The Industry of the Future: From Industry 4.0 to Industry 5.0 – Integration of Humans and Technology: New Technologies

Karabegović, Isak

2025
Akademija nauka i umjetnosti Bosne i Hercegovine
https://bastina.anubih.ba/handle/123456789/837

DOI: 10.5644/PI2025.220.08

Evaluating the Environmental Impact of AI and Information Technologies

Samir Lemeš*[1]

Abstract: *Artificial intelligence (AI) and digital technologies are already used to address environmental challenges through applications such as climate modelling. AI-driven systems contribute to climate predictions and optimisation of energy grids. Satellite imaging and IoT sensors provide real-time environmental monitoring. These promising applications simultaneously increase the environmental burden of AI and IT infrastructure. Data centres for high-performance computing require vast amounts of energy due to enormous carbon emissions. The growing amount of hardware in data centres and IT infrastructure drastically increases the need to extract critical minerals, which are rarely environmentally friendly. This analysis aims to examine the dual nature of digital technologies and their relationship with environmental protection and investigate whether it is possible to reconcile these technologies' environmental benefits and drawbacks. Are "GreenAI" and "SustainableIT" possible, and do benefits for Industry 4.0 and societal development justify the environmental burden these technologies produce?*

Keywords: *AI, Environmental Protection, Green AI, Sustainable IT*

1. Introduction

During a time of rapid technological growth, Information Technology (IT) and Artificial Intelligence (AI) are increasingly shaping our understanding, monitoring, and protection of the natural environment. They generate new opportunities for improved resource management, accelerated threat identification, and informed decision-making. However, the deployment of these technologies poses challenges and risks, requiring an assessment of their beneficial and potentially adverse impacts.

An important application of IT and AI in environmental protection is data collecting and analysis. Sensor networks, Internet of Things (IoT) devices, and intelligent measuring stations provide real-time assessment of weather/climate, air, water, and soil quality, whereas satellites and drones offer critical insights about trends in land use, urban expansion, and biodiversity status. Data that was previously challenging to obtain or costly to examine is now processed in real time across extensive geographic regions.Artificial intelligence improves and

*[1]University of Zenica, Polytechnic Faculty, Zenica, Bosnia and Herzegovina
E-mail: samir.lemes@unze.ba

can speedup the analysis of this data. Machine learning algorithms identify patterns and trends, which are essential for forecasting pollution, climate extremes like floods and droughts, and for delivering early warnings of possible environmental disasters. Moreover, AI facilitates the creation of predictive models that reveal the long-term impacts of human actions on the environment.

IT and AI can be used to enhance the management of natural resources. Smart energy and waste management systems can improve recycling operations and the allocation of energy from renewable sources. Geographic Information Systems (GIS), in conjunction with LiDAR (Light Detection and Ranging) data collection data analysis, can be used to formulate a strategy for the conservation of natural resources and urban green spaces. These technologies provide decision-makers with instruments facilitating more efficient environmental protection policies.

Interactive applications that simulate climate change and visualise environmental data can be used in education and awareness raising. Digital assistants and chatbots help citizens in adopting more sustainable practices.

Despite these advantages, these technologies possess a "dark side" that requires attention. The manufacturing and utilisation of digital gadgets demand substantial energy and resources, while the extensive aggregation and storage of data necessitate an exponentially growing number of data centres with considerable energy usage. The potential for unethical application of AI in environmental monitoring or decision-making exists, particularly when social dimensions of sustainability are disregarded.

These risks have recently become the focus of discussion among various researchers. Gundeti et al. examined the problems and unique opportunities presented by the rising use of artificial intelligence in environmental sustainability [1]. Chauhan et al. examined the environmental implications of AI, asserting that they require thorough consideration to guarantee a sustainable future [2]. Endersen focused on identifying the trends in energy usage and capital expenditure resulting from the design, development, and implementation of AI systems [3]. Akter in [4] examined solely the convergence of AI and sustainability, emphasising the utilisation of technical breakthroughs to reduce environmental consequences and foster a more sustainable future. Durai et al. examined the principles, challenges, and sustainability of AI, addressing its ethical and practical consequences. These issues encompass data privacy, AI inclusivity, and employment loss due to automation [5]. Aniko and Peyman examined the utilisation of artificial intelligence in the environmental sector [6]. Despite the advantages of AI, it is asserted that it remains in its early phase of growth, accompanied by environmental concerns. The power consumption and training duration of an AI model significantly influence its carbon emissions, hence intensifying the issues associated with climate change. Yehia and Alok examined the increasing awareness and concern over the environmental

consequences of AI and researched the development of tools and methodologies to promote Green AI [7].
Table 1 summarizes benefits and risks of digital tools use in environmental protection.

Table 1. The paradox: Digital technology both a solution and a problem

!! Digital Technology as a Solution !!	?? Digital Technology as a Problem ??
Real-time environmental monitoring: Sensors, drones, and satellites collect data on air and water quality, deforestation, emissions, etc.	**Energy consumption of data centres and networks:** Large-scale computing, including AI training and cloud storage, consumes huge amounts of electricity — often from fossil fuels.
AI for prediction and optimisation: Algorithms predict pollution, optimise energy use, reduce waste, and support smarter agriculture.	**E-waste generation:** Short device lifespans and fast tech turnover produce tonnes of electronic waste, much of it toxic and hard to recycle.
Sustainable urban planning: Geographic Information Systems (GIS) and smart city technologies enable greener infrastructure and transport.	**Resource extraction:** The production of digital devices depends on rare earth minerals, whose mining is environmentally destructive and often socially harmful.
Public awareness and behaviour change: Apps and digital campaigns educate people about sustainable practices	**Rebound effect:** Efficiency gains from technology (e.g., energy-saving apps) can be offset by increased usage or demand (e.g., more devices or services), which can cancel out the environmental benefits.

2. Positive Contributions of AI and it to Environmental Protection

Our civilisation confronts increasingly devastating effects from climate change and natural disasters; thus, the necessity for precise forecasting and prompt response has never been more critical. Artificial Intelligence (AI) came up as a powerful tool that enhances conventional scientific methodologies, providing novel approaches to comprehend complex environmental systems and augment our capacity to anticipate and address environmental hazards. In the domains of climate modelling and hazard forecasting, AI is already making substantial contributions.
Climate modelling is essential for comprehending long-term trends and forecasting future climatic conditions across many scenarios. These models are constructed using extensive mathematical calculations that replicate the Earth's atmosphere, oceans, terrestrial surface, and cryospheric processes. Nevertheless, conventional climate models often run into difficulties in accurately representing specific small-scale physical phenomena, such as cloud dynamics or ocean-atmosphere interactions, due to computational constraints. AI-driven models can

significantly decrease the computational resources needed to simulate climatic conditions, enabling researchers to conduct more simulations over a wider array of scenarios in a shorter timeframe.

AI improves climate modelling via data aggregation. Climate models require precise and updated observational data to generate accurate forecasts. The growing amount of environmental data from satellites, weather stations, and IoT devices presents a significant problem in real-time integration. AI enhances this process by learning to integrate various datasets into models more efficiently, therefore elevating the quality of the simulations. Moreover, AI methodologies are employed for downscaling—enhancing global climate model outputs to render them more applicable for local and regional decision-making, which is essential for infrastructure planning, agriculture, and urban development in response to climate hazards.

In addition to long-term climate forecasting, AI is essential for short-term disaster prediction. Natural disasters, like floods, wildfires, storms, and landslides, require prompt and precise forecasts to mitigate damage and preserve lives. AI systems utilising historical data and real-time environmental factors can accurately forecast the probability, location, and intensity of such catastrophes. For example, AI may evaluate precipitation patterns, terrain features, and soil moisture levels to predict landslides and to identify early indicators of wildfires through the analysis of satellite imagery. AI systems can evaluate data from satellites, drones, and social media to outline impacted regions, recognise individuals at risk, and allocate resources more effectively. In certain instances, AI algorithms observe mobile phone usage to identify evacuation trends or pinpoint groups of individuals who need assistance. Furthermore, AI is increasingly employed to manage infrastructure, including dams, highways, and bridges, facilitating the identification of weaknesses that may amplify the effects of natural disasters.

Early warning systems significantly benefit from artificial intelligence. When integrated with sensor networks and geospatial data, AI facilitates the creation of automated alert systems capable of issuing advance warnings for floods, storms, or tsunamis. These solutions not only improve community readiness but also provide faster and more coordinated emergency responses.

Artificial Intelligence (AI) significantly improves remote sensing and satellite monitoring by facilitating faster and more precise processing of extensive and complex environmental datasets. In the realm of deforestation, AI-driven image recognition algorithms can autonomously recognise variations in forest cover, categorise land use, and detect illegal harvesting activities in near real-time, thereby diminishing the necessity for manual analysis of satellite imagery. AI models assess satellite-derived data on sea surface temperatures, chlorophyll concentrations, and ocean colour to identify events such as harmful algal blooms, coral bleaching, and alterations in marine ecosystems, thereby contributing to ocean health.

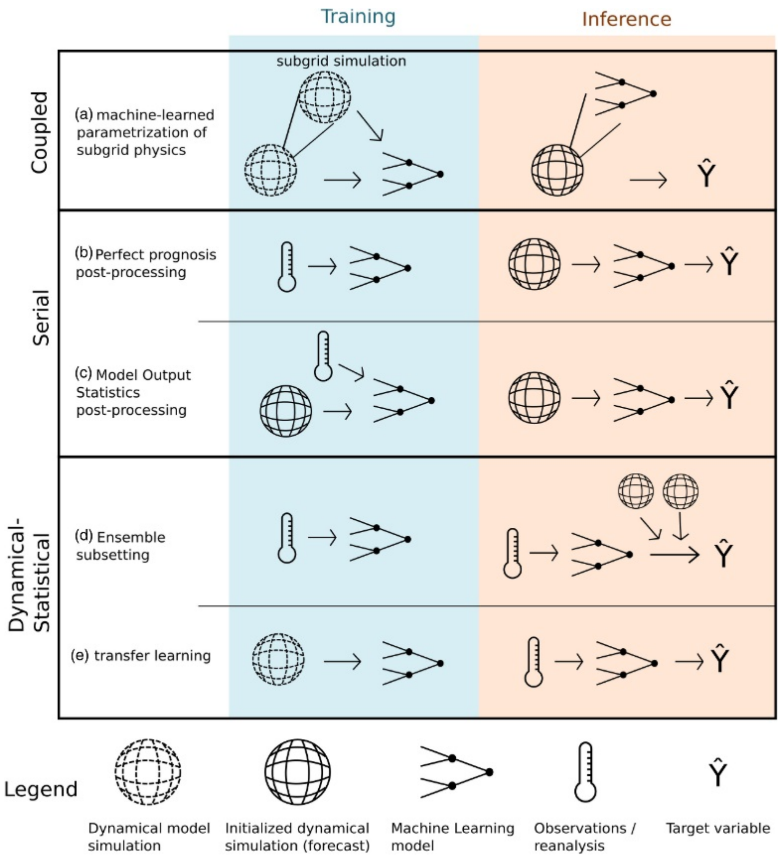

Figure 2. Combining dynamical models with deep learning to create hybrid predictions [8]

In the realm of biodiversity, AI facilitates the monitoring of alterations in habitat quality and species distribution through the analysis of multi-spectral and hyperspectral satellite data, thereby providing early alerts regarding habitat degradation or ecosystem imbalance. Integrating remote sensing with machine learning enables researchers to identify patterns, provide predictions, and enhance conservation initiatives more effectively and on a global scale.
IT and AI are rapidly transforming the development of smart grids and enhancing the efficiency of energy systems in sustainable urban environments. Smart grids employ sophisticated sensors, communication networks, and data analytics to oversee and regulate the real-time flow of electricity, facilitating

enhanced efficiency and reliability in energy distribution. Artificial intelligence improves these systems by examining consumption trends, forecasting demand variations, and optimising the incorporation of renewable energy sources such as solar and wind. For instance, AI can dynamically optimise grid operations to balance supply and demand, minimise energy losses, and minimise blackouts. AI-driven technologies in buildings and urban infrastructure optimise heating, cooling, and lighting according to occupancy and weather forecasts, therefore substantially reducing energy use. IT and AI are important facilitators of low-carbon urban development and the transition to sustainable, resilient cities by enhancing the adaptability and intelligence of energy systems.

Blockchain technology provides an effective mechanism for providing transparency and trust in the tracking and trade of carbon credits. Blockchain facilitates the secure storing and public verification of all transactions related to carbon credits—encompassing issuance, transfer, and retirement—through the establishment of an immutable and decentralised ledger. This mitigates the risk of fraud, double counting, and misreporting that have traditionally compromised the integrity of carbon markets. Smart contracts can facilitate compliance and enforcement, guaranteeing that carbon credits are used uniquely and in accordance with established regulations. Moreover, blockchain facilitates real-time tracking and verification of carbon reductions, thereby simplifying the monitoring of progress towards climate objectives for governments, corporations, and consumers. Blockchain fortifies the integrity of carbon offset efforts by augmenting accountability and transparency, hence enabling more effective climate action.

3. The Environmental Costs of it and AI

Data centres and high-performance computing (HPC) facilities form the backbone of the digital world, powering everything from cloud services to scientific simulations. However, they are also significant contributors to global carbon emissions due to their immense energy demands. These facilities require continuous power not only for computing operations but also for cooling systems to prevent overheating. According to estimates, data centres account for roughly 1–2% of global electricity consumption, with HPC applications contributing disproportionately due to their intensive workloads. The carbon footprint increases further when this energy comes from fossil fuel-based sources. As digital infrastructure expands to support AI, blockchain, and big data analytics, the environmental impact of computing is becoming an increasingly urgent concern.

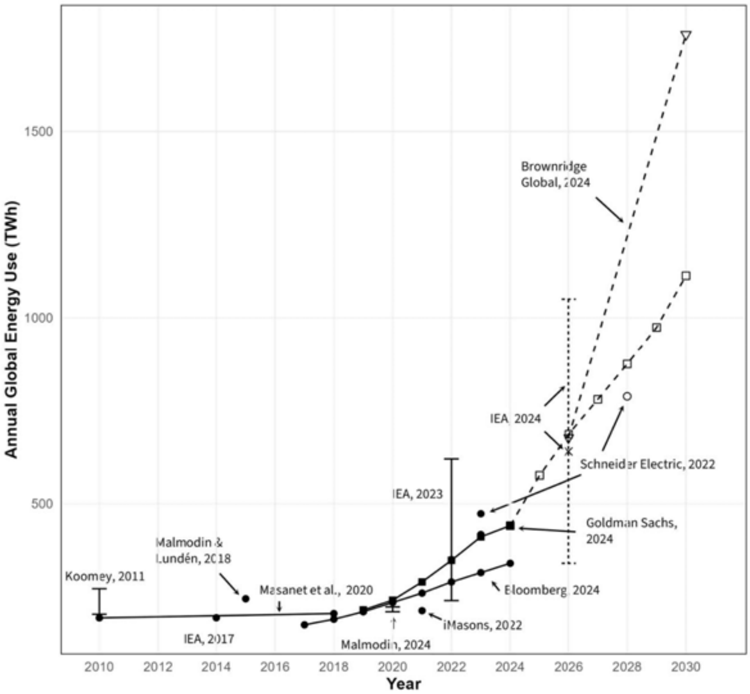

Figure 3. Academic and industry historical estimates of global data center energy use [9]

To mitigate this footprint, tech companies and research institutions are investing in energy-efficient hardware, advanced cooling technologies, and the use of renewable energy. Some data centres now operate in cooler climates to reduce the need for artificial cooling, while others utilise AI to optimise energy usage dynamically. Additionally, carbon-aware computing strategies—where workloads are scheduled during times when cleaner energy is available—are gaining traction. Despite these efforts, the rapid growth of data-intensive technologies means the challenge persists. Addressing the carbon footprint of data infrastructure is critical to aligning digital transformation with global sustainability goals.

The carbon footprint of data centres and high-performance computing (HPC) equipment is an escalating environmental issue due to the increasing global demand for digital services. These facilities utilise substantial quantities of electricity to operate servers, storage systems, and network infrastructure, in addition to powering intensive cooling systems necessary for maintaining appropriate temperatures. Data centres presently constitute approximately 1–2% of global electricity use, but the swift growth of AI, cloud computing, and big data analytics is anticipated to substantially elevate their energy requirements. High-performance computer systems, employed in scientific research, climate modelling, and intricate simulations, are notably energy-intensive owing to their extensive parallel processing capabilities. When derived from fossil fuels, this energy consumption results in significant carbon emissions. As digital infrastructure expands, mitigating the carbon footprint of data centres and high-performance computing is crucial for reconciling technical advancement with climate sustainability objectives.

The production of computer hardware relies heavily on rare earth minerals, which are essential for manufacturing components such as processors, memory chips, hard drives, and displays. These minerals—including neodymium, lanthanum, and dysprosium—are critical for creating powerful magnets, conductive materials, and other specialised electronic parts. However, the extraction and processing of rare earth elements pose significant environmental and social challenges. Mining operations often result in habitat destruction, soil and water contamination, and the release of toxic byproducts, particularly in countries where environmental regulations are weak or poorly enforced. Additionally, rare earth mining can lead to human rights concerns, including unsafe labour conditions and community displacement. As global demand for electronic devices grows, so does the pressure on rare earth supplies, highlighting the urgent need for more sustainable sourcing practices, recycling of electronic waste, and the development of alternative materials.

Figure 4. Forest devastation by mining operations in Bosnia and Herzegovina [10]

E-waste management refers to the collection, treatment, and recycling of discarded electronic devices such as computers, smartphones, and televisions.

As technology advances rapidly and device lifespans shorten, the volume of electronic waste is growing at an alarming rate. E-waste contains valuable materials like gold, copper, and rare earth elements that can be recovered and reused. However, it also carries hazardous substances such as lead, mercury, and flame retardants, which pose serious risks to human health and the environment if not handled properly. Effective recycling can reduce the need for raw material extraction, lower greenhouse gas emissions, and prevent toxic pollution, making it a critical component of a circular economy.

Despite its importance, e-waste recycling faces numerous challenges. Many countries lack the infrastructure, legislation, or enforcement mechanisms needed for safe and efficient e-waste management. A significant portion of e-waste is exported—often illegally—from wealthier nations to developing countries, where it is dismantled under unsafe conditions by informal workers without protective equipment. Additionally, modern electronic devices are increasingly complex and difficult to disassemble, with manufacturers often prioritising sleek designs over recyclability. Public awareness is also limited, leading to low recycling rates and the accumulation of obsolete devices in households. Addressing these issues requires coordinated global action, including stricter regulations, extended producer responsibility, investment in recycling technologies, and education to encourage responsible consumer behaviour.

Water consumption in chip manufacturing and cooling systems is a significant yet often overlooked contributor to the environmental impact of the IT industry. The production of semiconductors requires extremely clean environments and materials, including ultra-pure water used to rinse and clean silicon wafers during fabrication. A single semiconductor fabrication plant can consume millions of litres of water per day, placing pressure on local water resources—especially in regions already facing water scarcity. If not properly treated, wastewater from these processes can also carry harmful chemicals and heavy metals that pose environmental and health risks when released into the environment.

In addition to manufacturing, water is extensively used in the operation of data centres, where it plays a key role in cooling systems that prevent servers from overheating. Many facilities rely on evaporative cooling, which consumes large volumes of water, contributing further to water stress in some areas. While some companies are adopting more sustainable practices—such as closed-loop water systems or alternative cooling technologies—water use remains a critical environmental challenge in the lifecycle of IT infrastructure. As demand for digital services continues to grow, reducing water consumption and improving water management in both chip production and data centre operations will be essential for minimising the IT sector's overall ecological footprint.

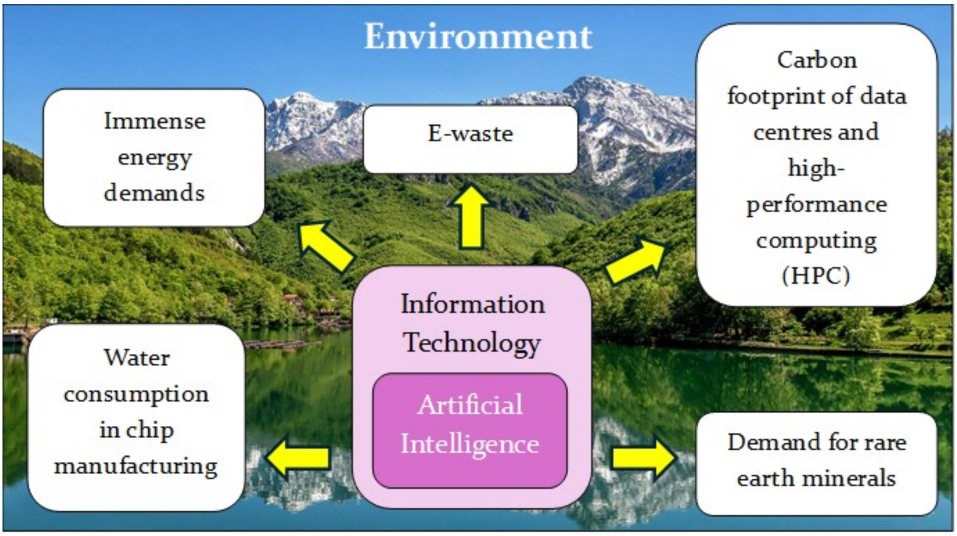

Figure 5. Possible environmental costs of IT and AI

4. Trade-Offs and Unintended Consequences

AI optimisation has the potential to offset, and in some cases even exceed, the energy it consumes—though this depends on how and where it is applied. On one hand, training and deploying large AI models, particularly in deep learning and generative AI, can be extremely energy-intensive, requiring vast computing resources and contributing significantly to carbon emissions. However, AI can also be used to optimise energy efficiency across a wide range of systems, including data centres, power grids, transportation networks, and industrial processes. For example, AI systems have been shown to reduce data centre cooling costs by up to 40% and to improve the efficiency of renewable energy integration into power grids by forecasting supply and demand more accurately [11].

The key to AI offsetting its own energy footprint lies in targeted, efficient deployment and careful system design. Lightweight, energy-efficient models can be used for many applications without incurring large carbon costs, and advancements in hardware and algorithms are continuously reducing the energy required for training and inference. Moreover, when AI is applied in sectors with large energy or emissions footprints—like manufacturing, logistics, or urban planning—the savings it generates can far outweigh its own consumption. Still, to ensure a net-positive environmental impact, the development and use of AI must be guided by sustainability principles, transparency, and lifecycle assessments. In short, while AI can offset its own energy use, whether it actually does sodepends on responsible implementation.

The risk of greenwashing is a growing concern in the tech industry, as companies increasingly promote their environmental credentials without always backing them up with meaningful action. Many tech giants now publish sustainability reports, commit to carbon neutrality, and invest in renewable energy, often framing themselves as leaders in the fight against climate change. While some of these efforts are genuine and measurable, others are criticised for being more about image than substance. For instance, a company might claim to be "carbon neutral" by purchasing carbon offsets rather than reducing actual emissions or highlight small eco-friendly initiatives while continuing unsustainable practices in their supply chains or data centres.

Scrutiny is especially warranted because much of the tech sector's environmental impact is hidden in complex global supply chains, resource extraction for hardware production, and massive energy use in data centres. Additionally, the fast pace of product obsolescence and limited repairability contribute to rising e-waste. True sustainability requires transparent reporting, third-party audits, and systemic changes—not just marketing campaigns or vague commitments. Without clear standards and accountability, the risk of greenwashing remains high, and consumers, investors, and regulators must be vigilant in distinguishing genuine progress from superficial branding.

AI-driven sustainability efforts offer powerful tools to combat climate change and manage natural resources more efficiently, but their prioritisation over social or economic goals raises important ethical concerns. On one hand, addressing environmental challenges is urgent and affects the long-term well-being of all societies, potentially justifying the prioritisation of sustainability. AI can optimise energy systems, reduce emissions, and improve environmental monitoring, contributing significantly to global climate targets. However, if these efforts come at the cost of job losses, increased surveillance, or the exclusion of vulnerable communities, they risk deepening social and economic inequalities.

Ethical AI deployment requires balancing environmental benefits with respect for human rights, equity, and justice. For example, smart city initiatives that reduce energy consumption through AI-based monitoring might infringe on privacy or disproportionately affect lower-income residents. Likewise, AI-driven automation in sustainability sectors could displace workers without adequate retraining or support. Rather than seeing sustainability and social and economic goals as competing priorities, they should be pursued in tandem. Responsible AI should be designed and governed to ensure that environmental benefits do not come at the expense of fairness, inclusivity, and human dignity.

5. Future Directions and Policy Recommendations

The term “Green AI” is an emerging movement that emphasises the development of energy-efficient algorithms and environmentally conscious artificial intelligence systems. As AI models grow in complexity—especially in areas like deep learning and natural language processing—the computational power and energy required to train and run them have skyrocketed. Some large-scale models consume as much energy as several households do in a year, raising serious environmental concerns. In response, researchers and organisations are advocating for “Green AI”, which prioritises not only accuracy and performance but also the environmental cost of computation [12].
The goal of Green AI is to reduce the carbon footprint of AI by designing algorithms that are more computationally efficient, using fewer parameters, and requiring less data and training time. Techniques such as model pruning, quantisation, transfer learning, and the use of specialised low-power hardware (like GPUs optimised for efficiency) all contribute to this effort. Additionally, transparency in reporting energy use and emissions associated with training AI models is gaining importance, encouraging accountability and responsible innovation. Green AI represents a critical shift toward sustainable technology development—ensuring that the benefits of AI do not come at an unsustainable cost to the planet.
Sustainable IT practicesthat organisations and technology providers are adopting to reduce their environmental footprint include:

- Carbon-Neutral Cloud Computing:Major cloud service providers like Google Cloud, Microsoft Azure, and AWS are investing in renewable energy and carbon offset projects to power their data centres and achieve carbon neutrality. Some offer tools that allow clients to track the carbon footprint of their cloud usage and make greener choices.
- Circular Economy for Hardware:This approach promotes designing IT hardware for durability, repairability, and recyclability. Companies like Dell and Fairphone are developing modular devices that can be easily upgraded or repaired, and programs for take-back, refurbishing, and responsible recycling of used electronics are growing.
- Energy-Efficient Software and Algorithms:Developers are optimising software to use less computational power, which reduces the energy demand on devices and servers. Lightweight code, efficient data structures, and Green AI techniques help lower the overall environmental impact of digital services.
- Virtualisation and Server Consolidation:By running multiple virtual machines on a single physical server, organisations can significantly

reduce hardware needs and energy consumption in data centres. This practice enhances resource utilisation and decreases electronic waste.

- Sustainable Procurement Policies:Organisations are adopting procurement standards that prioritise eco-friendly products, suppliers with strong environmental practices, and hardware with certifications like Energy Star, EPEAT, or TCO Certified.
- Intelligent Energy Management in IT Operations:Using AI and machine learning, IT systems can dynamically manage power consumption—for example, by adjusting cooling in data centres or powering down idle devices across an enterprise network.

These practices help align digital transformation with environmental sustainability goals while promoting cost savings and long-term operational resilience.

Regulatory frameworks for AI-driven environmental monitoring are emerging to ensure that the use of artificial intelligence in tracking environmental changes is ethical, accurate, and accountable. As AI technologies become integral to monitoring air and water quality, deforestation, wildlife patterns, and climate variables, governments and international bodies are recognising the need for clear standards and oversight. These frameworks aim to ensure data transparency, validate the accuracy of AI models, and prevent misuse or manipulation of environmental data for political or commercial gain.

Some countries and regions have begun incorporating AI into their environmental legislation. For example, the European Union's AI Act [13] includes provisions to regulate high-risk AI systems, which could include those used for environmental monitoring, especially when tied to critical decision-making. The EU Commission has announced it will soon be looking for third-party contractors relating to 'Technical Assistance for AI Safety,' covering the topics of CBRN, cyber offence, loss of control, manipulation, and other AI risks [14]. Additionally, agencies like the U.S. Environmental Protection Agency (EPA) and the UN Environment Programme (UNEP) are exploring the use of AI tools while emphasising the importance of data integrity, privacy, and inclusivity. However, global regulation is still fragmented, and many AI monitoring projects operate without standardised protocols. Strengthening international collaboration and establishing guidelines for ethical AI use in environmental contexts will be crucial for ensuring that these technologies genuinely support sustainability and environmental justice.

6. Conclusion

IT and AI have become powerful tools in environmental protection, enabling real-time monitoring, predictive analytics, and optimisation of resource use. From smart grids and precision agriculture to climate modelling and deforestation tracking, these digital innovations offer unprecedented opportunities to address ecological challenges with greater speed and accuracy. For instance, AI can analyse satellite data to detect illegal logging or predict the spread of wildfires, while IT systems help manage renewable energy distribution and reduce emissions through smart infrastructure. These capabilities demonstrate the potential of digital technologies to contribute meaningfully to environmental sustainability.

However, the same technologies can also contribute to environmental harm if deployed without consideration of their ecological footprint. High energy consumption in data centres, resource-intensive hardware production, and the rapid growth of e-waste are direct consequences of unchecked digital expansion. Moreover, AI models, especially large-scale systems, require significant computing power, often powered by non-renewable energy sources. There is also a risk of greenwashing—where companies overstate the environmental benefits of their digital initiatives—if clear standards and accountability measures are not in place. These tensions highlight the complex dual role of AI and IT, making it essential to view them not as inherently sustainable but as tools that require careful governance.

To balance technological progress with ecological responsibility, an interdisciplinary approach is crucial. Collaboration between technologists, environmental scientists, ethicists, and policymakers can help design digital systems that align with sustainability goals. Recommendations include investing in "Green AI," improving the recyclability of hardware, and developing transparent metrics for environmental impact assessments. Future regulatory frameworks should go beyond data protection and AI ethics to include environmental criteria, such as mandatory sustainability reporting, carbon accounting for digital infrastructure, and lifecycle impact assessments of AI systems. International coordination will also be necessary to ensure that sustainability standards are applied globally and equitably. With the right oversight and cross-sectoral dialogue, AI and IT can evolve from potential threats into essential allies for a sustainable future.

Finally, there is an additional concern not addressed herein. Increased IT usage influences human behaviour and perception, consequently impacting the environment. This issue requires additional observation and analysis.

7. References

[1] Gundeti R, Vuppala K, Kasireddy V (2024). The Future of AI and Environmental Sustainability: Challenges and Opportunities. In H. Kannan, R. Rodriguez, Z. Paprika, & A. Ade-Ibijola (Eds.), Exploring Ethical Dimensions of Environmental Sustainability and Use of AI (pp. 346-371). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-0892-9.ch017

[2] Chauhan D, Bahad P, Jain J K (2024). Sustainable AI: Environmental Implications, Challenges, and Opportunities. In D, L., Tiwari, R.S., Dhanaraj, R.K., & Kadry, S. (Eds.). (2024). Explainable AI (XAI) for Sustainable Development: Trends and Applications (1st ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9781003457176

[3] Endersen A E (2025). The Artificial Intelligence Revolution: Finding Sustainable Solutions: Artificial Intelligence Energy Consumption and Environmental Impact: AI will lead to an unsustainable increase in global energy consumption that will require sustainable solutions.Metropolia University of Applied Sciences

[4] Akter M S (2024). Harnessing Technology for Environmental Sustainability: Utilizing AI to Tackle Global Ecological Challenge. Journal of Artificial Intelligence General Science (JAIGS) ISSN:3006-4023, 2(1), 61–70. https://doi.org/10.60087/jaigs.v2i1.97

[5] Durai S, Manoharan G, Ashtikar S P (2024). Harnessing Artificial Intelligence: Pioneering Sustainable Solutions for a Greener Future. In A. Derbali (Ed.), Social and Ethical Implications of AI in Finance for Sustainability (pp. 89-117). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-2881-1.ch003

[6] Aniko K, Peyman N (2024). Recent applications of AI to environmental disciplines: A review,Science of The Total Environment,Volume 906,167705,ISSN 0048-9697,https://doi.org/10.1016/j.scitotenv.2023.167705

[7] Yehia IA, Alok M (2024). Green artificial intelligence initiatives: Potentials and challenges,Journal of Cleaner Production,Volume 468,143090,ISSN 0959-6526,https://doi.org/10.1016/j.jclepro.2024.143090

[8] Materia S et al. (2024). Artificial intelligence for climate prediction of extremes: State of the art, challenges, and future perspectives. WIREs Climate Change, 15(6), e914. https://doi.org/10.1002/wcc.914

[9] ShehabiA et al. (2024). 2024 United States Data Center Energy Usage Report. Lawrence Berkeley National Laboratory, Berkeley, California. LBNL-2001637, https://eta-publications.lbl.gov/sites/default/files/2024-12/lbnl-2024-united-states-data-center-energy-usage-report.pdf (accessed 14.5.2025)

[10] Dinarević H (2024). Prva godinazlatnedrhtavice: Koliko ičega je do sadaiskopano u Varešu?https://www.mreza-mira.net/vijesti/prva-godina-zlatne-drhtavice-koliko-i-cega-je-do-sada-iskopano-u-varesu/ (accessed 14.5.2025)
[11] Digitalisation World (2025). AI-enhanced Cooling System Optimizer reduces energy consumption by up to 40%, https://digitalisationworld.com/news/69806/ai-enhanced-cooling-system-optimizer-reduces-energy-consumption-by-up-to-40 (accessed 14.5.2025)
[12] Grum M, Ambros M, Rojahn M (2024). Aiming to Create Green AI. Industry 4.0 Science, 40. Jg.,Nr. 6, S.18-30. https://doi.org/10.30844/I4SE.24.6.18
[13] European Union ((2024). Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32024R1689 (accessed 15.5.2025)
[14] European Commission (2025). EU Funding & Tenders Portal, https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/tender-details/76f9edf2-d9e2-4db2-931e-a72c5ab356d2-PIN (accessed 15.5.2025)