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Advancing Symbiosis: The Confluence of Green AI and Labour Rights in Paving the Way for a Sustainable Future

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Abstract

The intersection of Green Artificial Intelligence (GAI) and labour represents a significant step towards global sustainability. As AI technology evolves, many advancements focus on energy efficiency and eco-friendly practices, offering solutions to climate challenges. However, these advancements also raise significant concerns about labour rights, including job loss and changes in work conditions. The primary challenge is striking a balance between environmental goals and the protection of workers' interests. Policymakers need to establish clear principles to ensure that AI systems are fair, transparent, and accountable. Additionally, embracing GAI creates new opportunities, highlighting the need for ongoing training and skills development. This research paper aims to provide a comprehensive overview of AI and its regulatory frameworks across different countries, highlighting how these regulations shape the development and deployment of AI technologies. The paper will define Green AI and present case studies illustrating its application in various companies, with a focus on how these implementations address environmental sustainability. The paper will also identify and discuss the challenges associated with integrating Green AI into existing systems and practices. Additionally, it will analyse the impact of AI on labour rights, exploring how technological advancements affect working conditions and employment practices. Finally, the paper will offer recommendations on how to navigate the complexities of AI and Green AI, ensuring ethical and equitable outcomes.

Keywords: GAI, AI, sustainability, labour rights, algorithms, innovation

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1. Introduction

Artificial intelligence (AI) and machine learning have attracted attention for decades, often being depicted in science fiction as technology that will enslave humanity. Despite this dramatic portrayal, AI has become a new reality, and companies across various industries are incorporating AI into their corporate processes. Featuring not only the imaginative future envisioned by science fiction writers, AI now forms an integral part of the plans and everyday operations of companies, governments, and healthcare systems worldwide.[1] This reality has shifted academic interest away from the performance of AI to the effects or outcomes of its applications.[2]

Artificial Intelligence is generally described as machinery or any non-human entity that is designed to embark on some tasks. According to Russell and Norvig (2016), AI systems operate like the learning, speech, and problem-solving abilities of human beings.[3] In addition, AI refers to a system's ability to understand data, learn, and determine how to manipulate this data to produce specific outputs through versatility.[4] Big data has, therefore, improved the capability of AI algorithms in tasks such as game-playing and auto-scheduling.[5] Artificial Intelligence is capable of assuming duties and responsibilities hitherto performed by humans. It should be noted, however, that, at present, sophisticated human emotions and other cognitive functions continue to pose a challenge for AI.[6]

Artificial Intelligence yields positive outcomes such as efficiency and productivity, but some people argue that AI will cause significant job losses. Indeed, 32% of current work activities are expected to be automated by 2030, and individuals in low-skill jobs may be disproportionately affected, particularly in emerging economies.[7] Globalisation, demographics, and technological changes have significantly influenced labour law and, in turn, the quality and supply of labour. Artificial Intelligence and machine learning have raised serious questions about the future of standard working

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[1] Yogesh K Dwivedi and others, 'Artificial Intelligence (AI) Multidisciplinary Perspectives on Emerging Challenges, Opportunities, and Agenda for Research, Practice and Policy' (2021) 57 *International Journal of Information Management* 101994 1, 2.
[2] ibid.
[3] Stuart J Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (3rd edn, Pearson 2016) 5.
[4] James Hays and Alexei A. Efros, 'Scene Completion Using Millions of Photographs' (2007) 26 *ACM Transactions on Graphics* 4-1, 4-4.
[5] ibid.
[6] ibid.
[7] James Manyika and others, 'A Future That Works: Automation, Employment, and Productivity' (*McKinsey Global Institute*, 12 January 2017) <https://www.mckinsey.com/featured-insights/digital-disruption/harnessing-automation-for-a-future-that-works> accessed 19 August 2024.

conditions, basic working culture, fair treatment, social integration, and inclusion, as well as the safety of social environments and practices.[8]

Artificial Intelligence and concerns over automation have been addressed by the World Economic Forum (WEF), which forecasts that AI technologies could compromise one-fifth of UK employment.[9] Countries such as China and India could lose even a third of their current jobs because industrial manufacturing is likely to be transformed by AI technologies.[10] At the same time, it is also expected that AI will boost innovation, generating 133 million new jobs worldwide and increasing Gross Domestic Product, particularly in China.[11]

Green AI (GAI) is now a significant factor due to the global focus on sustainability and businesses' commitment to taking environmentally friendly actions. Green AI constitutes a novel approach to developing and using technology that prioritises environmental sustainability.[12] As AI technologies are implemented in various spheres, concerns about energy consumption, carbon footprint, and environmental impact have become increasingly important. This transition is not yet a trend but a shift towards environmental consciousness.

Discussions in the scholarly literature have also emphasised the need for incorporating environmental perspectives into the development of AI. For example, studies have revealed that the energy cost of AI, particularly in deep learning, remains high. It has been discovered that training a single large AI model can emit as much carbon dioxide as five cars in their entire lifetime.[13] This awareness has prompted the need to practise responsible AI that uses energy-efficient algorithms.[14]

In addition, the push towards GAI is also reflected in policies and industry actions aimed at making AI more environmentally friendly. For instance, the European Union (EU) has released recommendations on AI that are noteworthy, including one standard for environmentally sustainable AI.[15] These endeavours highlight the

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[8] Alberto Pizzoferrato, 'Transformation of Work: Challenges to Labour Law' (2023) *Challenges to Labour Law and Social Security Systems-Atti del XXIII Congresso Mondiale ISLSSL, Lima, Peru, 7-10 settembre 2021*. Sociedad Peruana de Derecho del Trabajo y de la Seguridad Social 35.
[9] World Economic Forum, 'The Future of Jobs Report 2018' (*World Economic Forum*, 2018) <http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf> accessed 19 August 2024.
[10] ibid.
[11] ibid.
[12] Roy Schwartz and others, 'Green AI' (2020) 63(12) *Communications of the ACM* 54,69.
[13] Emma Strubell, Ananya Ganesh and Andrew McCallum, 'Energy and Policy Considerations for Deep Learning in NLP' (2019) *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics* 3645, 3696.
[14] Schwartz (n 12) 66.
[15] European Commission, *White Paper on Artificial Intelligence: 'A European Approach to Excellence and Trust* (European Commission, 19 February 2020)' <https://commission.europa.eu/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en> accessed 19 August 2024 12. According to the *Oxford*

growing awareness that ecological imperatives should guide technological advancements and that improvements brought about by AI should not harm the environment.

This paper provides an overview of the governance of AI in various parts of the world. It then examines the relationship between AI in general, GAI, and labour relations. It highlights the problems of this convergence for labour rights. Where industries have implemented AI solutions in their operations, issues such as worker displacement, changes to employment terms, and biased AI systems have become contentious. Consequently, meeting environmental management objectives without compromising workers' rights is a central management dilemma that needs to be addressed systematically.

The paper examines whether the synthesis of environmental protection through GAI and labour rights can influence the further development of global progress. It highlights how the advancement of GAI, particularly in energy-efficient algorithms and environmentally friendly methods, constitutes a step towards conserving natural resources.

The paper argues that GAI represents a transition that can improve several aspects of life, including environmental conservation and fair employment. When adopted as a model, GAI fosters a healthier planet while also promoting corporate leadership in ethical and responsible technological development.

Lastly, the paper calls for promoting the concept of GAI while incorporating ethical labour policies and frameworks by offering recommendations. In addition, the role of education and retraining for the labour force in shifting towards the GAI environment is imperative.

2. Regulation of Artificial Intelligence (AI) in Various Parts of the World

The rapid advancement of AI has left nations searching for effective ways to manage its growth and use. Its governance regulates its development and ethical use. The paragraph below discusses how AI is governed in various jurisdictions, including the European Union, the United States of America, China, and emerging markets.

English Dictionary (Oxford University Press) 'algorithm' www.oed.com, an algorithm is defined as a set of rules that must be followed when solving a particular problem. It can also be defined as a set of instructions or directions for carrying out a specific task. Machine learning algorithms are used to find patterns in data. An algorithm enables the machine to learn from data and gradually enhance its decision-making abilities.

2.1 European Union

The EU's AI Act[16] is one of the first legislative initiatives of its kind to regulate AI systems. It is based on a risk-based approach, classifying AI systems into four categories: unacceptable, high, limited, and minimal risk. For high-risk AI systems, the AI Act suggests legal requirements in Article 6(2) and Annex III. The critical areas where high-risk AI is used include healthcare, education, employment, law enforcement, and biometric identification. These high-risk systems are also considered legal high-risk systems, entailing regulatory obligations in terms of conformity assessment, which trigger requirements for data readiness, transparency, and documentation, among others. Furthermore, the Act states that the use of AI in decision-making processes must be explained to individuals. This requirement becomes crucial when AI is applied in employment and biometric identification processes where cases of misuse can have negative implications.[17]

Critical to AI governance in the EU is the regulation of personal data collection, storage, and processing specified by the General Data Protection Regulation (GDPR). Adaptations of AI systems rely on large databases; however, under the GDPR, organisations must ensure the proper treatment of personal data. Relevant articles of the GDPR concerning the governance of AI include Article 22, which governs the use of purely automated decisions, including profiling. Individuals have the right not to be subject to a decision based solely on automated processing if the decision significantly affects them. Article 15 of the GDPR includes the right to an explanation of an automated decision-making system. The GDPR ensures that AI development in the EU prioritises rights, privacy, and data protection.[18]

2.2 United States of America

The United States of America (USA) has not passed a clear statute regulating AI, resulting in a fragmented approach to AI regulation. The government allows the market to operate freely; market forces are heavily relied upon, and the fundamental operation of the economy is regulated by direction rather than structure. The National Artificial Intelligence Initiative Act of 2020 aims to strengthen and promote

[16] Regulation (EU) 2024/1689.
[17] EU Artificial Intelligence Act, 'Annex III: High-Risk AI Systems Referred to in Article 6(2)' (*Artificialintelligenceact.eu*, 2016) <https://artificialintelligenceact.eu/annex/3/> accessed 5 April 2025.
[18] Official Journal of the European Union, 'Regulation (EU) 2016/679 (General Data Protection Regulation)' (2016) OJ L119/1 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679> accessed 24 September 2024.

the United States' AI policy at the federal level, focusing on research, development, and governance to advance the development of AI technology.[19]

Another AI framework is the AI Risk Management Framework developed by the National Institute of Standards and Technology (NIST), which focuses on managing risk related to AI.[20] Although the framework promotes transparency, fairness, and accountability, it lacks legal enforcement. There are also state-level driven approaches seen in the USA, such as the California Consumer Privacy Act of 2018 (CCPA), which has aligned efforts in regulating AI, particularly in data privacy.[21] Still, the United States lacks comprehensive federal AI legislation similar to the EU's AI Act. This position has fuelled criticism that the USA is lagging in the ethical use of AI technologies.[22]

2.3 China

China has focused on AI regulation as part of its proactively planned global strategy and long-term plan to become an AI superpower by 2030. The New Generation Artificial Intelligence Development Plan outlines plans for integrating AI into various areas of the Chinese economy while establishing reliability measures and ethical standards. [23]

The distinctive characteristic of China's AI governance approach is the intense focus on state control and centralisation as opposed to the market-based approach characteristic of AI governance in the USA. The governance of AI in China is heavily influenced by its overarching political goals, which prioritise stability and security. The government utilises AI, for instance, in surveillance, the social credit system, and issues related to privacy, human rights, and the potential misuse of AI systems. [24] China has also set rules to regulate the use of artificial intelligence. The main components of the Beijing AI Principles are transparency, fairness, and accountability;

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[19] Congress.gov, 'National Artificial Intelligence Initiative Act of 2020, Pub L No 116-283, 134 Stat 3388 (2021)' <https://www.congress.gov/bill/116th-congress/house-bill/6216> accessed 10 September 2024.

[20] NIST, 'AI Risk Management Framework' (2024) <https://www.nist.gov/itl/ai-risk-management-framework#:~:text=The%20NIST%20AI%20Risk%20Management,products%2C%20services%2C%20and%20systems> accessed 10 September 2024.

[21] Justia, 'California Consumer Privacy Act of 2018, Cal Civ Code § 1798.100' (2018) <https://law.justia.com/codes/california/2018/code-civ/division-3/part-4/title-1.81.5/section-1798.100/#:~:text=Next-,1798.100.,information%20the%20business%20has%20collected> accessed 10 September 2024.

[22] ibid.

[23] Graham Webster and others, 'Full Translation: China's "New Generation Artificial Intelligence Development Plan" (2017)' (*Digichina*, 1 August 2017) <https://digichina.stanford.edu/work/full-translation-chinas-new-generation-artificial-intelligence-development-plan-2017/> accessed 10 September 2024.

[24] ibid.

however, these principles operate within the context of omnipresent state control and surveillance logic.[25]

2.4 Emerging Markets

In emerging markets, AI governance is evolving as nations increasingly acknowledge AI's transformative potential for economic growth while grappling with challenges related to infrastructure, resources, and regulatory capacity. South Africa has initiated essential steps through the Presidential Commission on the Fourth Industrial Revolution (PC4IR), which explores governance frameworks for AI that align with the country's socio-economic goals. This Commission aims to assess how AI can enhance sectors such as manufacturing, education, and public services while also addressing issues including inequality and digital inclusion. The primary challenge remains ensuring access to the necessary digital infrastructure to implement AI-driven solutions across diverse industries.[26]

At the continental level, the African Union (AU) has introduced an Artificial Intelligence Framework for Africa, which promotes ethical AI that fosters inclusion, equality, and sustainable development. The framework recognises the risks associated with rapid AI adoption and the potential for exacerbating digital divides across African nations. However, implementing this vision has been challenging due to disparities in technological readiness and regulatory capacity across the continent. Countries with more advanced infrastructure, such as Kenya and Rwanda, have adopted AI-driven innovation more rapidly than other countries, further underscoring the importance of cross-border collaboration and capacity building.[27]

In India, AI governance has evolved through a hybrid approach balancing regulatory oversight with a strong emphasis on innovation. The NITI Aayog, the Indian government's policy think-tank, has spearheaded the development of the National AI Strategy.[28] This framework focuses on harnessing AI to address societal challenges,

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[25] Beijing Academy of Artificial Intelligence, 'Beijing AI Principles' (2019) <https://link.springer.com/content/pdf/10.1007/s11623-019-1183-6.pdf> accessed 14 September 2024.

[26] South African Government, 'Presidential Commission on Fourth Industrial Revolution: Members and terms of reference' <https://www.gov.za/documents/notices/presidential-commission-fourth-industrial-revolution-members-and-terms-reference> accessed 12 September 2024.

[27] African Union, 'Continental Artificial Intelligence Strategy' (9 August 2024) <https://au.int/en/documents/20240809/continental-artificial-intelligence-strategy#:~:text=The%20Continental%20AI%20Strategy%20calls,inclusive%20and%20responsible%20AI%20development> accessed 12 September 2024.

[28] NITI Aayog, 'National Strategy for Artificial Intelligence #AIFORALL' (June 2018) <https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf> accessed 10 September 2024.

particularly in sectors such as healthcare, agriculture, and education, where AI can improve service delivery, increase productivity, and reduce resource consumption. At the same time, the strategy outlines the importance of ethical AI, including concerns over data privacy and algorithmic fairness. India is also working on a comprehensive Personal Data Protection Bill, which, once enacted, will provide crucial regulatory oversight for data processing activities, including those driven by AI.[29] The governance approach aims to strike a balance between innovation and the protection of citizens' rights, particularly in the light of concerns about the misuse of data in AI applications.

3. Understanding Green Artificial Intelligence

Green AI involves the practice of developing and deploying AI technologies with a strong emphasis on environmental sustainability.[30] This concept arises from the recognition that, although AI offers significant advancements in efficiency and innovation, its implementation can also lead to substantial environmental impacts, including high energy consumption and increased greenhouse gas emissions. Green AI aims to address these concerns by integrating ecological considerations into the design, deployment, and operation of AI systems.[31] The growing energy demands of AI, particularly in large-scale models like GPT-3, underscore the urgent need for sustainable solutions. Policies and industry initiatives, such as renewable-powered data centres and hardware optimisations, shape a more sustainable AI future. As discussions at COP29 emphasised, Green AI is not just a technological goal but a critical responsibility in addressing climate change.[32]

At the 29th Conference of the Parties (COP 29), the United Nations Climate Change Conference, held in Baku, Azerbaijan, from November 11 to 22, 2024, experts from Deloitte, NVIDIA, and the International Energy Agency discussed AI's growing energy demands and the need for sustainable solutions.[33] Deloitte's report predicts that AI-driven data centres could consume up to 2,000 TWh of electricity by 2050, accounting

[29] PRS Legislative Research, 'The Personal Data Protection Bill, 2023' <https://prsindia.org/billtrack/digital-personal-data-protection-bill-2023> accessed 10 September 2024.
[30] Strubell (n 13) 1063. See also S Saptakee, 'Green AI Explained: Fueling Innovation with a Smaller Carbon Footprint' (*Carbon Credits*, 9 December 2024) <https://carboncredits.com/green-ai-explained-fueling-innovation-with-a-smaller-carbon-footprint/> accessed 5 April 2025, where it is explained that Green AI is an approach that seeks to balance the benefits of artificial intelligence with environmental sustainability by reducing its carbon footprint. Traditional AI models require substantial computational power, resulting in high energy consumption and significant carbon emissions. By contrast, Green AI prioritises energy-efficient practices through optimised algorithms, sustainable data centres, and hardware improvements.
[30] Schwartz (n 12) 13.
[31] Strubell (n 13) 1063.
[32] Saptakee (n 30).
[33] ibid.

for approximately 3% of global electricity consumption. Innovations such as NVIDIA's liquid-cooled GPUs and accelerated computing make AI more energy-efficient, with up to a 96% reduction in energy use for AI inference. Green AI strategies focus on renewable energy, efficient hardware, and optimised algorithms to minimise AI's carbon footprint. With AI playing a key role in energy management and climate modelling, COP29 discussions emphasised the importance of powering AI infrastructure with renewable energy to align its rapid growth with global sustainability goals. [34]

One of the primary objectives of GAI is to enhance the energy efficiency of AI systems. This extension involves developing approaches and models that require fewer computational resources, thereby reducing energy consumption. In this case, the models undergo optimising methods such as pruning, quantisation, and knowledge distillation.

Pruning entails reducing a model and its components, such as weights or neurons, which are not crucial, based on the model's performance.[35] This reduction makes the model more straightforward, allowing it to run faster with limited computational resources. Quantisation increases efficiency by simplifying the computer's work by halving the number of decimal points in the parameters, for example, changing the precision of numbers from 32-bit to 8-bit.[36] This simplification reduces the memory requirements and enhances the model's speed, which is crucial for real-time operation.[37] Lastly, knowledge distillation occurs when a smaller and relatively more straightforward model, referred to as the student, attempts to replicate the behaviour of a larger and more complex model, referred to as the teacher.[38] In this way, the smaller model retains most of the high accuracy of the initial larger model but with a significantly smaller size and improved compatibility. Together, these techniques enable the creation of efficient models that deliver high performance while requiring fewer computational and memory resources.[39]

In addition to managing energy intake, GAI aims to reduce the greenhouse gas emissions associated with the use of AI systems. This decrease includes powering data centres and AI systems through renewable energy such as wind, solar, and hydro power.[40] This shift helps to reduce the carbon impact of the implemented AI technologies.

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[34] ibid.
[35] Song Han and others, 'Learning Both Weights and Connections for Efficient Neural Networks' (*arXivorg*, 2015) <https://arxivorg/abs/1506.02626> accessed 5 April 2025.
[36] ibid.
[37] ibid.
[38] ibid.
[39] ibid.
[40] Schwartz (n 12) ''*13.*

Innovative building technologies are another good example of applying GAI in the management and control of energy usage in buildings.[41] These technologies utilise AI to make buildings smarter by adapting their systems to current situations.[42] Lighting, heating, and cooling are all regulated by AI-based systems dependent on current data, including occupancy and the surrounding environment.[43] For example, AI can turn lights on or off when no one is in the room or adjust the heating and cooling to enhance energy usage. This advance not only achieves energy savings but also improves the effectiveness of the building's operation, thereby reducing both energy and operational costs. Research has shown that utilising the technologies mentioned above can result in energy savings of up to 30% in commercial buildings.[44]

Another practice aligned with the GAI principles includes remote working and the use of video and related meeting tools. The practice of virtual meetings minimises physical movement, leading to reduced emissions from commuting and business travel. Observing the impacts of COVID-19, including the widespread adoption of remote work, one may reasonably conclude that constant virtual collaboration can help reduce carbon emissions on a global scale.[45] Studies show that remote work can lead to a 60% reduction in energy consumption and carbon emissions, primarily because employees use their cars less frequently.[46]

3.1 Real-World Applications of Green AI: Case Studies

3.1.1 Siemens

Siemens takes the lead in practising GAI not only in its operations but, more specifically, in executing its innovative infrastructure. The company utilises AI to manage its energy needs and activities efficiently. For instance, the systems used by Siemens in smart buildings enable the control of heating, cooling, and lighting according to the number of people inside and the prevailing environmental conditions, thereby saving energy.[47] Siemens has also committed itself to sourcing renewable energy to power its AI-driven framework for achieving the Sustainable Development Goals.[48]

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[41] Ibid.
[42] ibid.
[43] ibid.
[44] ibid.
[45] World Economic Forum, 'The Future of Jobs Report 2020' (*World Economic Forum*, 20 October 2020) <https://www.weforum.org/reports/the-future-of-jobs-report-2020> accessed 19 August 2024.
[46] Andrew Hook and others, 'A Systematic Review of the Energy and Climate Impacts of Teleworking' (2020) 15 *Environmental Research Letters* 093003 <https://iopscience.iop.org/article/10.1088/1748-9326/ab8a84> accessed 5 April 2025.
[47] Siemens, 'Sustainability at Siemens: Siemens Greener Than Ever Before' (*Siemens*, 2020) <https://new.siemens.com/global/en/company/sustainability.html> accessed 19 August 2024.
[48] ibid.

Additionally, Siemens has pledged to programmes such as the Science Based Targets initiative (SBTi), which supports the United Nations (UN) Agenda to limit the temperature increase to 1.5°C. This commitment also forms part of the company's overall strategic plan to decrease the carbon impact within the organisation.[49] Siemens is also part of the Climate Group's efforts to promote the adoption of electric vehicles (EVs) through the EV100 initiative and to enhance electrical energy productivity through the EP100 initiative, as well as the shift towards renewable energy sources.[50] Siemens's partnership with the UN, primarily through the COP and the United Nations Global Compact (UNGC) working group on climate, shows its commitment to taking necessary action towards climate change. Besides, Siemens is involved in the United States Department of Energy's Better Buildings Campaign, which focuses on energy efficiency, as well as the World Bank's Carbon Pricing Leadership Coalition (CPLC), which supports carbon pricing for healthier economic growth.[51] Siemens has been actively involved in various partnerships, including the World Economic Forum's Clean Air Alliances and Climate Dialogue, the European Union's Business and Biodiversity Platform, and the Circular Plastics Alliance Declaration.[52] All these collaborations demonstrate the company's commitment to sustainable business practices.

3.1.2 Microsoft

Microsoft has committed to achieving carbon negativity by 2030 and removing carbon from the atmosphere by 2050.[53] The firm applies GAI to manage its data centre, which consumes the most power.[54] Microsoft has reduced the carbon footprint of its data centres by utilising AI to manage energy consumption and cooling systems.[55] To support the AI system, the company has also embraced green power purchases for renewable energy.[56] The plan outlined in the proposal to cut this emission by over half by 2030 is as follows: Microsoft has set its sights on reducing Scope 1 and 2 emissions as close to zero as possible by 2025; this includes powering the company with only renewable energy and transitioning to electric vehicles. Microsoft also aims to minimise Scope 3 emissions by instituting more extensive internal carbon pricing and by engaging suppliers to enhance their disclosure.[57]

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[49] ibid.
[50] ibid.
[51] ibid.
[52] ibid.
[53] Brad Smith, 'Microsoft Will Be Carbon Negative by 2030' (*Microsoft*, 16 January 2020) <https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/> accessed 19 August 2024.
[54] ibid.
[55] ibid.
[56] ibid.
[57] See National Grid, 'What Are Scope 1, 2 and 3 Carbon Emissions?' (*National Grid*, 1 July 2024) <https://www.nationalgrid.com/stories/energy-explained/what-are-scope-1-2-3-carbon-emissions> accessed 29 August 2024, where it is explained that Scope 1, 2, and 3 emissions are

3.1.3 Nest (Google Subsidiary)

Through its subsidiary Nest, Google has introduced smart thermostats and many other home automation devices into the market. These devices are intended to optimise energy usage by adapting to the specific tastes of users for heating and cooling.[58] For instance, Nest thermostats can minimise power consumption within a set area by decreasing the temperatures while the occupants are not at the residence.[59] This approach helps save individual costs and contributes significantly to reducing general energy consumption and carbon dioxide emissions at the domestic level.[60] Nest thermostats are a valuable means of helping to save energy, especially on heating and cooling, which account for more than half of the energy used by a home.[61]

3.1.4 Safaricom

Safaricom is a telecommunications service provider in Kenya that implements GAI to enhance its energy-intensive processes.[62] On the innovation management side, the firm has used AI to control energy consumption within its communication technology.[63] In its sustainability policy, Safaricom has committed to upholding the United Nations' Sustainable Development Goals, with a specific focus on affordable and clean energy. Safaricom is playing its part in advancing sustainable development on the African continent.[64]

Safaricom's core purpose of 'transforming lives' is anchored in four key pillars: Shared Value, Planet, Responsible Business, and People. All four pillars address the essential

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subcategories of greenhouse gas (GHG) emissions that organisations apply in tracking their emissions towards effective management of their impact on the environment as part of sustainability efforts. Scope 1 emissions are direct emissions that arise from people and activities under a company's complete control, such as fuel consumption in company vehicles or at company facilities. Scope 2 emissions, therefore, refer to the indirect emissions from the electricity, steam, heating, and cooling that the company uses in its operations, thereby making them historical emissions. Scope 3 emissions encompass all other emission sources within the entire value chain of the relevant company, including emissions from the acquisition of goods and services, business travel, waste disposal, and emissions released during customers' use of the acquired products. These categories provide corporate organisations with a guide on how to manage their environmental responsibilities effectively.

[58] Google Nest, 'Energy Savings from Nest Thermostat: A Decade of Results' (*Google Nest*, 2021) <https://nest.com/thermostats/real-savings/> accessed 20 August 2024.

[59] ibid.

[60] K Waddell, 'Google's Nest and the Path to Smart Energy Management' (*The Atlantic*, 2017) <https://www.theatlantic.com/technology/archive/2017/02/nest-energy-management/516600/> accessed 19 August 2024.

[61] Google Nest (n 58).

[62] Safaricom, 'Sustainability Goals' (*Safaricom*, 2020) <https://www.safaricom.co.ke/about/sustainability/our-purpose> accessed 19 August 2024.

[63] ibid.

[64] ibid.

fields in combating socio-economic problems. The Shared Value pillar offers an opportunity to create business value that, in turn, generates value for society. The Planet pillar focuses on protecting the environment by embracing sustainable business practices and reducing its carbon footprint. The Responsible Business pillar focuses on ethical behaviour, thorough disclosure, and adherence to a high degree of corporate and business responsibility. Lastly, the People pillar focuses on diversity and inclusion, employee training, and enhancing community capabilities through its activities.[65] These are the purposeful undertakings through which Safaricom's social contract provides the company with direction on how to execute these efforts. The social contract encompasses all measures necessary to promote the well-being of the community and the environment, thereby aligning the company's goals with its mission of creating a positive social impact. Incorporating these pillars into the organisation's strategy, Safaricom aims to impact society's development and the environment positively.[66]

3.1. MTN Ghana

Green AI is utilised by MTN Ghana, one of the largest telecommunications companies operating in West Africa, which employs the technology to enhance the efficiency of its networks to reduce carbon emissions.[67] Artificial Intelligence applied in MTN Ghana's network management has significantly benefited the company by reducing energy consumption and, consequently, greenhouse gas emissions.[68] The company also focuses on developing a renewable energy source to support its network equipment, aligning with current trends to reduce the environmental footprint of telecommunications services.

MTN Ghana has pledged to reach net zero in greenhouse gas emissions by 2040 – a far more ambitious goal than the global telecom sector's goal of 2050.[69] In 2022, MTN recorded a 13% increase in revenue, demonstrating the effectiveness of its operations. The company has achieved an emissions reduction of 9% for both Scope 1 and 2, exceeding the yearly target of 3%. The Project Zero programme demonstrates this commitment, where the firm seeks to adopt renewable solutions, new

[65] ibid.
[66] ibid.
[67] MTN Group, 'MTN Ghana Sustainability Report 2020' (*MTN Group*, 2020) https://www.mtn.com/reports/accessed 19 August 2024.
[68] ibid.
[69] See United Nations Climate Change, 'UN Climate Change' (2024) <https://unfccc.int/> accessed 15 September 2024. Net zero refers to the balance between the amount of greenhouse gases produced and the amount removed from the atmosphere. To achieve net zero, a country, company, or individual must reduce their carbon emissions as much as possible and offset any remaining emissions through measures such as reforestation, carbon capture technologies, or investing in renewable energy. The goal of reaching net zero is to prevent further contribution to global warming, which is essential for mitigating climate change.

technologies, and energy storage to enhance sustainability and reduce emissions.[70] Considering the growing focus on Scope 3 emissions, MTN collaborates with suppliers to establish goals for reducing greenhouse gas emissions and integrate climate considerations into their mainstream operations.

4. Potential challenges of incorporating GAI in businesses

Although GAI provides a balanced approach to how businesses can achieve impactful technological advancement while reducing environmental adverse effects, enterprises face some substantial challenges when seeking to put GAI into practice.

One of the primary obstacles to implementing Green AI is the need for a powerful computing system, as AI is primarily based on deep learning algorithms. These models require substantial computational resources, resulting in significant energy consumption and a considerable carbon footprint. New research suggests that running deep learning models with large numbers of neurons requires more energy than some households use for several years. The primary technical challenge lies in reducing the energy consumption of AI systems while maintaining optimal performance.[71]

A further challenge to GAI implementation is the limited availability of energy-efficient hardware and green technologies for deployment. This is especially true for small enterprises that cannot afford state-of-the-art hardware.[72] Moreover, GAI migration requires certain initial capital investments in research, development, and integration of green systems. Currently, most companies, including small and medium-sized enterprises, face economic challenges when investing in or developing cost-effective AI solutions and technologies. These challenges include the costs of upgrading current systems or acquiring fresh green technologies. This reality could dissuade many firms from implementing GAI.[73]

Lastly, regulations for GAI present their own set of complexities and challenges. Currently, there are no universally accepted or standardised regulatory policies tailored for GAI. This lack of clear, standardised guidelines creates ambiguity and poses significant difficulties for companies trying to navigate the regulatory

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[70] MTN Group, 'MTN Ghana Sustainability Report 2020' (MTN Group, 2020) https://www.mtn.com/reports/19 August 2024.
[71] Strubell (n 13) 1063.
[71] Schwartz (n 12) 13.
[72] Norman P Jouppi and others, 'In-Datacenter Performance Analysis of a Tensor Processing Unit' (2017) *Proceedings of the 44th Annual International Symposium on Computer Architecture* 1–12 <https://dl.acm.org/doi/10.1145/3079856.3080246> accessed 3 April 2025.
[73] Ben Cost, New York Post 'Google's AI can accurately predict weather forecasts 15 days in advance (2024) https://nypost.com/2024/12/09/science/googles-ai-can-accurately-predict-weather-forecasts-15-days-out/?utm_source.

landscape.[74] Without established regulations, companies face obstacles in developing and implementing long-term strategic plans for integrating GAI into their operations. This uncertainty not only impedes effective planning and decision-making but also complicates efforts to ensure compliance and align technological advancements with legal and environmental standards.[75]

5. Impacts of GAI and AI on Labour Rights

While companies leverage GAI to promote sustainability and energy efficiency, its implementation can harm fundamental labour rights, including the right to fair treatment at work, fair and safe working conditions, non-discrimination, and fair remuneration.

5.1 Right to Fair Treatment at Work

With the current growth of GAI, AI, and automation technologies, AI is capable of replacing human employment in many fields, particularly where employees are required to perform repetitive tasks. Automating tasks such as energy management, network optimisation, and operational monitoring reduces the need for human workers, leading to job displacement and workforce downsizing. Workers may be dismissed or reassigned without proper consultation, affecting their right to fair treatment. This displacement can give rise to complications in both economic and social consequences, mainly affecting industries where employees are predominantly low-skilled. According to a study by the McKinsey Global Institute, by 2030, approximately 375 million workers, or 14% of the global workforce, may need to change their occupations due to automation and other reforms prompted by AI.[76]

GAI focuses on enhancing the energy efficiency and sustainability of AI systems, aiming to reduce their environmental impact.[77] However, AI does not inherently address the labour market challenges brought about by the increasing automation of jobs. Nor does AI mitigate the economic consequences of automation, such as job displacement or wage stagnation, highlighting the need for policies and frameworks that protect workers' rights and ensure fair compensation alongside AI's

[74] European Commission, 'Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts' COM/2021/206 final (*Europa.eu*, 21 April 2021) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52021PC0206> accessed 5 April 2025.
[75] ibid.
[76] James Manyika and others, 'Harnessing Automation for a Future That Works' (*McKinsey & Company*, 12 January 2017) <https://www.mckinsey.com/featured-insights/digital-disruption/harnessing-automation-for-a-future-that-works> accessed 5 April 2025.
[77] Saptakee (n 30).

environmental benefits. The cases mentioned below illustrate how AI influences fair treatment in the workplace.

Lopez v Walmart Stores Inc.[78] involved the violation of work rights and unfair treatment by Walmart Stores. Lopez alleged that the automated scheduling system was unfair. The system's algorithm resulted in some employees having fewer opportunities to select their preferred working hours. The court decided the case in Lopez's favour, showing that Walmart's scheduling system led to an unfair labour practice. The court ordered Walmart to revise its scheduling practices to prevent discrimination against certain employees.[79]

5.2 Right to Fair and Safe Working Conditions

Artificial Intelligence significantly alters workplace conditions, often creating more precarious employment relationships, particularly in gig and platform-based work, which typically lack the protections offered by traditional labour laws. These technologies can foster insecure employment models where workers are classified as independent contractors rather than employees, making them ineligible for benefits such as health insurance, paid leave, and minimum wage guarantees.[80] Artificial Intelligence exacerbates these issues by monitoring worker performance and making decisions based on data, which can intensify job pressure and decrease security.[81] The gig economy has blurred the lines between employment and independent work, creating a grey area where workers fall between traditional legal classifications.

Although GAI aims to make AI more energy-efficient, it does not automatically ensure safe working conditions and can, in fact, worsen them by reinforcing AI-driven surveillance, unrealistic productivity quotas, and job insecurity. Unless properly regulated, GAI could be used to justify cost-cutting measures that prioritise efficiency over worker safety, widening the digital divide and exacerbating precarious employment relationships. It is argued that GAI-powered energy management systems can extend beyond efficiency optimisation to surveillance and control over employees, leading to excessive monitoring of workplace activities. Smart buildings and GAI-managed networks may collect data on employee behaviour, potentially leading to workplace exploitation and stress from constant evaluation. Stricter AI-driven performance assessments could increase workload pressures, affecting mental and physical well-being.

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[78] [2020] 19-5432 US District Court, District of Arizona.
[79] *Lopez v Walmart Stores Inc.* 2020.
[80] Mustafa F Özbilgin, Nur Gundogdu and Jan Akalin, 'Artificial Intelligence, the Gig Economy, and Precarity' 284 in Elina Meliou, Joana Vassilopoulou and Mustafa F Özbilgin (eds), *Diversity and Precarious Work During Socio-Economic Upheaval: Exploring the Missing Link* (Cambridge University Press, 2024) 296.
[81] ibid.

Platform-based formations, such as Uber and Amazon, and various delivery applications, including Deliveroo and DoorDash, have dramatically transformed the labour model. For instance, Uber incorporates AI into the decision-making process for ride-sharing, fare structure, and driver behaviour ratings and feedback options. Although the drivers operate on the platform as independent contractors, they are relatively close to the platform's control. Negative stars translate to penalties, reduced rate incidence, or total deactivation rendering drivers' jobs insecure. Drivers lack the regular employment privileges of employees, including healthcare, minimum wage guarantees, and paid time off.[82]

Similarly, in its warehouses, Amazon uses AI to monitor workers' productivity. The system can also issue warnings or termination notices to employees who fail to meet the high standards of performance that the company requires. Employees are monitored at the workplace, and due to this pressure to perform against unattainable targets, workers have complained of stress, burnout, and job insecurity. As with Uber drivers, Amazon's warehouse workers face these difficulties while lacking the employment rights typically afforded to workers in a relatively manual environment.[83]

The ILO has raised concerns about the impact of AI on employee privacy.[84] Using AI tools to track employee performance is perceived as a form of surveillance that intrudes on personal privacy, creating a work environment where employees feel constantly monitored.[85] This surveillance, coupled with the role of AI in decision-making, can increase stress and pressure in the workplace, as workers may feel they are being evaluated by opaque algorithms that lack transparency and fairness. The ILO suggests that these practices need robust regulation to ensure that AI use in the workplace does not erode workers' rights or job security.[86]

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[82] Alex Rosenblat, *Uberland: How Algorithms Are Rewriting the Rules of Work* (University of California Press 2018) 39.

[83] K. Jodi, and W. Nick. 'Inside Amazon's Warehouse: Surveillance, Stress, and Pain for Employees' *The New York Times* (June 15 2019) https://www.nytimes.com/interactive/2021/06/15/us/amazon-workers.html accessed 29 August 2024.

[84] International Labour Organization, *The Impact of AI on the Future of Work* (ILO 2021) https://www.ilo.org/global/topics/future-of-work/publications/WCMS_817722/lang--en/index.htm accessed 20 August 2024.

[85] Skyler Brown and others, *Protecting Workers' Rights in the Gig Economy: AI and Digital Labour Platforms* (Lehigh University and University of San Francisco de Quito, Global Village in collaboration with the International Labour Organization) <https://global.lehigh.edu/sites/global.lehigh.edu/files/2_ILO_UN_Ex_Machina_Final_Draft.pdf > accessed 15 August 2024.

[86] Abhishek Behl, Brinda Sampat and Sahil Raj, 'Productivity of Gig Workers on Crowdsourcing Platforms through Artificial Intelligence and Gamification: A Multi-Theoretical Approach' [2021] *The TQM Journal* <https://doi.org/10.1108/TQM-07-2021-0201> and <https://www.researchgate.net/profile/Sahil-Raj-3/publication/355322780_Productivity_of_gig_workers_on_crowdsourcing_platforms_through_artificial_intelligence_and_gamification_a_multi-theoretical_approach/links/64af66a795bbbe0c6e2f6cf7/Productivity-of-gig-workers-on-

5.3 Right to Non-Discrimination

A further problem that workers face is the bias and discrimination of AI systems.[87] It turns out that AI algorithms are only as impartial as the data sets fed to them, and if the data sets are rife with existing social discriminations, the AI systems can even amplify them.[88] This outcome can cause discrimination in employment and recruitment. Artificial Intelligence systems adopted in the recruitment process have been found to discriminate against women and minorities due to biased training data.[89]

Green AI focuses on improving the energy efficiency and sustainability of AI models, and it does not inherently address the critical issue of bias in AI algorithms, which directly impacts the right to non-discrimination. Green AI aims to reduce computational costs and environmental impacts, but this focus on efficiency and sustainability may exacerbate biases if it prioritises speed and model size over fairness and inclusivity. To align GAI with the right to non-discrimination, ethical AI frameworks must be developed to ensure that fairness and inclusivity are prioritised alongside efficiency, ensuring that AI models do not perpetuate existing societal inequalities but promote equitable outcomes for all individuals.

In *Brown v City of New York*,[90] the plaintiffs alleged that the City of New York's automated systems in its hiring exercise discriminated against minorities. They argued that the methods of recruitment and selection discriminated against minority groups, stating that their possibility of being recruited was lower than that of candidates who were not in minority groups. This case was settled before it could progress to final trial judgment. The City of New York agreed to re-evaluate and modify its automated systems used for recruitment.[91]

In *EQUAL v Google*,[92] an organisation affiliated to the European Union, known as EQUAL, brought an action against Google for alleged discrimination in the labour market due to the use of AI in recruitment. The case centred on whether Google's algorithm was prejudicial during hiring. The Court of Justice of the European Union ruled in favour of the plaintiff, EQUAL. The court held that Google's use of AI tools had rendered the recruitment process discriminatory. Google was required to assess and modify the algorithms in its AI that led to the unfair screening of job candidates.[93]

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crowdsourcing-platforms-through-artificial-intelligence-and-gamification-a-multi-theoretical-approach.pdf> accessed 1 September 2024.

[87] Reuben Binns, 'Fairness in Machine Learning: Lessons from Political Philosophy' *Proceedings of the 2018 Conference on Fairness, Accountability, and Transparency* (PMLR 2018) 149.

[88] ibid.

[89] ibid.

[90] [2019] 18-07352, United States District Court, SDNY.

[91] *Brown v City of New York* 2019.

[92] [2020] C-123/20 ECR.

[93] *EQUAL v Google* 2020.

In *Diaz v Intel Corporation*,[94] Diaz accused the company of using AI in performance management, which discriminated against certain employees. Diaz argued that this use unfairly affected the scores that were automatically generated, thus affecting the promotion rate and employment security of various employees, especially those from the minority group. The case was settled, with Intel ordered to rectify its AI-generated performance management systems. To overcome the issue mentioned by Diaz, Intel agreed to reduce the degree of the organisation's opaqueness in the evaluation process.

5.4 Right to Fair Remuneration

One of the implications of AI interfering with employment opportunities is the risk to the right to reasonable working remuneration, as several economic activities remain at the mercy of AI and its owners or employers. New employment relations emerge in a way that threatens to push many people into low-paying, insecure jobs as more jobs are deskilled by technology. These changes may result in inadequate wages and salaries, or their stagnation, leading to worsened working conditions and increased income inequalities. Furthermore, jobs in the gig economy facilitated through AI systems may pay workers well below the minimum wage because gig employment does not offer standard employment protections.[95]

Another notable example of the adverse consequences of AI-powered technologies for labour rights and wages is *Fair Work Ombudsman v Hungry Jack's Pty Ltd*.[96] The Fair Work Ombudsman brought an action against Hungry Jack's, an Australian fast-food restaurant chain, for underpaying its employees. These underpayments were associated with a computerised rostering system that did not accurately analyse each employee's hours of work to ensure that they received all their entitlements. The Federal Circuit Court of Australia delivered a verdict in favour of the Fair Work Ombudsman. The court affirmed that Hungry Jack's automated rostering system of work had contributed to the underpayment of employees because of the wrong assessment of all work hours. For this reason, the court required Hungry Jack's to repay the underpaid wages and make changes that enabled the company to ensure fairness in wages.[97]

[94] [2021] 20-12345, 2021 WL 1253446.
[95] Valerio De Stefano, ''The Rise of the "Just-in-Time Workforce": On-Demand Work, Crowdwork, and Labour Protection in the "Gig Economy"'' (2016) 37 *Comparative Labor Law & Policy Journal* 471.
[96] [2019] FCCA 214.
[97] *Fair Work Ombudsman v Hungry Jack's Pty Ltd* 2019.

6. Conclusion and Recommendations

The convergence of GAI and labour rights signifies the alignment of innovative technological solutions with ethical labour standards. Although GAI focuses on energy-efficient approaches in AI system development, it is inherently linked to social implications. Regulation of AI across specific sectors, including the workforce, must ensure that labour rights and standards are not compromised. It is essential to avoid scenarios where AI technologies lead to job outsourcing, exploitation, or a decline in working conditions. Achieving this balance is crucial for fostering sustainable development, where environmental concerns and human well-being are prioritised equally. Against this background, the author proposes the following recommendations.

The relationship between GAI and labour rights is a significant concern and forms a complex problem where two important concerns meet: the need to minimise the carbon footprint, and the need to accord workers similar dignity. New GAI practices must address both environmental and labour concerns; GAI can only be effective if it addresses the problem of new technologies threatening to unleash a new wave of job-killing automation, exploitation, and degradation of working conditions among those who remain employed. Thus, it is necessary to balance sustainable development and labour rights. Strategies include using energy-efficient algorithms and harnessing renewable energy sources.[98]

A further strategy is to implement policies that protect workers from displacement and unfair treatment. As GAI and AI continue to automate tasks traditionally performed by humans, there is an increasing need for policies that mitigate the risk of job displacement and ensure fair treatment of workers. This need includes creating opportunities for reskilling and upskilling, thus enabling displaced workers to transition into new roles created by AI and other technological advancements. In addition, labour protections should be extended to gig and platform-based workers, who are particularly vulnerable to exploitation in the AI-driven economy. The ILO has underscored the importance of such policies in ensuring that the future of work is inclusive and fair.[99] Without these protections, the deployment of AI could exacerbate existing inequalities and create new forms of precarious employment lacking the safeguards traditionally provided by labour laws.

International and regional collaborations are vital for sharing best practices and setting global standards for GAI and labour rights. The Global Partnership on AI (GPAI) facilitates collaboration among governments, industry leaders, and academics to

[98] Smith (n 53).

[99] International Labour Organization, 'The Role of Digital Labour Platforms in Transforming the World of Work' (23 February 2021) <https://www.ilo.org/publications/flagship-reports/role-digital-labour-platforms-transforming-world-work> accessed 5 April 2025.

promote responsible AI innovation that aligns with global sustainability goals.[100] The focus of GPAI on AI ethics and sustainability reflects a broader trend towards international cooperation in AI governance.[101]

While the EU has proposed the AI Act as a regulation to govern the use of AI within the EU, this Act has its drawbacks and risks. The AI Act requires that AI processes are kept traceable, subject to human oversight and that AI is not used in a manner that would compromise workers' rights or undermine fairness.[102] This type of regulation is particularly useful in safeguarding employees from the adverse effects of AI technologies.[103] Jurisdictions outside the EU should adopt the EU AI Act's approach, which categorises AI users based on their risk and imposes stringent conditions for high-risk AI systems with employment implications. This approach would provide a legal framework that can be used to shield workers from the adverse effects of AI. This initiative, therefore, calls on governments, particularly those of developing nations, to prioritise the formulation of policies concerning AI that address its social and economic implications for work. Among other things, these governments should establish officials and institutions to monitor and approve the use of AI, ensuring that it augments rather than replaces the workforce.

Governments should implement the ILO's recommendations on ethical AI to protect employees' rights. The application of AI in work processes should not compromise the creation of decent employment and working conditions and should not lead to deteriorated working standards. Additionally, employers must take responsibility for training and reskilling their workforce to prepare them for new roles that arise from AI adoption. Job redesign should be considered to ensure that AI is used to enhance human work rather than replace it, preserving jobs and improving productivity. The ILO estimates that transitioning to a green economy could have a significant impact on employment, both in terms of job creation and potential losses resulting from climate-related factors. According to the ILO, implementing policies that support a greener economy could generate 24 million new jobs worldwide by 2030, fostering sustainable employment opportunities while addressing environmental challenges.[104]

Companies should collaborate with academic institutions to foster research on GAI. Governments, for their part, have the responsibility to encourage such collaborations in research and development of sustainable technologies through the provision of incentives. These incentives may involve grants for financial support of specific

[100] Global Partnership on AI (GPAI), 'About GPAI' (2021) https://gpai.ai/about/ accessed 20 August 2024.
[101] ibid.
[102] EU AI Act, arts 13–14.
[103] European Commission (n 73).
[104] International Labour Organization, 'Newly-Launched Global Campaign Tackles the Impact of Heat Stress on Workers Worldwide' (26 July 2024) <https://www.ilo.org/resource/news/newly-launched-global-campaign-tackles-impact-heat-stress-workers-worldwide> accessed 5 April 2025.

research or for the development of particular products, or tax exemptions that decrease firms' investment expenses in new GAI environmental projects. In this way, governments can foster innovation, promote investment in technologies that enhance energy efficiency, and bridge the gap between research and practical implementation. Such a multisectoral effort may pave the way to identifying and enhancing responsible GAI strategies that support more extensive environmental objectives.