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Green Blindness in the Digital Age: Towards a Regulatory Agenda for Digital Environmental Justice*

Abstract

The twin transitions of green and digital transformation are redefining sustainable development agendas, yet current digital innovation often suffers from "green blindness," the neglect of environmental externalities and justice concerns. This oversight can lead to significant environmental harm and exacerbate inequalities, as recent analyses have warned, highlighting that environmental issues are being sidelined in favor of digital growth. This study examines the legal aspects of this issue, situating the discussion within a global context and employing a comparative lens on developing countries. In Vietnam, for example, a booming digital economy coupled with pressing environmental challenges highlights the need for integrated governance to avoid high resource consumption and other sustainability risks. The paper introduces the concept of digital environmental justice, to ensure that the benefits and burdens of digital transformation are distributed equitably, and ecological impacts are mitigated. It examines how emerging technologies, including artificial intelligence, blockchain, and big data systems, intersect with climate and environmental goals, identifying gaps where regulatory frameworks lag behind technological advancements. By bridging digital rights and environmental law, the paper argues for a more equitable, inclusive, and sustainable digital age, guiding the twin transitions toward both green and just outcomes.

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1 Introduction

The "twin transition" of digital transformation and green transition is now a central narrative in sustainable development policy.[1] Governments increasingly treat digitalization, through artificial intelligence (AI), big data, cloud services, and digital platforms, as an enabler of climate mitigation, environmental monitoring, and resource efficiency. However, this optimistic framing often obscures a structural risk, since digital innovation can fall prey to "green blindness," advancing rapidly while its environmental externalities and distributional impacts are under-regulated and under-accounted for. In practice, the digital economy relies on material infrastructures, data centers, networks, devices, and global supply chains that consume energy and water at scale, extract critical minerals, and generate escalating streams of electronic waste.[2] When these burdens are displaced onto particular communities (often poorer, peripheral, or less politically empowered), digital growth can reproduce and intensify environmental injustice rather than reduce it. This paper responds to that problem by developing and operationalizing the concept of Digital Environmental Justice (DEJ). DEJ sits at the intersection of digital justice (access, rights, and fair participation in digital society) and environmental justice (fair distribution of environmental benefits and burdens). It reframes the digital transition not only as a question of innovation or economic competitiveness, but also as one of legal obligations, rights-based governance, and institutional accountability. The central claim is straightforward that a sustainable digital future requires law to make environmental costs

1 Aude-Solveig Epstein, "EU Environmental Law in the Digital Age: A Critical Outlook on the Twin Transition's Legal Structure" *European Journal of Risk Regulation*, 28 July (2025): 1-17. Dominik Bierecki, Christophe Gaie, Mirosław Karpiuk, Jean Langlois-Berthelot, "Creating Resilient Artificial Intelligence Systems. A Responsible Approach to Cybersecurity Risks" *Prawo i Więź*, No. 5 (2025): 131-149.

2 Md. Abdus Shabur, "Analyzing the Challenges and Opportunities in Developing a Sustainable Digital Economy" Discover Applied Science, No. 12 (2024): 667.

visible, governable, and fairly allocated, rather than treated as collateral damage or a problem for later mitigation.

Methodologically, the paper adopts a doctrinal and comparative orientation. It situates DEJ within contemporary environmental law principles and examines how emerging legal frameworks are beginning to address digital externalities. To avoid purely abstract theorizing, the paper also uses Vietnam as an illustrative developing-country exemplar, where ambitious digital growth objectives operate alongside significant environmental pressures. The paper proceeds in four moves. First, it clarifies the nature of green blindness within the digital ecosystem and explains why the twin transition is not automatic but must be actively governed. Second, it proposes DEJ as a normative and legal framework, grounded in environmental rights and the "right to know" the footprint of digital services and products. Third, it introduces evaluative criteria to assess whether legal systems are genuinely integrating environmental concerns into digital governance, updating environmental laws to address ICT risks, ensuring participation and fairness, and establishing credible enforcement and transparency mechanisms. Fourth, building on that diagnosis, the paper sets out a regulatory agenda that can steer digital transformation toward both sustainability and equity. By reframing digital governance through environmental justice and operational legal tools, this study helps bridge two domains that are too often treated separately. It argues that the twin transition will remain fragile unless legal systems make environmental impacts a core constraint and design parameter of the digital economy, rather than a peripheral afterthought.

2 Integrating Digital and Green Transitions: A Conceptual and Normative Framework

2.1. The Twin Transition and "Green Blindness"

The term "twin transition" refers to the simultaneous pursuit of digital transformation and ecological sustainability. Policymakers, especially in the EU, herald this twin transition as a synergistic strategy: digital innovation is expected to drive environmental protection (through better monitoring, efficiency, etc.), while green policies can guide technology

towards sustainable ends.[3] However, this optimistic narrative often suffers from "green blindness," a failure to see or address the environmental externalities of digitalization. In practice, many digital policies and tech initiatives overlook the environmental costs of digital tech, including massive energy and water use, intensive resource extraction, and growing electronic waste.[4]

The twin transition rhetoric often assumes digitalization will automatically advance sustainability, whereas in reality, there is nothing automatic about it. Indeed, experts caution that digital and green goals can conflict, and that achieving both sustainability and technological progress requires deliberate effort rather than technocratic optimism.[5] Green blindness manifests in digital strategies that focus on growth and innovation, while ignoring externalities such as carbon footprints, e-waste, and pollution.[6] This oversight is evident in the rebound effect: efficiency gains from new tech are often offset by increased demand and consumption. To concretize the environmental externalities that green blindness obscures, one can consider a matrix of three impact vectors in the digital ecosystem: (i) artificial intelligence (AI) and data centers; (ii) blockchain and fintech; (iii) user devices, the Internet of Things (IoT), and global supply chains.

2.1.1. AI and Data Centers

The AI revolution and explosion of data are driving a steep increase in energy demand. Training and running large AI models require power-hungry data centers and server farms, which in turn consume vast amounts

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3 For example, the European Commission asserts that "Europe's digital transition goes hand in hand with the European Green Deal." In Vietnam as well, leaders emphasize that digital transformation and green transition are twin pillars of sustainable growth. See Epstein, "EU Environmental Law in the Digital Age"; OpenGov Asia, "Vietnam: Smart, Green and Digital Development in Action – OpenGov Asia" *OpenGov Asia*, 17 December 2025. https://opengovasia.com.

4 Epstein, "EU Environmental Law in the Digital Age."

5 Antonio Aloisi, "A Green, Digital and Just Transition? The Not-So-Bizarre EU Policy Love Triangle | IE Insights" *Ie.Edu*, 13 March 13, 2025.

6 For instance, EU law and policy widely promote digital tools for climate solutions but have historically overlooked the rising energy consumption, GHG emissions, and mining of critical minerals tied to digitalization. See Epstein, "EU Environmental Law in the Digital Age."

of electricity (and often water for cooling).[7] Globally, data centers already account for a significant share of electricity use and carbon emissions.[8] However, digital policies seldom impose hard environmental constraints on data centers or AI development. This is a paradigmatic case of green blindness: AI advancement is pursued with little regard for its carbon cost.[9] Without stronger measures (such as efficiency standards or requirements to use renewable energy), the AI and cloud computing boom could undermine climate goals.

2.1.2. Blockchain and Fintech

The rise of blockchain technologies, especially cryptocurrencies like Bitcoin, illustrates another digital sector with an outsized environmental impact. A single Bitcoin transaction has been estimated to use as much electricity as one typical person's consumption over several years.[10] Fintech data centers and high-frequency trading infrastructure also contribute to energy demand, though cryptocurrencies are the clearest example of digital finance colliding with climate concerns. Although, some positive developments are emerging,[11] the overall fintech sector reveals how digital innovation can carry hidden environmental costs. Policymakers are only

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7 Studies have found that training a single cutting-edge AI model can emit ~626,000 pounds of CO_2 (over 280 metric tons), roughly five times the lifetime emissions of an average car. See Packt, "Carbon Footprint of AI and Deep Learning" *Learning Tree*, 31 July 2019. www.learningtree.com.

8 By 2022, data centers (and crypto mining, discussed next) consumed about 2% of the world's electricity and nearly 1% of global CO_2 emissions. This footprint is projected to grow to 3.5% of electricity by 2025, equivalent to the power use of a country like Japan. See Shafik Hebous, Nate Vernon-Lin, "Carbon Emissions from AI and Crypto Are Surging and Tax Policy Can Help" *IMF*, August 15, 2024, www.imf.org.

9 The EU's proposed AI Act, for example, largely treats sustainability as an afterthought, as its only environmental provision is a reporting duty. See Epstein, "EU Environmental Law in the Digital Age."

10 By some measures, the Bitcoin network's annual electricity consumption exceeds 140 TWh (terawatt-hours), comparable to that of a mid-size country. This translates into tens of millions of tons of CO_2 emissions per year. In the U.S. alone, cryptocurrency mining was estimated to emit 25-50 million tons of CO_2 annually. See Samuel Asumadu Sarkodie et al., "Assessment of Bitcoin Carbon Footprint" *Sustainable Horizons* 7 (2023): 100060; Samuel Huestis, "Cryptocurrency's Energy Consumption Problem" *RMI*, 30 January 2023. https://rmi.org.

11 For instance, Ethereum's switch to a "proof-of-stake" algorithm in 2022 drastically cut its energy use. See Huestis, "Cryptocurrency's Energy Consumption Problem."

starting to react; proposals include carbon taxes or electricity excise taxes on crypto mining,[12] but legal frameworks have yet to fully internalize the climate externalities of blockchain.

2.1.3. Devices, IoT, and Supply Chains

The third vector concerns the physical footprint of our digital devices, from smartphones and laptops to the expanding Internet of Things (smart appliances, wearables, sensors in infrastructure, etc.). Manufacturing these devices requires significant energy and raw materials, including critical minerals (rare earths, lithium, cobalt, etc.), often extracted at high environmental and social cost.[13] Toxic substances (lead, mercury, dioxins, etc.) leach into soil and water from rudimentary e-waste processing, causing severe health and environmental harms.[14] This global flow of e-waste disproportionately burdens poorer communities, demonstrating an apparent digital environmental injustice. However, until recently, legal systems paid scant attention to e-waste and device life-cycles.

2.2. Digital Environmental Justice

In response to the inequities highlighted above, scholars and policymakers are developing the notion of Digital Environmental Justice (DEJ). This concept lies at the intersection of two established frameworks: digital justice (equitable access and rights in the digital sphere) and environmental justice (fair distribution of environmental benefits and burdens).[15]

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12 Ibidem.

13 For example, mining of cobalt for batteries or rare earths for electronics is linked to habitat destruction, pollution, and labor abuses in parts of Africa and Asia. These upstream impacts are often invisible to end-users – a classic externality. At the downstream end, electronic waste (e-waste) is among the fastest-growing waste streams globally. As devices become obsolete at a rapid pace, mountains of e-waste are generated each year. In 2022, the world produced an estimated 62 million tonnes of e-waste, but only 22% of it was formally collected or recycled. See World Healt Organization, *Electronic Waste (e-Waste)*, 1 October 2024. www.who.int.

14 Ibidem.

15 Kristina Lyons, Marilyn Howarth, "The Importance of Hemispheric Perspectives for the Environmental Humanities: Reflections on Bilingual Digital Environmental Justice Storytelling" *Tapuya: Latin American Science, Technology and Society*, 31 December 2022, www.tandfonline.com/doi/abs/10.1080.

It insists that technological progress must not come at the expense of environmental health or social equity, especially for those least able to bear the consequences.[16] DEJ takes the core demand of environmental justice that no group or generation shoulders disproportionate environmental harm and extends this logic from its traditional contexts (like polluted or resource-extracted communities) to the realm of digital technology.[17] It shines a light on how the entire life-cycle of digital products, from the mines extracting rare minerals, to energy-guzzling data centers, to e-waste dumps, may impose environmental burdens on specific populations.[18] DEJ encompasses specific rights and obligations that can be recognized by law. These include:

1. The Right to a Healthy (or Clean) Environment. This right has gained international momentum, with the UN General Assembly in 2022 affirming a universal human right to a clean, healthy, and sustainable environment. Over 100 countries already recognize some form of this right in their constitutions or legislation.[19] While traditionally aimed at pollution and ecosystem health, this right is fully applicable to digital-era environmental harms. Likewise, the right implies a government obligation to ensure environmental quality even as it pursues digital economic growth. Recognizing this right pushes the twin transition toward a rights-based approach, where environmental quality is not just a policy preference but a legal entitlement that must be balanced against (or integrated with) digital development objectives.
2. The Right to Information and Digital Transparency. Access to information is fundamental for environmental justice. In legal terms, this has meant robust freedom of information laws, pollutant release registers, and corporate disclosure requirements in environmental

16 Sustainability Directory, *Digital Environmental Justice*, 7 December 2025. https://energy.sustainability-directory.com.

17 Ibidem.

18 For instance, communities in the Global South engaged in informal e-waste recycling, or living near lithium mines, may face health risks so that consumers in wealthy markets can have the latest gadgets. DEJ calls for remedying these imbalances through law and policy, ensuring inclusivity and equity in the digital transition).

19 Vietnam, for example, explicitly states in its Constitution that "everyone has the right to live in a clean environment and has the duty to protect the environment."

matters. For the ICT sector, one can analogously argue for a "right to know" the environmental footprint of digital products and services. Consumers and citizens should have access to data such as the energy efficiency of devices, the source of electricity for cloud services, the recyclability of gadgets, and the emissions from data processing.[20] The law can enforce transparency by requiring digital tech firms to conduct life-cycle assessments and publish results.[21] Thus, even trade secrets may yield when it comes to revealing what pollutants or greenhouse gases are released by a technology.

3. "Sustainability by Design" Obligations. Just as data protection law introduced the concept of "privacy by design," there is a growing call for sustainability (or ecology) by design in technology laws. This would impose a duty on designers and manufacturers to systematically integrate environmental criteria in product development.[22] A legal framework embracing sustainability-by-design might require software engineers to optimize code for energy efficiency, or mandate that cloud services dynamically shift loads to times/places of renewable energy availability. The underlying obligation is proactive: rather than fixing problems later (e.g., trying to recycle difficult materials), avoid creating the problem by smart design (e.g., using modular components that can be easily swapped and upgraded). Legislators and regulators would thus treat unsustainable design as a form of negligence or non-compliance.[23]
4. Extended Producer Responsibility (EPR). EPR is a regulatory approach that holds producers responsible for the post-consumer stage of their products. Under EPR, manufacturers must either take back

20 The EU's Corporate Sustainability Reporting Directive requires standardized disclosure of sustainability data, including scope 1-3 emissions, which would cover ICT operations. See Epstein, "EU Environmental Law in the Digital Age."

21 Ibidem.

22 For example, the EU's recent Ecodesign for Sustainable Products Regulation (2024) will require that a wide range of products, including electronics, meet criteria for energy efficiency, durability, repairability, and recyclability – effectively ensuring sustainability is built into the design phase. Another example is the concept of digital product passports, where each product carries a digital record of its material composition and environmental impact to facilitate responsible end-of-life handling. See ibidem.

23 Hedda Roberts et al., "Product Destruction: Exploring Unsustainable Production-Consumption Systems and Appropriate Policy Responses" *Sustainable Production and Consumption* 35 (2023): 300-312.

used products for recycling or disposal or pay fees to cover the costs municipalities or third parties incur to do so. This creates an incentive for producers to design products that are easier to recycle and that last longer.[24] Coupled with consumer awareness (right to information) and design mandates, EPR is part of a toolkit that makes the digital sector more accountable for its environmental footprint.

2.3. Criteria for Evaluating the Legal Framework

Drawing from the above analysis, this section proposes four criteria to evaluate a legal framework's response to the twin transition. These criteria serve as diagnostic questions to "measure" where legal systems may be falling short.

Criterion 1: Integration of Environmental Concerns into Digital Laws. A key sign of green blindness is when a nation's digital transformation strategy or ICT regulatory acts completely ignore sustainability issues (energy usage, e-waste, etc.). Conversely, a forward-looking legal framework will mainstream environmental considerations into its digital governance regime. This could take various forms: requiring digital industries to adhere to climate targets, mandating green procurement for IT equipment in the public sector, or including environmental criteria in the licensing of telecom or data center operations.[25] Evaluating this criterion involves checking: Do the laws governing digital infrastructures and services

24 Vietnam's recent EPR regulations (effective 2022) are a case in point: producers and importers of electronic equipment must register recycling plans or contribute financially to a recycling fund. Non-compliance can lead to penalties, and there are targets set for recycling rates. Such laws ensure that developing countries like Vietnam, often on the receiving end of global e-waste, strengthen their capacity to manage it and share responsibility with multinational firms. See Yen Vu, "Vietnam Extended Producer Responsibility (EPR) Regulations" *ChemLinked*, 25 December 2023. http://sustainability.chemlinked.com.

25 For example, the European Union has started moving in this direction by acknowledging the need for climate-neutral and energy-efficient data centers by 2030 as part of its Digital Decade goals. Some proposed EU digital regulations (like those on AI or cloud services) have begun to include sustainability clauses – albeit often limited to reporting obligations. See Jessica Commins, Kristina Irion, "Towards Planet Proof Computing: Law and Policy of Data Centre Sustainability in the European Union" *Technology and Regulation* 2025 (2025): 1-36.

contain substantive environmental standards or references? Are there cross-references between digital law and environmental law? If environmental impact assessments (EIAs) are mandated for large ICT projects, or if data protection laws allow use of personal data for environmental oversight, these would be positive signs.

Criterion 2: Updating Environmental Laws for ICT Risks. Classic environmental laws (pollution control, waste management, conservation, etc.) were often drafted in a pre-digital era, targeting smokestack industries and traditional pollutants. Thus, a legal framework demonstrates integration if it has expanded or adapted environmental regulations to encompass ICT-related externalities, such as emissions from data centers, electronic waste streams, or the environmental implications of global supply chains for tech components. The presence of EPR laws for electronics (as discussed) is a strong positive sign, it shows the environmental law recognizes and governs the end-of-life of digital products. Another example is integrating greenhouse gas emissions from ICT operations into national climate accounting and requiring mitigation (e.g., adding data center emissions into emissions trading schemes or carbon tax regimes).[26]

Criterion 3: Fairness and Public Participation. Key elements to examine this criterion include public participation rights, access to environmental information related to digital projects, and mechanisms to protect vulnerable groups.[27] Fairness also involves intergenerational justice, whether long-term impacts are weighted, and global justice, in the sense of recognizing cross-border effects (for instance, exporting e-waste to poorer countries or heavy resource extraction abroad to fuel domestic tech).[28] Additionally, this criterion also require the just transition ensuring that workers and communities reliant on old, unsustainable tech industries

26 The EU's experience is telling while it has directives on e-waste (WEEE) and energy use of appliances, critics point out that EU environmental law still struggles with indirect and diffuse emissions from digital tech (like the CO_2 from electricity used by IT, or the life-cycle impacts in supply chains). See Epstein, "EU Environmental Law in the Digital Age."

27 For example, if a government is creating a policy for national digital transformation, are environmental stakeholders and community representatives at the table? When environmental impact assessments are conducted for new tech infrastructure (like a semiconductor plant or an undersea internet cable), does the law mandate community consultations and consider social impacts (perhaps on local fishing grounds, etc.)?

28 Nicholas Theis, "The Global Trade in E-Waste: A Network Approach" *Environmental Sociology*, No. 1 (2021): 76-89.

(e.g., those in electronics manufacturing with hazardous processes) are not left behind as we shift to greener practices.[29]

Criterion 4: Enforcement and Transparency Mechanisms. This criterion checks whether there are robust institutions and tools in place to ensure compliance with both digital and environmental requirements, and whether information flows enable oversight.[30] If a legal framework leans excessively on self-regulation (e.g., expecting tech companies to police themselves via codes of conduct) and "paper" transparency (disclosures without consequence), it may fall short on enforcement. A failure here would be a situation where laws exist on paper, but violations (like illegal dumping of e-waste or data centers running on coal power in breach of pledges) go unchecked due to weak governance.

3 Global Diagnosis with Vietnam Exemplar

3.1. Global Frameworks and National Comparisons

3.1.1. International Environmental Frameworks

3.1.1.1. INTERNATIONAL TREATIES

The 2015 Paris Agreement provides an overarching climate framework (with most nations pledging net-zero emissions by mid-century), but does not explicitly address the ICT sector. In the waste realm, the 1989 Basel Convention controls transboundary movements of hazardous wastes, including certain e-waste. Over 180 countries have ratified Basel, imposing prior informed consent for hazardous e-waste exports but a notable gap is the United States, which has signed but not ratified Basel.[31] Such exclusions highlight regulatory fragmentation; for example, illegal e-waste

29 J. Mijin Cha, *A Just Transition for All: Workers and Communities for a Carbon-Free Future* (Cambridge: MIT Press, 2024).

30 Anton Shevchenko, "Do Financial Penalties for Environmental Violations Facilitate Improvements in Corporate Environmental Performance? An Empirical Investigation" *Business Strategy and the Environment*, No. 4 (2021): 1723-1734.

31 Zhang Hui, Aftab Haider, Asif Khan, "International Trade and Plastic Waste in Oceans: Legal and Policy Challenges" *Frontiers in Marine Science*, 12 August 2025. www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2025.1627829.

exports from the U.S. still find pathways to developing countries through this loophole. On public participation, the 1998 Aarhus Convention champions access to environmental information and justice, including in decisions about technology infrastructure. However, Aarhus's principles (e.g., community consultation rights) are not global norms; many countries, especially in the developing world, lack equivalent legal guarantees.[32]

3.1.1.2. "SOFT" STANDARDS AND FRAGMENTATION

Outside of binding treaties, a variety of voluntary guidelines and coalitions address sustainable ICT, though in a fragmented way.[33] Multi-stakeholder initiatives, such as the Coalition for Digital Environmental Sustainability (CODES), launched by the UN in 2021, aim to align digital transformation with the Sustainable Development Goals. There are also industry-led pledges, such as the Climate Neutral Data Centre Pact in Europe.[34] However, these efforts are disparate and non-binding. This institutional fragmentation means progress relies on piecemeal adoption of standards, and the risk of "forum shopping" remains.[35]

3.1.2. EU and the U.S.

The European Union has explicitly embraced a "twin transition," seeking to harmonize digital innovation with green goals. The EU's Digital Strategy is meant to complement the European Green Deal, with initiatives such as circular-economy action plans for electronics and energy-efficiency rules.[36]

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32 Carolyn Abbot, Maria Lee, "NGOs Shaping Public Participation Through Law: The Aarhus Convention and Legal Mobilisation" *Journal of Environmental Law*, No. 1 (2024): 85-106.

33 For instance, the ITU (a UN agency for ICT) has developed technical standards for green ICT (e.g., criteria for ICT product eco-design and methodologies for assessing ICT's environmental impact). See Paul Keng Fai Wan, Shanshan Jiang, "Enabling a Dynamic Information Flow in Digital Product Passports during Product Use Phase: A Literature Review and Proposed Framework" *Sustainable Production and Consumption*, 54 (2025): 362-374.

34 UNEP, *Digitalization for Sustainability*, 14 November 2023, www.unep.org.

35 This term refers to the phenomenon of companies relocating activities to jurisdictions with weaker regulatory frameworks.

36 Purva Mhatre et al., "A Systematic Literature Review on the Circular Economy Initiatives in the European Union" *Sustainable Production and Consumption*, 26 (2021): 187-202.

The EU has even pledged that all data centers will be "climate-neutral, highly energy-efficient and sustainable by 2030." In practice, however, blind spots exist. EU policies thus far focus on hardware efficiency and e-waste collection, leaving gaps in software optimization, data-driven emissions, and frivolous energy use such as crypto mining.[37] On e-waste, the EU's WEEE Directive and Circular Economy policies are advanced, but enforcement is uneven; a lot of Europe's discarded electronics still end up in countries with weaker protections.[38]

By contrast, the United States lacks an integrated approach linking digital regulation with environmental policy; digital and green laws primarily operate in silos. The U.S. tech policy centers on data privacy, competition, etc., while climate policy (e.g., the Inflation Reduction Act) focuses on power and transport sectors, not the ICT industry specifically. The U.S. has no federal e-waste law; e-waste management is governed by a patchwork of state laws. The U.S. also stands alone among developed economies in not ratifying the Basel Convention, which hampers a coordinated response to e-waste exports.[39] Similarly, energy-intensive crypto mining in the U.S. is not federally regulated for environmental impact, any measures (such as New York State's 2022 two-year moratorium on certain fossil-fueled crypto mining) are local. The absence of national standards means high-energy tech industries can relocate to jurisdictions with cheap, carbon-heavy power, undermining overall climate efforts.[40] The U.S. approach remains *ad-hoc*, as incentives for tech growth on one hand, and separate efforts to green the power sector on the other, without formally linking the two.

37 For example, the energy demand of data centers (especially for AI) is soaring, EU data centers already consume ~4% of EU electricity, and could reach 150 TWh by 2026. See Bart Brouwers, "AI's Hidden Energy Bill: Europe Grapples with Digital Growth" *IO+*, 5 October 2025. https://ioplus.nl.

38 Ibidem.

39 Paul Hagen, Ryan Carra, "The Expanding Regulation of Used and End-of-Life Electronic Products" *Beveridge & Diamond PC*, 1 September 2014. www.bdlaw.com. [accessed: 28.12.2025].

40 Hebous, Vernon-Lin, "Carbon Emissions from AI and Crypto Are Surging and Tax Policy Can Help."

3.1.3. Developing Countries

Many developing countries are experiencing *a déjà vu* of environmental risks as they pursue digital growth, echoing the pitfalls of earlier industrialization. Key patterns include:

3.1.3.1. CARBON-INTENSIVE DIGITAL INFRASTRUCTURE

Fossil fuels often power the digital boom in emerging economies. Data centers, telecom networks, and crypto mining operations are frequently plugged into coal-heavy or oil-based grids.[41] For example, both China and India have seen a surge in energy-hungry server farms and Bitcoin mining rigs tapping cheap coal power, causing local spikes in emissions. Without intervention, the AI and crypto waves could significantly worsen the carbon footprints of developing countries.[42] The lack of green energy mandates or efficiency standards in these jurisdictions creates a classic regulatory vacuum: digital industries expand with little requirement to use renewables or curb energy use.

3.1.3.2. E-WASTE IMPORT AND INFORMAL RECYCLING

Developing nations also bear the brunt of the world's e-waste tsunami. Higher-income countries routinely ship used electronics to lower-income regions, where enforcement of import bans is often lax.[43] This has made

41 Globally, about 56% of electricity consumed by data centers comes from coal and natural gas combined. In regions like Asia and Africa, this share can be even higher due to reliance on coal-fired power and diesel generators for backup. The International Energy Agency projects that until 2030, over 40% of new data center electricity demand will be met by coal and gas if current trends continue. See International Energy Agency, *Energy and AI*, World Energy Outlook Special Report (April 2025). www.iea.org.

42 Indeed, one IMF analysis estimates that by 2027, data centers and crypto mining combined could generate ~450 million tons CO_2 annually (about 1.2% of global emissions), much of that growth in countries with fossil-based grids. See Hebous, Vernon-Lin, "Carbon Emissions from AI and Crypto Are Surging and Tax Policy Can Help."

43 An estimated 5.1 million tonnes of e-waste were traded across borders in 2022, and about 65% of those shipments flowed from high-income to middle- and low-income countries via uncontrolled channels. See United Nations Institute for Training and Research, *Global E-Waste Monitor 2024: Electronic Waste Rising Five Times Faster than Documented E-Waste Recycling*, 20 March 2024. https://unitar.org.

places like Ghana's Agbogbloshie or Nigeria's Alaba market dumping grounds for the globe's discarded gadgets. Southeast Asia faces similar pressures that despite national laws, containers of old computers and phones have entered countries like Cambodia and Malaysia for unsupervised recycling. Once imported (legally or illegally), e-waste in developing countries is usually processed by a vast informal sector, street recyclers, backyard smelters, and salvage yards, using primitive methods.[44] Workers (including children) often burn cables in open air, use acid baths to extract gold, and dump residual toxins. The result is severe environmental injustice: local communities suffer contamination of air, soil, and water by heavy metals and dioxins, with dire health impacts.[45]

3.1.3.3. GAPS IN IMPACT ASSESSMENT AND PLANNING

A common issue is that Environmental Impact Assessment (EIA) regimes in developing countries have not fully caught up with the digital infrastructure boom. Traditional EIA regulations often do not explicitly list data centers, large server farms, or crypto-mining facilities as projects requiring assessment. Even when EIAs are conducted, they may overlook digital-specific issues (such as high water use for cooling or the climate resilience of network infrastructure). For example, in Kazakhstan and Iran, surges of informal crypto mining strained electric grids and caused blackouts, yet such operations were largely unregulated at first.[46] Developing states often lack policies on the books to evaluate and mitigate the cumulative impact of digitization, such as increased electricity demand, electronic waste generation, and land use for server facilities.

3.1.3.4. LIMITED ENFORCEMENT CAPACITY

Even when laws exist, and many developing countries are enacting e-waste rules or energy efficiency standards on paper, enforcement is the Achilles' heel. Regulatory agencies in these countries are frequently under-resourced, and technical expertise in fast-evolving tech fields is thin.[47]

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44 Ibidem.

45 Ibidem.

46 Shawn Tully, "Kazakhstan Internet Shutdown Sheds Light on a Big Bitcoin Mining Mystery" *Fortune*, 5 January 2022. https://fortune.com.

47 The Global E-waste Monitor notes that while 81 countries have some e-waste legislation, "enforcement [...] remains a genuine challenge globally," and only

In lower-income regions, environmental authorities struggle to monitor illegal scrap imports or informal recycling operations hidden in urban slums. Environmental police units exist but often lack the equipment and workforce to monitor hundreds of small-scale recyclers or to audit the energy usage of dispersed IT facilities.[48] Corruption and the prioritization of economic growth can further undermine strict enforcement.

3.2. Vietnam – a Case in Point

Vietnam is aggressively pursuing digital transformation as a driver of economic growth while simultaneously committing to sustainability goals, such as achieving net-zero carbon by 2050.[49] This dual aspiration makes Vietnam a telling case of the digital-environment nexus in the developing world. Vietnam's government has placed digital development at the heart of its strategy. The National Digital Transformation Programme (Decision 749/QĐ-TTg 2020) sets targets for a digital economy comprising 20% of GDP by 2025 and 30% by 2030.[50] The country is rapidly expanding e-government, digital services, and ICT infrastructure (broadband now reaches >99% of villages). In parallel, Vietnam made a landmark pledge at COP26 in 2021 to achieve carbon neutrality by 2050. It has since enshrined climate goals in domestic policy, issuing a National Climate Change Strategy to 2050 and integrating climate considerations into sectoral plans (e.g., Power Development Plan VIII emphasizes shifting to renewables).[51] Thus, Vietnam recognizes that unchecked ICT emissions or pollution could undermine its climate and environmental objectives.

Vietnam's legal landscape regarding digital and environmental issues includes strong elements, but also significant gaps. The 2020 Law on Environmental Protection (LEP) is Vietnam's umbrella environmental law.

42 countries have explicit collection or recycling targets. See United Nations Institute for Training and Research, *Global E-Waste Monitor* (2024).

48 Kathirvel Brindhadevi et al., "E-Waste Management, Treatment Options and the Impact of Heavy Metal Extraction from e-Waste on Human Health: Scenario in Vietnam and Other Countries" *Environmental Research*, 217 (2023): 114926.

49 Minh Hanh, *Fulfilling Climate Commitments at COP26: Vietnam's Comprehensive, Cross-Sector, and Whole-of-Society Action*, Ministry of Agriculture and Environment, 30 September 2025. https://en.mae.gov.vn:443.

50 VNA, *National Digital Transformation – New Driver for Sustainable Development*, 10 October 2025, sec. Sci-Tech. https://en.vietnamplus.vn.

51 Minh Hanh, "Fulfilling Climate Commitments at COP26."

It introduced a comprehensive climate change chapter and the principle of Extended Producer Responsibility (EPR). Under the LEP 2020 and its implementing Decree 08/2022, producers/importers of certain products must take responsibility for recycling and waste treatment. Notably, electrical and electronic products will be subject to mandatory recycling obligations from January 1, 2025.[52] This means tech manufacturers in Vietnam must either organize take-back and recycling of e-waste or contribute to a state recycling fund. The LEP also generally bans the import of waste (including e-waste) and requires EIAs for projects likely to affect the environment. However, the LEP and its detailed regulations do not yet specifically regulate emerging digital industries such as data centers or crypto as they are not explicitly named in any annexes or standards.

The National Digital Transformation Programme focuses on the digital government, economy, and society pillars, with objectives such as expanding broadband and e-commerce.[53] Until recently, concepts such as green IT and energy-efficient tech were absent from such strategies. However, policy awareness is growing. In late 2024, the Politburo issued Resolution 57-NQ/TW, which, for the first time, called for sustainable, green digital infrastructure development. Vietnam is even drafting a Law on Digital Transformation, which reportedly will classify digital infrastructure as national strategic assets and emphasize that they must be "modern, secure, sustainable, and green."[54] This is a positive signal that "green-by-design" principles may soon be embedded in Vietnam's digital regulations, though the law is still in draft.

On climate and energy, Vietnam's Power Development Plan (PDP VIII) (approved in 2023) and other strategies aim to dramatically increase renewable energy, which could benefit the ICT sector's carbon footprint. Vietnam is exploring Direct Power Purchase Agreements (DPPAs) to allow large power consumers (such as data centers) to buy electricity directly from renewable generators. Indeed, a recent government Decision 2161/QĐ-TTg in 2025 set ambitious targets for digital infrastructure by 2030, including 50% of national data center capacity to be supplied by green data centers.[55]

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52 "Vietnam: Extended Producer Responsibility–Latest Legislative Development" *Baker & McKenzie*, 19 January 2023. https://insightplus.bakermckenzie.com.

53 VNA, *National Digital Transformation – New Driver for Sustainable Development.*

54 Ibidem.

55 David Harrison et al., "Vietnam Embraces Digital Infrastructure, Green Data Centers, and AI" *Www.Hoganlovells.Com*, 21 October 2025. www.hoganlovells.com.

The same decision explicitly links data center expansion with renewable energy supply via DPPAs.

Despite these developments, regulatory gaps remain, as follows:

1. Lack of "Green-by-Design" in Digital Regulations. Vietnam's digital legal instruments thus far have not systematically incorporated environmental requirements. The Law on Information Technology, telecom regulations, or strategies such as "Made in Vietnam 4.0" mostly ignore issues such as energy-efficiency standards for ICT equipment, e-waste minimization in device manufacturing, and lifecycle assessments for new tech projects. For instance, until the recent Decision 2161, a data center investor faced no legal obligation to use renewable energy or reuse waste heat. Likewise, telecom operators are not yet mandated to power cellular towers with clean energy. The concept of "green ICT" is just starting to enter policy discourse in Vietnam. As noted, the draft Digital Transformation Law's mention of "green digital infrastructure" is promising. However, it will need concrete provisions (e.g., incentives for energy-efficient cloud computing, requirements for public agencies to procure green IT equipment, etc.) to avoid being merely aspirational. In short, Vietnam is still building out its digital infrastructure largely on conventional lines, energy and environmental design considerations are not front-loaded in project planning or licensing.
2. Environmental Law Not Targeting ICT-specific Risks. Vietnam's environmental regulations have yet to catch up with the novel impacts of the ICT sector. EIA rules in Vietnam (under Decree 08/2022 and related guidance) enumerate the types of projects that require assessment, including thermal power plants, factories, and waste treatment facilities. However, data centers are not explicitly listed; only massive construction projects or power-consuming facilities might trigger an EIA by general criteria. Thus, a new data center could avoid a rigorous EIA if it is interpreted as a service facility. There are no standards or guidelines specific to data centers' environmental performance (e.g., on allowable power usage effectiveness, or backup generator emissions). Similarly, cryptocurrency mining operates in a grey zone when Vietnam's government has discouraged crypto use in finance, but mining *per se* is not clearly regulated. As of mid-2025, Vietnam's Law on Digital Technology Industry recognizes

digital assets and is piloting exchanges,[56] yet it says nothing about the energy or carbon footprint of mining rigs. In fact, Vietnam's cheap electricity has made it a hotspot for underground crypto farms, which could undermine local energy conservation efforts. Also, Vietnam does not currently regulate the import or manufacture of smart devices from an eco-design perspective, beyond general chemical safety regulations. The Environmental Protection Law's EPR scheme will target e-waste broadly, but it does not single out high-risk ICT product categories, such as batteries in gadgets or solar panels, which could pose future waste challenges. In summary, Vietnam's green laws cover traditional pollution sources well but miss emerging ICT-centric issues such as significant data center emissions, crypto energy use, and new waste streams.

3. Limited Community Consultation in Digital Infrastructure. Rooted in Confucian traditions that emphasize social harmony, Vietnamese society has historically placed less emphasis on litigation as a means of resolving conflicts than Western nations do.[57] This cultural context, coupled with a firm reliance on governmental authority, shapes public engagement in environmental matters. While legal frameworks, such as the Environmental Impact Assessment (EIA) process, mandate community consultation and the public disclosure of reports, their implementation often faces challenges. In practice, these consultations can become formalities. A contributing factor is a certain public passivity; until a tangible problem emerges, environmental issues are frequently perceived as falling within the state's sole purview. This mindset, combined with sometimes ineffective official communication channels,[58] means that citizens often have little influence over decisions about digital infrastructure, whether fiber-optic cable routes, cell tower locations, or data center construction.[59]

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56 Evan Hultman, "The Financial and Regulatory Risks of Energy-Intensive Crypto Mining in Emerging Markets" Ainvest, 24 November 2025.

57 Minh Trang Nguyen, Hung Tran, "The Conflict Between Individual Freedom and Social Order in Vietnam Traditional Communities" *IJSSER*, No. 05 (2025): 170-1720.

58 Simon Lockrey et al., "Recycling the Construction and Demolition Waste in Vietnam: Opportunities and Challenges in Practice" *Journal of Cleaner Production*, 133 (2016): 757-766.

59 For instance, residents might learn of a new peri-urban data center only after construction begins, with limited avenues for input.

4 A Regulatory Agenda for Digital Environmental Justice

The rise of the digital economy must be steered in tandem with environmental sustainability to avoid the "green blindness" seen in many current tech initiatives. A robust regulatory agenda for Digital Environmental Justice (DEJ) should ensure that digital transformation policies explicitly incorporate environmental objectives and that environmental laws are updated to address digital-era challenges.

4.1. Integrate Environmental Objectives into Digital Governance

To overcome green blindness, policymakers should mainstream environmental sustainability into digital strategies and regulations. Thus, every national digital transformation plan, ICT law, or tech industry policy must include clear environmental standards and climate targets. For example, governments can require data centers, telecom networks, and other digital infrastructures to meet carbon-reduction goals aligned with national climate commitments.[60] Public procurement in the tech sector should prioritize energy-efficient and eco-friendly equipment. Licensing requirements for digital services can impose conditions on environmental performance, such as mandating that telecom operators or cloud data centers use a portion of renewable energy or implement e-waste reduction programs. In short, digital governance should embed green criteria by design. Just as privacy-by-design became a norm in data protection, sustainability by design should be a guiding legal principle in technology development.[61] Software and hardware designers would then be obliged to consider energy use, resource efficiency, and recyclability at every stage.

60 Abhiram Reddy Bommareddy, "Towards Sustainable Federal Financial IT: Green Computing Practices In Data Centers And Cloud Platforms" *International Journal of Environmental Sciences*, No. 24 (2025).

61 Leonie Reins and Julia Wijns, "The 'Safe and Sustainable by Design' Concept – A Regulatory Approach for a More Sustainable Circular Economy in the European Union?" *European Journal of Risk Regulation*, No. 1 (2025): 96-113.

4.2. Update Environmental Regulation for the Digital Era

Environmental laws and standards must be modernized to cover digital industries and their externalities. Traditional environmental regulations, often written with factories and pollution in mind, should be expanded to address issues like data center emissions, cryptocurrency mining, and electronic waste. For instance, data centers and large server farms should be explicitly included in Environmental Impact Assessment (EIA) regimes and subject to efficiency and cooling standards. If a country has a carbon trading or tax program, it should account for substantial greenhouse gas emissions from ICT operations (e.g., by including data center CO_2 output in national carbon budgets).

Likewise, electronic waste (e-waste) laws need strengthening; governments should enforce and broaden Extended Producer Responsibility (EPR) programs for electronics, requiring tech manufacturers to take back and recycle devices at the end of their life. Strong EPR not only shifts the burden of disposal off communities, but also incentivizes companies to design products that last longer and are easier to repair or recycle.[62] Additionally, environmental regulations should anticipate new digital technologies, for example, setting guidelines for safe battery disposal from electric vehicles and gadgets, or rules for sustainable sourcing of rare minerals used in high-tech devices.

4.3. Ensure Equity and Public Participation in Tech Development

Fairness and inclusivity are central to digital environmental justice. A key agenda item is to empower communities and stakeholders to participate in decisions about digital infrastructure and to protect vulnerable groups from disproportionate harms.[63] Public consultation and information disclosure should be mandatory for projects like data centers, 5G towers, or innovative city systems, just as they are for highways or power plants. This involves strengthening communities' legal rights to access environmental

62 Stéphanie H. Leclerc, Madhav G. Badami, "Extended Producer Responsibility for E-Waste Management: Policy Drivers and Challenges" *Journal of Cleaner Production*, 251 (2020): 119657.

63 Roksana Jahan Tumpa, Leila Naeni, "Improving Decision-Making and Stakeholder Engagement at Project Governance Using Digital Technology for Sustainable Infrastructure Projects" *SASBE*, No. 4 (2025): 1292-1329.

information related to digital projects and to voice concerns early in the planning process.

Laws should ensure that the benefits and burdens of digitalization are fairly distributed across society and future generations. This could mean investing in green jobs training for workers in polluting tech industries (ensuring a just transition as those industries transform). Globally, equity demands that wealthy digital economies not simply export their environmental costs. Regulations should prohibit the dumping of e-waste in developing countries and enforce due diligence on supply chains to avoid toxic "pollution havens." In practice, this might involve tighter controls on transboundary e-waste shipments (implementing treaties like the Basel Convention) and requiring tech companies to source minerals in ways that minimize environmental damage in producer countries.

4.4. Strengthen Enforcement and Transparency Mechanisms

Even the best laws mean little without vigorous enforcement. Regulators must therefore bolster oversight institutions and transparency tools to hold the tech sector accountable.[64] This agenda calls for well-resourced environmental agencies that can monitor digital industries, for example, tracking energy consumption of data centers, auditing companies' e-waste management practices, and inspecting crypto-mining facilities for compliance with emissions rules. Governments should facilitate real-time reporting and open data on key indicators (energy use, emissions, waste), leveraging digital technology to improve transparency. A robust "right to know" the environmental footprint of digital services can be enacted so that consumers and citizens have access to information on data centers' energy sources, device manufacturing impacts, and more. Importantly, companies must face consequences for violations: fines or permit revocations for data centers running on coal power despite green pledges, or penalties for illegal electronic waste dumping, as examples.

64 Gaurav Agrawal, "Accountability, Trust, and Transparency in AI Systems From the Perspective of Public Policy: Elevating Ethical Standards," [in:] *AI Healthcare Applications and Security, Ethical, and Legal Considerations* (IGI Global Scientific Publishing, 2024), 148-1462.

Additionally, enforcement bodies in the environmental and digital realms should work in tandem.[65] This could mean joint task forces between ICT regulators and environmental inspectors to address cross-cutting issues (such as air pollution from diesel backup generators at server farms or the climate impacts of blockchain operations). International cooperation is also vital for enforcement: countries should share data and best practices to prevent regulatory arbitrage where polluting digital businesses migrate to laxer jurisdictions.

5 Conclusion

The promise of the twin transition is real: digital technologies can support environmental monitoring, optimize resource use, and accelerate climate solutions. However, the analysis in this paper shows that digitalization is not environmentally neutral, and sustainability outcomes are not automatic. When digital strategies prioritize growth while overlooking energy demand, resource extraction, and e-waste, they institutionalize "green blindness." This blindness is not merely a technical oversight; it is a governance failure with justice consequences because the material burdens of digital life tend to concentrate on particular communities and jurisdictions least able to resist or remediate harm. To address this gap, the paper advances Digital Environmental Justice (DEJ) as a framework that integrates environmental law's distributive and procedural commitments into the digital sphere. The paper's regulatory proposals emphasize that DEJ requires a toolbox, not a single statute. Effective governance must combine institutional coordination (to overcome siloed regulation), corporate accountability (to internalize lifecycle harms through disclosure, due diligence, and extended producer responsibility), and economic instruments (to correct price signals and incentivize green digital infrastructure).

Ultimately, the twin transition will be judged not by how quickly societies digitize, but by whether digital growth produces net environmental gains and whether burdens are distributed fairly. This paper argues that

65 Jorge Stürmer, Maurício Serva, "Environmental Governance That Emerges from Action: Pragmatist Studies in Protected Areas" *Revista de Administração Contemporânea*, 28 (2024): e240105.

the appropriate response is neither technocratic optimism nor blanket resistance to digital innovation, but a legal and institutional settlement that makes sustainability and justice core design constraints of the digital economy. Future research can deepen this agenda by refining metrics for algorithmic and infrastructure resource accounting, exploring legal remedies and standing for communities affected by digital externalities, and assessing how international cooperation, through standards, trade, and environmental treaties, can reduce regulatory arbitrage and strengthen accountability across borders. For now, the key implication is clear: without DEJ-oriented law and governance, the digital age risks reproducing environmental harms under a new technological guise; with DEJ, the twin transition can be redirected toward outcomes that are both green and just.

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