GENERATIVE AI AND ENVIRONMENTAL SUSTAINABILITY ISSUES HOW SHOULD ORGANIZATIONS ADDRESS THIS?

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Abstract: Generative Artificial Intelligence (GenAI) offers remarkable opportunities for organizations in improving productivity, innovation, and efficiency. However, the rapid development and massive adoption of GenAI also raise serious concerns about its environmental sustainability. The training and operation of GenAI models consume enormous amounts of electricity and water, contributing significantly to global carbon emissions. This article presents a comprehensive perspective on how organizations should address the environmental challenges posed by GenAI. It highlights the urgency for integrating digital sustainability, ethical AI governance, and environmental responsibility into corporate strategies. The paper also discusses regulatory gaps, psychological barriers to climate action, and the growing need for Scope 3 emission reporting. Ultimately, this study emphasizes the need for an inclusive and adaptive governance framework to ensure that GenAI becomes a solution, not a threat, to the climate crisis.

Keywords: Generative AI, Sustainability, Governance, Emissions, Environmental Ethics

1. Introduction

Artificial Intelligence (AI) has become one of the significant breakthroughs in digital technology usage. AI has long been used in healthcare, social services, marketing, manufacturing, and many other fields that can facilitate human work. One of the latest developments in AI that has gained much attention is generative AI (GenAI). If the use and utilization of AI previously were only used by corporations because they required substantial investment, GenAI can be used by all people connected to the internet (Websensa, 2025). GenAI can produce text, images, music, and videos with very rapid development, making them almost indistinguishable from human work. GenAI adoption has spread rapidly across various sectors, driven by its potential to increase productivity, drive innovation, and transform how humans interact with information and technology. However, behind the impressive advances, innovations, and various benefits offered, the use of GenAI presents new challenges. The development and operation of AI systems, especially large-scale GenAI, also require enormous energy. Research shows that the training process of one large AI model can produce a carbon footprint equivalent to emissions from five cars during their lifetime (Strubell et al., 2019). The supporting infrastructure of the digital world, from personal devices to massive data centers, consumes enormous energy and resources. This process involves the use of thousands of graphics processing units (GPUs) that work for extended periods and requires data center infrastructure that consumes massive amounts of electricity.

Sam Altman's response, CEO of OpenAI, the organization behind ChatGPT, when answering netizens' questions about energy usage by OpenAI is interesting to note. How a simple command in AI models like "please" and "thank you" written by ChatGPT users costs tens of millions of US dollars in energy (Sharma, 2025). Using models to respond to user requests can use up to 100 times more energy compared to Google searches and contributes about 60 percent of overall GenAI energy usage (Cho, 2023). In the AI Index Report published by Stanford

University, there is a fact that training the GPT-3(175B) model produces 502 tons of emissions, while the average US citizen produces 18.08 tons of emissions per year. However, on the other hand, GenAI model development increasingly shows efficiency. A study by Epoch AI featured in the AI Index Report presents the fact that machine learning hardware is becoming 40 percent more efficient per year (Stanford, 2023). DeepSeek, a GenAI model from China, even began innovation by placing their data center servers at sea for energy efficiency in cooling their devices (Garg, 2025). It should be noted that besides requiring energy for data center operations, GenAI models also require large amounts of energy to cool their hardware.

This provides facts and perspectives that may be newly realized by most of society about how this technology that facilitates humans also harbors problems in earth's sustainability, especially as GenAI usage becomes more massive. An article from Microsoft presents the fact that 92% of knowledge workers in Indonesia already use GenAI in the workplace, exceeding the global average of 75 percent and Asia Pacific's 83 percent (Mutiahanifa, 2024). Thus, it becomes increasingly important to evaluate the development and deployment of GenAI technology not only from the perspective of technical capabilities and economic benefits but also through the lens of environmental ethics.

Environmental ethics has become an inseparable part of organizations that prioritize sustainability in operations and strategic decision-making. In the context of current technological developments, particularly with the increasing use of GenAI, attention to environmental impacts should also include technology, including GenAI usage, as a factor in corporate social responsibility. GenAI, despite offering extraordinary efficiency and innovation in various aspects of work, also demands enormous energy consumption, especially in the training process of complex models and the use of large-scale computing infrastructure. This directly contributes to increased carbon footprint and significant natural resource consumption. Therefore, organizations need to be aware of and consider the environmental impact of implementing this technology and seek solutions that can minimize its negative effects.

This article attempts to provide a perspective on GenAI usage and its relationship with sustainability issues, which is also closely related to ethics and governance at the company or organizational level.

2. Literature Review

The fast growth of digital technologies, especially artificial intelligence (AI) and generative AI (GenAI), has increased debates about environmental ethics and corporate responsibility. These technologies bring many benefits, such as higher productivity, new creativity, and economic growth. However, these technologies also create serious environmental problems, especially high energy use and carbon emissions (Strubell, et al., 2019; Schwartz, et al., 2020). Addressing these issues requires a deeper exploration of environmental ethics as a philosophical foundation and corporate social responsibility (CSR) as a managerial framework to ensure that technological adoption aligns with sustainability principles.

Foundations of Environmental Ethics

Environmental ethics provides a moral foundation for organizations to evaluate the impact of their decisions and policies on the environment. It challenges the view that human interests are above all else and instead proposes that ethical considerations should include environmental sustainability for the sake of future generations (Rolston, 1988). Naess (1973) introduced the concept of “deep ecology,” which promotes an ecocentric perspective where nature holds intrinsic value beyond its utility for human activity. Similarly, Singer (2011) emphasized a utilitarian ethic that weighs the benefits of technological progress against the potential harm to the environment.

Applying these ethical perspectives to digital technologies raises critical questions. For instance, from a utilitarian perspective, productivity gains from GenAI must be balanced against the environmental costs of training and operating large language models (LLMs). From a deontological perspective, organizations may have a duty to reduce ecological harm regardless of financial implications. Virtue ethics would view sustainability as a reflection of organizational integrity, where "responsible innovation" becomes a virtue that demonstrates the organization's commitment to both technological progress and ecological stewardship.

Corporate Social Responsibility and Environmental Sustainability

CSR has developed significantly, shifting from purely philanthropic activities to a strategic approach that integrates sustainability into core business practices. Carroll's (1991) CSR pyramid highlights economic, legal, ethical, and philanthropic responsibilities as interconnected dimensions of corporate obligations. Elkington's (1997) "triple bottom line" framework further reinforced the need for businesses to create value across people, planet, and profit, making sustainability a central measure of organizational success.

Stakeholder theory provides a complementary perspective, emphasizing that organizations are accountable not only to shareholders but also to a broader set of stakeholders, including employees, customers, communities, and the environment (Freeman, 1984). This shift is also reflected in the growing adoption of ESG (Environmental, Social, and Governance) frameworks, which assess organizations' sustainability performance and provide benchmarks for responsible corporate behavior (Eccles et al., 2014).

The implications for digital technologies are profound. As companies increasingly adopt GenAI and other digital innovations, CSR and ESG frameworks provide a managerial foundation for evaluating not only the economic benefits but also the ecological costs associated with large-scale computational infrastructure.

3. Method

This research uses an exploratory qualitative approach with literature study methods as the basis for analysis. The main focus of this study is to explore the relationship between GenAI technology usage and ecological sustainability issues, particularly in the context of organizations and digital governance. Data and information were collected from various secondary sources, such as scientific journals, international agency reports, news articles, and regulatory documents related to emission reporting and AI governance.

GenAI is a new technology with very rapid development, so scientific research published in journals about GenAI, especially its relationship with sustainability issues, is still limited. Therefore, sources other than scientific articles are used, including reports from reputable national institutions and regulatory documents, as well as news sources to add context to analysis and discussion.

The literature used was selected purposively, based on its relevance to themes of GenAI, energy consumption, digital carbon emissions, and sustainability policies. Analysis was conducted descriptively-critically by mapping issues, opportunities, and challenges from environmental, governance, and organizational behavior perspectives. The results of this study do not aim to produce statistical generalizations but to present deep understanding and conceptual synthesis as a basis for formulating arguments and recommendations.

The following table shows the grouping of articles by theme.

Table 1 Articles Summaries

No	The	Summary	Article
1	Environmental impact and energy consumption of GenAI	GenAI requires large amounts of energy and contributes significant carbon emissions.	Strubell et al., 2019; Patterson et al., 2021; Jegham et al., 2025; Bashir et al., 2024; Tomlinson et al., 2024; Zewe, 2025; GAO, 2025; Cho, 2023; The Conversation, 2024; Le Poidevin, 2025
2	Ethics and sustainable AI governance	The importance of AI development that considers environmental sustainability aspects.	Bender et al., 2021; van Wynsberghe, 2021; Bolte and Van Wynsberghe, 2024; Verdecchia et al., 2023; Hacker, 2023; Brundage et al., 2023; OECD, 2023; European Commission, 2023
3	ESG and corporate responsibility	GenAI usage must be accompanied by emissions reporting (Scope 3) and integration into company ESG frameworks.	EY, 2024; World Economic Forum, 2022; WifOR Institute, 2025; Silitonga et al., 2024; Cui, 2025; Rane, 2024
4	Psychology and environmental awareness	Individual or organizational neglect of environmental impacts from technology due to psychological barriers	Gifford, 2011; Kollmuss and Agyeman, 2002
5	Technology implementation and corporate innovation	Organizations implementing GenAI and examples of innovations for energy efficiency and HR training in AI usage.	Sharma, 2025; Garg, 2025; Kell, 2025; Hölzle, 2009; websensa, 2024

A total of 31 scientific articles, research reports, and news coverage were used in this discussion. The grouping of themes in the discussion was not based on article themes but regrouped into themes relevant to the research discussion.

4. Result and Discussion

Sustainability becomes important when humans realize that life will continue to exist and run, unlike the limited lifespan of humans. Awareness of this brings understanding that resources, energy, environment, and social balance must be maintained and preserved for future generations. The same awareness also emerges in organizational governance practices when organizations and business entities include sustainability in their operational practices. Organizations that use or plan to adopt and utilize GenAI need to build environmental awareness as part of their corporate ethics. This will help ensure that the digital transformation taking place is not only efficient and competitive but also sustainable and aligned with social and ecological responsibilities in an era of increasingly advanced and developing technology.

Digital Technology Usage as a Contributing Factor to Emissions

Digital technology has brought digital culture into human daily life, including in corporations. Searching through Google, replying to emails, writing company profiles, conducting transactions, have become common practices in corporations. Even the term "googling," which refers to searching through the Google search engine, entered the Oxford English Dictionary in 2006, showing that digital technology has become a driver of new cultural emergence.

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In 2009, Google through its official blog via the Senior Vice President of Operations stated that one Google search, on average, uses energy equivalent to boiling water for 10 seconds, quantitatively about 0.0003 kWh or 1 kilojoule (Hölzle, 2009). This number appears small but is actually large when considering that Google's search engine is used by many people worldwide. Since 2009, Google has also made efforts to reduce energy usage in managing their data centers, but this number still provides a new perspective that digital technology, besides facilitating, also produces emissions that impact environmental sustainability.

Meanwhile, energy usage in GenAI usage is even larger. Large models like GPT-3, GPT-4, and BLOOM have experienced tremendous exponential growth in terms of capabilities. However, this also triggers deep concerns regarding energy consumption and environmental impact, especially if energy sources still come from non-renewable fossil energy sources. Training GPT-3, for example, is estimated to consume about 1,287 MWh of electricity and produce about 502 tons of carbon dioxide equivalent to emissions from 112 cars in a year (GAO, 2025). GenAI models like ChatGPT, Claude, or Gemini require large models (Large Language Models - LLM) that process input complexly with hundreds of millions to billions of parameters, so a single prompt can consume 50 to 100 times more energy compared to googling (Strubell et al., 2019; Patterson et al, 2021). Another study conducted by Jegham et al. (2025) estimates that a response process to a prompt, known as inference, can contribute up to 90 percent of the total environmental footprint (energy, water, carbon) of an AI model. They found that one GPT-4o query consumes about 0.43 Wh of electricity, and when this is done up to 700 million times daily, the resulting figure is equivalent to the electricity consumption of 35 thousand homes and water needs - used for hardware cooling - for 1.2 million people annually.

In GenAI hardware infrastructure, it's not just electricity that contributes to GenAI's carbon footprint, but also data center cooling that requires large amounts of water. A simple question and answer session with GenAI like 10–50 requests to GPT-3 can use up to half a liter of water, and the construction and operation of new data centers are estimated to significantly increase water consumption (GAO, 2025). MIT studies confirm that electricity and water needs put direct pressure on electrical grids and local water resources, which are increasingly impacted by GenAI expansion. This is because data center infrastructure for GenAI can consume 7 to 8 times more energy compared to data center loads for regular computing (Bashir et al., 2024). This is why the innovation done by DeepSeek by placing data centers at sea deserves appreciation. Globally, data centers that are mostly used for AI contribute 1 to 1.5 percent of world electricity consumption and are targeted to rise to 6 percent by 2026 (The Conversation, 2024). This escalation is also reflected in reports from the International Telecommunication Union (ITU), a UN body for digital technology, which reveals that indirect emissions from major technology companies increased 150 percent between 2020 and 2023, alongside their AI expansion (Le Poidevin, 2025).

However, there is efficiency potential: models like BLOOM, which were trained in data centers with efficient architecture and green energy, have much lower carbon footprints, only about 25 tons of carbon dioxide, compared to hundreds of tons for similar models (Tomlinson et al., 2024). The AI Index Report also presents the fact that machine learning hardware is becoming 40 percent more efficient per year thanks to the development of increasingly efficient hardware (Stanford, 2023). Regarding the ITU report, several technology giants like Meta, Amazon, Microsoft, and Google are committed to improving efficiency for their data centers, including using more environmentally friendly hardware and investing in nuclear and renewable energy.

GenAI as the latest product of digital technology indeed demands heavy infrastructure in its operation, which potentially makes it environmentally unfriendly if it still uses fossil energy for its operation. Research by Cui (2025) shows that intensive GenAI usage will increase company ESG (Environment, Social Governance) values, although it doesn't automatically support ecological sustainability if not accompanied by other strategies. Another study by Silitonga et al, (2024) confirms that AI integration in ESG governance enables companies to validate net-zero claims and improve environmental transparency, showing that on the other hand, AI usage also supports environmental sustainability. Although not directly referring to GenAI usage, at least this research can provide insight into the potential generated by GenAI. Awareness of sustainability should also drive the philosophy and practice of digital technology, including GenAI, to expand its focus from performance and efficiency to environmental responsibility. The concept of sustainable AI separates two main domains: AI for Sustainability—the use of artificial intelligence to support sustainable development goals—and sustainability of AI, which focuses on the ecological footprint of AI itself during model training, in usage, and its hardware infrastructure (van Wynsberghe, 2021). Bolte and Van Wynsberghe (2024) also state that AI initiatives often ignore the environmental impact of their development and operational processes. They call for the importance of including ecological considerations in technology design standards. This is reinforced by the systematic review by Verdecchia et al. (2023) which shows several Green AI strategies, such as carbon footprint monitoring, energy optimization, and sustainable model selection, have been proven to reduce consumption by more than 50 percent.

Organizational Responsibility for the Environment in the AI Era

Digital transformation accelerated by Artificial Intelligence (AI) technology, particularly generative AI (GenAI), has changed business operational paradigms. GenAI, with its ability to automatically generate content like text, images, and videos with just text commands, offers significant efficiency and innovation for companies. However, these benefits come with environmental consequences that cannot be ignored. GenAI usage in daily processes, such as content creation, internal document searches, or customer service automation, involves thousands of inferences that utilize energy-intensive computing infrastructure, thus driving the need to integrate sustainability issues into the strategy for adopting this technology in companies.

Modern organizations are now increasingly faced with two simultaneous demands: pursuing technological innovation like GenAI while fulfilling environmental sustainability commitments. This responsibility is not just about regulatory compliance but is also reflected in the principle of Corporate Environmental Responsibility, which is how companies manage their operational impact on the environment ethically and sustainably, including GenAI usage in their operations, both collective GenAI usage regulated by companies and individual usage within corporations.

Responsibility for sustainability issues, for corporations, is no longer a choice but has become an inseparable part of good governance. The World Economic Forum (2022) emphasizes the importance of integrating Environmental, Social, and Governance (ESG) principles throughout the company's value chain, including in digital strategy. This integration includes selecting more environmentally friendly technologies, energy efficiency in information technology infrastructure, and transparency in digital carbon footprints. Companies that adopt GenAI without considering these factors risk experiencing pressure from stakeholders, whether from investors, consumers, or governments as regulators who increasingly demand environmental accountability. This might not happen in the near future, but in the long term, as GenAI development is so rapid, everything can happen.

The large amount of energy needed in GenAI usage, as discussed in the previous subsection, provides insight that daily operations of GenAI used widely in business must remain within the framework of ESG principles. In the carbon emission reporting framework, emissions are divided into three categories: Scope 1 (direct emissions from company activities), Scope 2 (indirect emissions from purchased energy), and Scope 3 (indirect emissions from activities occurring in the company's value chain). The use of cloud services and AI-as-a-Service, including GenAI, is categorized as Scope 3 because it is a service purchased or utilized from third parties.

EY (2024) states that if AI services are considered as purchased services, then companies are required to include them in Scope 3 reporting. This is reinforced by the European Union's new policy through the Corporate Sustainability Reporting Directive (CSRD) which requires nearly 50,000 companies to disclose their Scope 3 emissions (WifOR Institute, 2025). The absence of reporting in this category not only results in regulatory risk but also creates a transparency gap that can damage corporate reputation.

Global regulation toward stricter sustainability reporting cannot be avoided. Countries like the European Union, UK, and even the United States are beginning to establish ESG reporting policies that include digital technology usage. Therefore, integrating sustainability into technology strategy is not just about current compliance but also readiness to face continuously evolving regulations.

Integrating sustainability principles in AI usage is not just about moral or legal obligations but also opens opportunities for efficiency and competitiveness. According to Scientific Reports (2025), a 1% increase in AI usage can reduce carbon emission intensity by up to 0.0395%, as long as its implementation is directed toward process efficiency and energy reduction. With the right strategy, companies can optimize GenAI usage while minimizing their carbon footprint, creating resilient and responsible business models.

Thus, organizations need to develop digital sustainability frameworks, including calculating emissions from GenAI usage in company operations. Organizations can also choose technology providers that use renewable energy to utilize paid GenAI services. Corporations also need to implement ethical and efficiency limits in their usage, for example, by using GenAI for priority tasks that have significant strategic impact on the company, or conducting employee training before using GenAI. A positive step was taken by Johnson and Johnson, a cosmetics company that trained more than 56 thousand of its 138 thousand employees in using GenAI before they were allowed to use it in their daily company activities (Kell, 2025). Environmentally conscious organizations should also refer to the ESG (Environmental, Social, Governance) framework in their AI governance. Integrating sustainability principles in GenAI usage will support the company's long-term reputation and ensure that the digital transformation undertaken does not harm the environment.

Implications and Future Directions

The intensive adoption of GenAI brings two opposing impacts: on one side providing innovative acceleration and high operational efficiency, including in creating ecological sustainability models (Rane, 2024). However, on the other side, GenAI usage also causes serious environmental consequences in the form of carbon footprints and large resource consumption for training, inference, and hardware cooling in data centers that require enormous water usage. There are at least several implications for corporations in GenAI usage.

First, future regulations are increasingly strict, and rising public awareness will drive companies to be transparent about energy footprints, including GenAI usage that falls into

Scope 3 category (indirect emissions from value chain), covering the use of third-party AI services. Therefore, corporations should no longer consider GenAI as a neutral digital asset but are obligated to integrate it into the company's ESG system as part of full responsibility. Without clear efforts, organizations may face social, even financial and legal penalties. Second, with increasing energy usage due to GenAI usage and utilization, although indirectly, organizations must consider shifting to renewable energy. Next, organizations need to adopt the Environment, Social, Governance (ESG) framework in GenAI usage governance, from carbon footprint measurement to sustainability report transparency.

In the future, further research is needed to develop more efficient LLM models using more environmentally friendly devices and cooling. On the corporate side as users, GenAI usage needs to be promoted as an item in ecological sustainability audits within the ESG context. Policymakers, in this case corporations, can take initiatives like those proposed in the Sustainable AI Regulation journal (Hacker, 2023), such as setting energy consumption limits, requiring carbon reporting, and encouraging participation in global emission trading schemes or carbon trading. Furthermore, there needs to be awareness and education among executives, including government as policyholders, to be able to balance economic efficiency goals with social and ecological obligations. Companies can organize internal training, workshops, and develop responsible GenAI usage guidelines for their employees.

Implementation Challenges of Sustainability Issues in GenAI Usage

The emergence of GenAI technology with all its advantages and innovations has made people worldwide utilize it in a short time. In its Artificial Intelligence Trend 2025 report, it only took 3 years for AI to be utilized by 50 percent of American society, compared to 20 years for personal computers and 6 years for mobile internet (BOND, 2025). This shows how quickly this technology entered people's lives. The challenge is that people are still fascinated by the speed offered, stunning outputs in the form of text, images, and sounds produced, and practical usefulness in work, education, and entertainment, thus ignoring the negative impacts that emerge. This phenomenon presents new challenges in growing awareness of the importance of ecological sustainability in GenAI usage. This is also raised by Gifford (2011) through the theory of temporal and psychological distance within the framework of psychological barriers to climate change action, known as "The Dragons of Inaction."

In temporal distance, people tend to assume that climate change impacts will occur in the future, not now, so ecological sustainability issues are very far from attention. Meanwhile, in psychological distance, environmental issues often feel emotionally, geographically, or socially distant. This means individuals don't feel they will be personally affected, or that their daily actions, like using GenAI, have significant contributions to environmental problems.

GenAI technologies like ChatGPT, DALL·E, MidJourney, and others feel harmless to users. They only type prompts and receive results without seeing the process behind them. Users don't see millions of intensive computational operations performed by GPUs in data centers that consume large amounts of electricity and generate carbon emissions, data centers that are lit 24 hours, or server cooling that requires large amounts of water. As a result, users don't associate personal usage with global environmental consequences. Users never realize this because there are no reminders in GenAI displays. There are no carbon labels in ChatGPT or DALL·E interfaces, no reminders that generating 1 image in DALL-E could equal charging 1 smartphone, and technology companies haven't been transparent about emissions. This creates a phenomenon called invisible pollution when there are real pollution impacts but hidden from user view (Bender et al., 2021).

This phenomenon is not new. When the internet, smartphones, and social media emerged, people were also too enthusiastic to think about environmental impacts. Only after a decade did criticisms emerge about electronic waste, rare earth metal mining that potentially damages the environment, and energy usage from cloud computing. GenAI's presence only repeats the same pattern. Enthusiasm followed by mass consumption, followed by negative environmental impacts, when awareness emerges it's already too late, and finally regulations emerge that also come too late.

Even if users care about climate change, many of them feel they have no choice but to follow technology trends. Users can't refuse GenAI's existence if it makes them work faster, more competitively, or more recognized in the work world. This is what's called the attitude–behavior gap, when someone has environmental concerns but still takes actions that don't support environmental sustainability due to social, cultural, or economic pressure (Kollmuss and Agyeman, 2002).

The implications for ecological sustainability efforts, because there's no direct sense of guilt or responsibility, users tend not to demand transparency from AI service providers or push companies to adopt sustainable technology practices. This also impacts the drive to regulate, report, or limit carbon footprints from GenAI usage will be very low. Companies that utilize and optimize GenAI as users will have reasons that they are not responsible for emissions because they only use services. This reinforces the psychological distance between actions and their impacts.

From another perspective, regulation of GenAI usage faces serious challenges due to this technology's rapid pace. GenAI capabilities that develop exponentially exceed public and regulator expectations, so emerging regulations are reactive. Reactive regulations are not sufficiently able to keep up with the complexity and speed of this technology's evolution, resulting in what's known as regulatory lag, when there's a gap between innovation speed and legal and state institutions' ability to regulate it effectively (Brundage et al., 2023).

From the ecological sustainability perspective, regulatory challenges become even more complex. Emissions generated by GenAI model training and usage processes, including mass inference activities, are often not formally recorded in corporate emission reporting. This is largely due to the lack of transparency from AI service providers who are reluctant to share information about energy consumption and carbon footprints of their systems (Bender et al., 2021). The lack of international standards and policies that force companies to report their digital environmental impacts makes tracking emission impacts from AI technology difficult.

In this context, several international organizations have begun advocating for new governance approaches that are more adaptive, anticipatory, and collaborative. OECD (2023) mentions that AI governance must be principle and risk-based, not merely on technical compliance, so that regulation can respond to continuously changing dynamics. Several jurisdictions, like the European Union, have developed regulatory sandbox approaches to allow technology experiments under ethical supervision while waiting for more permanent global standards to form (European Commission, 2023).

The gap between technological progress and regulatory instruments is not only a challenge for countries but also for user companies. Without clear policies, companies might use GenAI without considering its environmental impact, either due to lack of knowledge or absence of legal obligations. As a result, there's a risk that the high speed of GenAI adoption will increase global carbon footprints without adequate mitigation mechanisms.

In this condition, the urgency to develop inclusive and adaptive regulatory frameworks becomes increasingly high. Without progressive regulatory efforts, environmental sustainability risks from GenAI technology usage will become greater, and opportunities to make GenAI part of long-term solutions to the climate crisis could actually turn into new threats. Therefore, synergy is needed between regulators, technology providers, corporate users, and the scientific community to build policy foundations that can ensure GenAI adoption will go hand in hand with sustainability principles.

5. Conclusions

The emergence of GenAI with all its advantages cannot be avoided and should be utilized as best as possible to optimize efficiency and increase innovation in companies. However, the use of electricity and water in training and using GenAI hardware is enormous and potentially brings negative impacts to the environment, so shared responsibility is needed to reduce these negative impacts.

Responsibility for environmental sustainability should not only be borne by GenAI developers but also users, including corporations that utilize GenAI in their business operations. A perspective and awareness need to be instilled that all conveniences offered by GenAI's presence also bring consequences for the environment, and if ignored will have negative impacts on future environmental sustainability.

Challenges arise when GenAI's presence is enthusiastically received by society, thus ignoring negative environmental risks due to psychological barriers from the emergence of new things. Added to this is the exponential speed of GenAI development that makes it difficult for regulators to regulate GenAI usage effectively and responsibly. Therefore, an inclusive and adaptive governance design is needed for GenAI's rapid development, so that GenAI's presence, which is hoped to be a solution to the climate crisis, does not become a new threat.

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