologies.

These steps are crucial for transitioning to a Doughnut Economy, as they address the root causes of our current unsustainable economic practices. By realigning our economic goals, policies, and metrics with the doughnut model principles, we can establish a system that operates within both social and planetary boundaries (Raworth 2012). Achieving this shift requires a collaborative effort across all sectors of society and a willingness to challenge long-held assumptions about economic growth and progress. Ultimately, these steps lay the foundation for a more resilient, equitable, and sustainable economic future that benefits both people and the planet.

1.3 UN SDGs, ESGs, and the Doughnut Economy

Maike Gericke's research on the interrelationships between UN SDGs, ESGs, and the doughnut model—and the development of a mapping framework—offers us an executable roadmap for measuring progress toward the UN's SDG (Gericke 2021). Figures 2 and 3 illustrate how the SDGs map to ESG principles and the doughnut economics model. This roadmap provides individuals, governments, institutions, economists, scientists, and technologists clear, well-developed targets and actionable steps for both individual and collective implementation.

This framework requires capturing, storing, processing, managing, and measuring a vast array of data and information. AI tools can play an important role in achieving measurable progress within a reasonable timeframe. However, the use of AI to support sustainable development must not itself become a barrier to sustainability. In other words, while AI can help address the SDG problems, it must not evolve into a "wicked problem"—a solution that inadvertently creates new issues. A more integrated approach is necessary—one where AI is not treated as an add-on to the framework but as an integral component to the framework's success.

SDGs mapped
to ESG targets

mapping according
to Berenberg, 2019

Figure 2: UN SDGs and ESGs

Sustainable Development Goals
mapped to the Doughnut Model

Figure 3: UN SDGs and The Doughnut Model

The next section describes the role of AI in greater detail by analyzing the various applications of AI in promoting sustainable development and the important steps required to ensure that AI plays this integrative role.

2. The Role of AI

Artificial Intelligence is a powerful enabler for implementing and refining the Doughnut Economy model, offering innovative solutions beyond traditional data analysis.

Urban planning and development

One of AI's most promising applications is in urban planning and development. AI–powered simulations can model entire city ecosystems, allowing planners to visualize how different policies and interventions might impact both social and environmental factors within the doughnut framework. For example, the city of San Francisco is exploring options such as repurposing underutilized space—like converting an eco park or a golf course near public housing into an urban farm (C40 Cities, "Scaling Up Climate Action"). These models help optimize resource allocation, improve public transportation systems, and design more inclusive and sustainable urban spaces.

Investments and operations

AI also plays a key role in investments and business operations. AI algorithms can evaluate investment portfolios for their alignment with Doughnut Economy principles, enabling investors to make more informed decisions that support both social equity and environmental sustainability (Marmon). In daily operations, AI–driven supply chain management systems can track and verify the social and environmental impacts of products throughout their life cycle, promoting transparency and accountability in global trade (Nature Communications).

To fully harness AI's potential in advancing the Doughnut Economy, several key steps are necessary:

- Develop AI–enabled participatory platforms for community engagement in local doughnut initiatives.
- Create AI systems that can identify and quantify regenerative economic opportunities (those that are designed to improve and renew) that align with the Doughnut Economic model.
- Implement AI–driven early warning systems to detect potential breaches of social or ecological boundaries.
- Design AI tools to enhance cross-sector collaboration on Doughnut Economy projects.

- Establish AI–powered marketplaces for Doughnut Economy solutions and sustainable innovations.
- Invest in AI research focused on measuring and enhancing social and ecological resilience.
- Develop AI applications for personalized sustainability guidance and behavior change support.
- Enlist interdisciplinary teams to review the ethical use of AI, including assessments of environmental risks such as energy and water consumption.

These steps are crucial because they promote dynamic, inclusive, and responsive approaches to implementing the Doughnut Economy. By leveraging AI in these ways, feedback loops can inform and refine economic strategies, ensuring they remain within social and ecological boundaries. AI integration into Doughnut Economy initiatives can also help bridge the gap between global goals and local actions, making the model more accessible and actionable at various scales. Ultimately, these AI–driven approaches can accelerate the transition toward a more regenerative and distributive economic system, aligning technological innovation with the principles of social and environmental sustainability.

3. Current Policy Landscape

AI has played a pivotal role in addressing a myriad of issues in health care, education, and climate change. In 2018, AI's capabilities ranged from natural language processing to sound recognition and tracking. At that time, AI had around 170 recognized use cases, but in the past six years, that number has tripled to approximately 600 (Chui et al. 2018). This rapid expansion has been particularly notable in the fields of Doughnut Economy and climate health.

For instance, AI is being leveraged to develop evidence-based technological solutions for climate-health mitigation and adaptation, as demonstrated by projects at the University of Oxford (University of Oxford 2024). Its potential to boost data-driven policymaking for the Doughnut Economy has also been recognized, given its ability to process vast datasets and identify patterns that inform more effective policies (McKinsey & Company 2024). In the realm of taxation, generative AI is being explored for its ability to revolutionize tax compliance and administration in support of Doughnut Economy initiatives (OECD). More broadly, AI plays a key role in mapping innovations and measuring their impact on the Sustainable Development Goals (SDGs). These 17 SDGs tackle global challenges across critical areas such as climate change, environmental degradation, food security, health, inequality, and poverty alleviation (The Global Goals).

The current AI policy landscape focuses on research and development of AI tools for statistical analysis in key areas such as health care, education, climate change, the Doughnut Economy, taxation, and the broader Sustainable Development Goals (SDGs).

To fully leverage AI's benefits while mitigating risks, policymakers emphasize the following actions:

- Develop a community-based strategy to align and address shared challenges in AI adoption for sustainable development.
- Strengthen global partnerships between companies, nations, and academic institutions (GPAI).
- Ensure equitable distribution of AI benefits, including access for vulnerable and marginalized communities (UNESCO).
- Establish firm policy and legislative frameworks to direct AI's vast potential toward individual and environmental well-being, as well as SDGs achievement (European Commission).
- Reduce polarization triggered by social media by promoting diverse perspectives and limiting AI's potential behavioral manipulation.
- Expand legislation on AI transparency and accountability while defining ethical standards for AI–based technology(COE).

Figure 4 showcases the roles of various key stakeholders in shaping AI's interaction with society. It highlights the urgent need for interconnected institutions to effectively regulate AI's future.

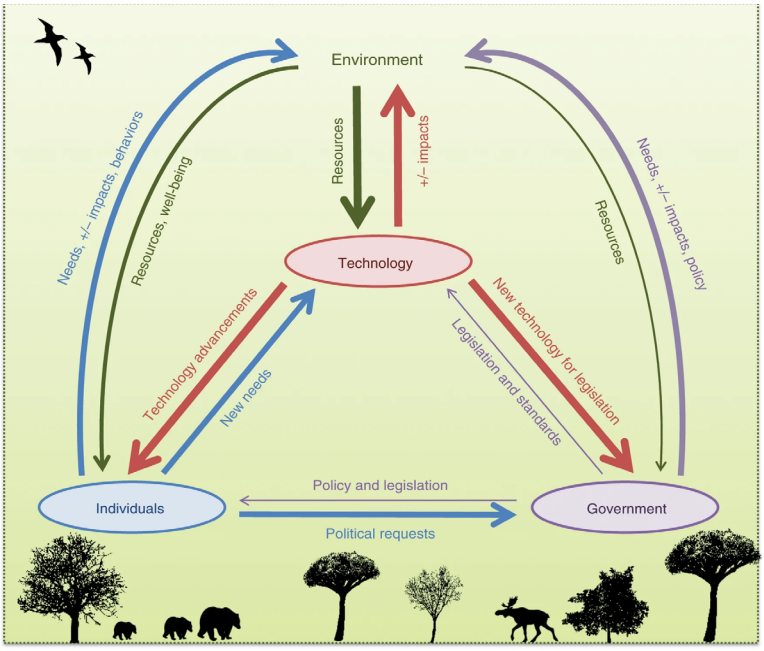

Figure 4: Depiction of Interconnections

3.1 Gaps in the Existing Policy Landscape

AI systems can sometimes be counterproductive, as they require enormous amounts of energy and water, posing a significant but often overlooked environmental challenge. Large language models and generative AI, in particular, consume vast resources. Training a single AI model can emit as much carbon as five cars over their lifetimes while using up to 700,000 liters of clean freshwater for cooling (Chui et al. 2018). This level of resource consumption directly contradicts sustainability goals and exacerbates existing environmental challenges.

The scale of AI's water usage is staggering. Research projects that by 2027, AI's water consumption will reach between 4.2 billion and 6.6 billion cubic meters—nearly half of the UK's annual water consumption (Lenton et al. 2023). This is primarily due to the cooling needs of massive data centers to cool servers running complex AI models. While some water can be recycled, a significant amount evaporates, leading to substantial net water loss.

Tech giants like Microsoft, Google, and Meta have pledged to replenish more water than they use by 2030, but experts argue that these measures are insufficient (Gordon 2024). Greater transparency and accountability from AI firms are essential, including detailed disclosures on water consumption and environmental impact. Additionally, adopting innovative cooling technologies and optimizing existing systems can help reduce water use.

As AI becomes more prevalent, understanding its hidden water footprint is crucial for developing effective sustainability strategies. This includes not only cooling data centers but also the water-intensive electricity generation required to power them. Addressing these challenges head-on requires collaboration among tech companies, policymakers, and environmental organizations to ensure technological innovation aligns with environmental stewardship (Gupta et al. 2024).

To fully harness AI's potential in achieving the SDGs, a holistic approach is needed—one that considers not just technological aspects but also the environmental, social, and ethical implications of AI deployment. A promising framework that aligns with the perspective is the Doughnut Economy.

4. Proposed Policy Framework

The field of Applied AI spans a variety of tools and mechanisms designed to improve everyday activities. As described in the previous sections, AI benefits institutions, industry, academia, and even world-changing activities such as the SDGs, impacting humanity as a whole. While the possibilities of Applied AI seem limitless, its development and deployment raise serious ethical and moral concerns, necessitating a policy framework to ensure responsible use. Incorporating Doughnut Economy principles adds a new dimension to this discussion, helping to guide AI advancements within sustainable and equitable boundaries.

This section provides specific guidance on how to apply Doughnut Economy principles to ensure the judicious use of AI in support of sustainable development and SDG alignment.

- Leverage AI for resource efficiency by improving statistical analysis, reducing waste production, and enhancing recycling and reuse processes.
- Foster collaboration across organizations (e.g., companies, cities, industries) to implement AI–driven sustainability solutions.
- Regulate AI usage within the doughnut economy framework to prevent unintended negative impacts.
- Develop measurement tools to assess AI's success and impact on various communities.
- Monitor progress and maintain equilibrium within the doughnut model using AI–driven insights.
- Use AI as a support tool for individuals and institutions adopting doughnut models, accelerating SDG progress.
- Establish AI as a universal tool for sustainable development, ensuring accessibility and ethical implementation.

Figure 5: Proposed Framework: AI (represented by arrows) integrated into the doughnut model

Figure 4 shows AI as a fully integrated component of the doughnut model, connecting various UN SDGs. The arrows depict AI's role in collaboration, measurement, monitoring, regulation, language, and support, demonstrating its impact across the framework.

Conclusion

This policy brief underscores the transformative potential of Artificial Intelligence in addressing the United Nations' Sustainable Development Goals. AI's ability to optimize resource management, enhance environmental protection, and support economic growth makes it an indispensable tool in advancing global sustainability and social equity. However, its deployment must be approached with caution to mitigate associated risks, such as ethical concerns, high-energy consumption, data privacy, and security threats, to ensure responsible use.

Integrating Doughnut Economy principles adds a new dimension to this narrative, offering a structured framework to maximize AI's benefits while minimizing its drawbacks. By designing products to reduce waste, extend material life cycles, and incorporate recycling, the Doughnut Economy significantly improves resource efficiency and lowers environmental impact, ensuring AI contributes meaningfully to sustainable development aligned with the SDGs.

In conclusion, AI has the power to accelerate progress toward the UN's SDGs, influencing industries, economies, and daily life. However, its deployment must be carefully managed to maximize benefits and minimize harm. By integrating AI with circular economy principles, we can harness its potential to drive sustainable innovation. Moving forward, it is crucial to develop and implement AI technologies ethically, ensuring they support long-term environmental balance and social well-being.

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