



**DIGITAL TRANSFORMATION, SOCIETY, AND
GLOBAL GOVERNANCE: POLITICAL AND
ECONOMIC INSTRUMENTS FOR
ECOLOGICAL SUSTAINABILITY**

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Abstract: *This article analyzes how digital transformation reshapes ecological sustainability at the intersection of society and global governance. Digital technologies—data infrastructures, remote sensing, digital platforms, and AI—can strengthen evidence-based environmental policy by improving measurement, reporting and verification (MRV), transparency, compliance, and green innovation. UNEP emphasizes that timely, credible, accessible information is essential for sustainability decision-making and highlights Digital Public Infrastructure (DPI) as a key enabler. The article compares major international approaches: the EU's regulation-and-market architecture (ETS reform under Fit for 55 and CBAM), the United States' incentive-heavy climate industrial policy under the Inflation Reduction Act, and Asian pathways such as Singapore's carbon tax trajectory and China's national ETS. The conclusion argues that digitalization is an enabling tool, while durable outcomes depend on institutional quality, policy coherence, and the credibility of governance arrangements.*

Keywords: *digital transformation, ecological sustainability, global governance, carbon pricing, emissions trading system (ETS), green finance, MRV, digital public infrastructure, open data, just transition.*

Digital transformation is increasingly becoming the “nervous system” of modern environmental governance. Ecological sustainability

is no longer treated as a narrow conservation agenda; it is now embedded in economic competitiveness, public health, food and water security, energy transitions, and social justice. In this context, policies succeed not only because they set ambitious goals, but because they can reliably measure problems, track progress, detect non-compliance, and adjust instruments based on evidence. This is where digital capabilities become decisive: without robust data infrastructures and MRV systems, even well-designed regulation or large-scale finance packages risk producing weak or unverifiable results.

UNEP frames a central governance challenge as an “information gap” in sustainability decision-making: stakeholders often lack timely, credible, accessible data, and this undermines the quality and legitimacy of environmental choices. UNEP’s report on Digital Public Infrastructure for Environmental Sustainability develops the idea that shared digital building blocks standards, interoperable data systems, and trusted registries—can help close these gaps by institutionalizing how environmental information is collected, validated, and used. [1] In practice, DPI-oriented approaches link public authorities, firms, and communities through more consistent data flows, enabling better enforcement, targeted incentives, and greater public accountability. However, this also raises societal questions about digital inequality, governance of sensitive data, and trust: if participation in digital systems is uneven, then “what gets measured” may reflect power imbalances rather than ecological reality.

Comparative experience shows that leading climate and sustainability policies rely on a mix of political instruments and economic instruments, but countries differ in where they place the main weight.

The European Union has built a tightly integrated architecture that combines rulemaking with carbon market mechanisms. The EU ETS is the core carbon market instrument, and the European Commission describes Fit for 55 reforms as a major redesign of EU climate and energy policy, with ETS-related legislative changes approved by the European Parliament and the Council and now in force. Alongside ETS reform, the EU's Carbon Border Adjustment Mechanism (CBAM) aims to align the carbon price of imports with the carbon price faced by EU producers by addressing "embedded" emissions in certain imported goods. CBAM's practical implication for firms is that sustainability governance becomes supply-chain governance: exporters to the EU face stronger pressure to produce credible emissions data, maintain auditable product-level calculations, and build verifiable reporting pipelines that match EU guidance.

This is precisely where digital transformation matters: high-integrity reporting and verification at scale is extremely difficult without interoperable data systems and well-designed registries.

The United States has emphasized a different policy logic, relying heavily on investment incentives and tax credits to accelerate the deployment of clean technologies and industrial transformation. U.S. government sources highlight that the Inflation Reduction Act expands clean energy support through mechanisms such as loan authority and program funding, while agency guidance also details the transition toward new clean electricity production and investment tax credits that take effect for projects after late 2024[2]. In this model, the state creates strong "pull" incentives for private investment rather than making carbon pricing the central instrument. Yet the governance challenge

remains similar: credibility and effectiveness still require monitoring, measurement, and transparent reporting—especially when large-scale subsidies and tax expenditures must demonstrate real emissions reductions and avoid misuse.

Asian pathways illustrate additional designs. Singapore provides a clear example of a carbon tax approach with an explicit trajectory: the National Climate Change Secretariat states the carbon tax was raised to S\$25/tCO_{2e} from 2024 and is planned to rise to S\$45/tCO_{2e} in 2026–2027, with a longer-term objective range by 2030 [3]. This trajectory strengthens the price signal for business while allowing time to adapt, and it shows how a tax-based instrument can be paired with transition support and competitiveness considerations. China, by contrast, has built a national emissions trading system that began operating in 2021, and credible trackers describe it as the world's largest ETS by covered emissions[4]. Reuters reporting also indicates China's ETS expansion to additional industrial sectors is part of its evolving design, while maintaining a phased approach to compliance and data quality[5]. These cases reinforce a core governance lesson: carbon pricing is spreading globally, but its institutional form is shaped by domestic political economy, sectoral structure, and administrative capacity.

At the global governance level, the environmental policy mix is becoming increasingly interconnected across borders through standards, markets, finance, and reporting requirements. OECD's Effective Carbon Rates 2025 synthesizes price signals from fuel excise taxes, carbon taxes, and emissions trading systems into a single metric and reports coverage across 79 countries accounting for a very large share of global emissions in 2023[6]. This matters for firms because sustainability compliance is

progressively tied to trade, investment, and finance: companies may face carbon costs directly, or indirectly through supply-chain requirements and market access conditions. As carbon pricing expands—driven especially by ETS coverage growth—corporate strategies increasingly depend on credible emissions accounting, traceability, and audit-ready reporting.

International cooperation frameworks also embed digital needs. The UNFCCC describes Article 6 of the Paris Agreement as enabling international cooperation to tackle climate change and unlock financial support, while the Paris Agreement text provides the formal basis for mechanisms and cooperative approaches that require integrity and transparency[7]. In practical terms, cooperative approaches and carbon market mechanisms depend on reliable registries, consistent MRV, and protections against double counting—functions that are increasingly digital by necessity. Without trusted data and interoperable systems, cross-border cooperation struggles to maintain credibility.

A useful emerging-economy comparison is Uzbekistan's recent climate transparency and MRV development. Uzbekistan's Third NDC (submitted in 2025) references the country's first Biennial Transparency Report and national inventory reporting, describes steps toward a National Transparency System, and mentions an online platform to support MRV reporting elements, alongside institutional monitoring arrangements[7]. This illustrates a broader point for countries building sustainability governance capacity: rather than copying any single foreign model, it is often more effective to adapt the underlying logic—strengthening MRV and transparency foundations first, then layering

economic instruments and sectoral policies in a way that preserves social legitimacy and competitiveness.

Conclusion: Comparative experience suggests that ecological sustainability outcomes depend less on any single “perfect” instrument and more on the coherence of the full governance system. The EU’s ETS-and-CBAM architecture, the U.S. incentive-based approach under the Inflation Reduction Act, and Asian carbon tax/ETS pathways differ in design, but all converge on a shared requirement: high-integrity data, MRV capability, and credible accountability structures. UNEP’s DPI perspective clarifies why digital transformation is central: sustainability governance increasingly runs on the quality, accessibility, and interoperability of information. For systems still strengthening their institutional capacity, a strategic priority is to build trusted transparency and MRV infrastructures that can support a balanced policy mix—regulation, incentives, carbon pricing where feasible, and green finance—while safeguarding equity and social acceptance during the transition.

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