The Intersection of Sustainability and Technology

How Technology Can Be Leveraged to Achieve Environmental Sustainability Goals

In this article, **Kavya Hari** and **Jaya Jain** say that an ecosystem approach entailing the key stakeholders, including enterprises, policymakers, and public and private investors, would accelerate the deployment of climate technologies, and enable climate resilient growth and achievement of environmental sustainability. This would facilitate the transition to a global net-zero economy by 2050 and bring us closer to achieving the goals of the Paris Agreement.

Impact of Technology on Sustainability

Achieving the goals of the Paris Agreement requires global greenhouse gas (GHG) emissions to be reduced to 50 per cent (of current levels) by 2030.[1] Capital and technology are two critical factors that can enable climate resilient growth and achievement of environmental sustainability. It is estimated that mature climate technologies could deliver around 60 per cent of emission reductions required for stabilizing the climate by 2050, if deployed at scale.

There are multiple examples to demonstrate how technology is a critical lever in enabling sustainability—both at an organizational and sectoral level.

Technologies play a critical role in paving the pathway towards sustainability by providing solutions to improve efficiency, reduce resource consumption, and enhance resilience. Energy efficient technologies (especially digitally integrated technologies such as energy management systems, smart meters, and sensor, etc.) optimize energy usage in applications, buildings/industries, and transport systems; thereby reducing fossil fuel consumption and emissions. According to the International Energy Agency, deployment of energy efficient technologies (like LED lighting, efficient appliances, and smart thermostats) enabled higher reduction in energy consumption by up to 15 per cent in 2021.[2]

Technology-enabled innovations are also playing a critical role in agriculture. Techniques such as precision farming reduce input (i.e., water and fertilizers) usage and improve crop productivity. This has led to increased climate resilience of agricultural systems. Various studies estimate that internet-of-things (IoT) enabled micro-irrigation and variable rate fertilizations have decreased water and fertilizer usage by up to 30–40 per cent.

Innovations in mobility (such as electric vehicles, shared mobility solutions, and smart transport systems) have reduced traffic congestion and fossil fuel consumption. Further, circular economy technologies are evidenced to create sustainable and efficient systems for production, consumption and waste disposal that improve resource efficiency and reduce waste. A report by Ellen MacArthur Foundation states that circular economy approaches (in five sectors of cement, steel, aluminium, plastic, and

[1] IIF - Taskforce on Scaling Voluntary Carbon Markets (2021)

[2] IEA - Energy Efficiency (2021)

food) can reduce global emissions up to 40–50 per cent by 2050.[3]

Moreover, emerging technologies such as blockchain and carbon capture and storage (CCS) are increasingly transforming environmental sustainability outcomes. Blockchain-based platforms improve supply chain transparency and promote responsible sourcing of resources/materials by providing an efficient mechanism for recording and tracking of unique transactions.

Landscape of Climate Investment

The intersection of technology and sustainability is also evident from the rising trend of investments in the climate-tech sector, despite macroeconomic and geopolitical crises that severely impacted global capital markets. This is mainly driven by the increasing commitments of private and public sector actors on climate action and by investors on funding for environment, social and governance (ESG) and net-zero.[4] The number of corporates committing to science-based targets more than doubled in one year to reach over 2200 in 2022. With respect to state commitments, 30 countries and the European Union have set net-zero targets as part of a policy or regulation, and more than 100 countries have either proposed or in the process of defining net-zero targets as of March 2023.[5] As for financiers, more than 450 financial institutions have pledged around $130 trillion to support investments for achievement of net-zero goals as a part of the Glasgow Financial Alliance for Net-Zero.

Globally, more than $260 billion has been invested in climate-tech since 2018, of which $50 billion was accounted for in 2022. Moreover, there was an increased rate of investment in sectors with higher potential for emission reduction. While in 2021, 35 per cent of climate-tech investment was attributed to sectors accounting for 85 per cent emissions; in 2022, 52 per cent of the funding was diverted towards those sectors (i.e., energy, food, agriculture and land-use, industry and built environment). Mobility and the transport sector continued to have the highest share of total climate-tech investments at 48 per cent in 2022, followed by 27 per cent share in energy and 12 per cent in the food, agriculture, and land-use sector.[6]

The ecosystem of climate-tech investment has evolved significantly over the last few years, with an increased focus on 'deep-tech' and

[3] EMF - Circular Economy and Climate Change (2021)

[4] PwC - Climate Tech Investing (2022)

[5] Climate Action Tracker - Net Zero Targets (2022)

[6] PwC – State of Climate Tech (2022)

'carbon-tech' solutions. Deep-tech solutions consist of innovations in segments of artificial intelligence, robotics, blockchain, drones, advanced materials, etc. Some use-cases include green hydrogen, peer-to-peer energy trading through blockchain, drones for precision agriculture, farm analytic platforms, energy storage, climate risk and analytics platform, etc. Carbon-tech typically comprises of solutions that enable carbon sequestration such as carbon capture utilization and storage (CCUS), carbon removal technologies, direct-to-air capture, carbon credit marketplace, and procurement platforms, etc. The prevailing investment trends also lay evidence of this global shift. Carbon-tech had a breakthrough in 2022 (at ~$48 billion), with more than 1.5x growth in investment for CCS technology over one year. Similarly, climate management (comprising of emissions and sustainability reporting, climate risk and analytics platform, remote sensing, ESG investing and fintech) and industry (consisting of low-carbon cement, steel, manufacturing, circular economy commerce, sustainable textiles and packaging, waste, and recycling) showcased a steady increase in investments between 2021 and 2022. Within the food, agriculture and land-use sector, there is increased investment in disruptive technology (like precision agriculture, farm analytics software, drone-based MRV, portable soil testers, etc.) that play a key role in emission reduction at the farm-gate level, pre- and post-production, and resource conservation. A recent estimate by McKinsey suggests that 'next-generation' climate-tech across the sectors of agriculture, electrification, carbon capture, hydrogen, and power grid (comprising segments of 'deep-tech' and 'carbon-tech') could attract $1.5–$2 trillion of capital investment annually by 2025.[7]

[7] McKinsey - Executives Guide to Climate Technology

Key Barriers to Leveraging Technology for Achieving Environmental Sustainability

Despite the demonstrated benefits, and an increased flow of funding for climate-tech, there persists a significant investment gap in the integration of technology towards achieving environmental sustainability. Low level of investments for early-stage climate tech, skewed funding towards certain sectors, and lack of diversity in capital sources and instruments could be attributed as key reasons for the investment gap.

Decreasing investments for early-stage climate tech

Even though the investment trend for the climate-tech sector has followed a steep upward trajectory, financing is largely skewed towards later stages of funding, i.e., series A and B. According to a recent report by PricewaterhouseCoopers (PwC), venture capital investment in climate tech for deals amounting to less than $5 million has declined by a staggering

66 per cent from 1620 deals to 556 deals from 2019 to 2022, demonstrating a decline in total investment of 64 per cent from $1.3 billion to $0.45 billion.
On the other hand, venture capital funding for deals between $5 million and $1 billion increased by 73 per cent in the same period, reaching a whooping $71 billion in 2021.[8] In India, equity funding for climate tech in 2022 was dominated by eight large IPO and post-IPO deals worth $5 billion. Investments at the seed stage stood at a very low $112 million.[9] If early-stage enterprises are unable to raise initial and pre-seed funding, the sector could start witnessing stagnancy in innovation and declining pipeline of climate tech start-ups.

Skewed funding at the sectoral level

Mobility and ag-tech continue to dominate the climate tech investment landscape at a sectoral level. Globally, mobility solutions attracted 61 per cent of the total venture capital funding in 2021.[10] In India, ag-tech funding grew by 20 per cent from 2021 to 2022.[11] This has resulted in a significantly lower share of funding for emerging sectors (such as circularity, built environment, etc.) Moreover, funding trends are skewed towards mitigation technologies. There is a critical need for increased investments towards adaptation technologies (like climate-proofing infrastructure, technologies for productive use of energy, clean cooking, water technologies, etc.) According to the UNEP Adaptation Gap Report 2022, the estimated annual adaptation needs are USD 160–340 billion by 2030 and USD 315–565 billion by 2050.[12]

[8] PwC - Climate Tech Investing (2022)

[9] Climake and Unitus Capital – State of Climate Finance in India (2023)

[10] PwC - Climate Tech Investing (2022)

[11] Climake and Unitus Capital – State of Climate Finance in India (2023)

[12] UNEP – Adaptation Gap Report (2022)

Limited diversity in sources and instruments of capital

Capital sources for technology-enabled solutions achieving environmental sustainability are dominated by venture capital and private equity. There is a lack of development finance, debt capital providers, and sovereign finance. Further, deployment of innovative funding mechanisms, including green bonds, risk mitigation instruments, results-based financing, and blended finance instruments, is largely limited. For instance, the Clean Technology Fund (CTF) that provides resources to scale up low-carbon technologies in developing countries, expects the largest share of co-financing (32%) to come from the private sector for its 161 projects in the pipeline, while a low 12 per cent to flow from Governments.[13] The lack of investments from public sources and international development institutions undercuts the economic attractiveness of capital-intensive clean technologies.

An Ecosystem Approach for Effective Integration

To effectively and efficiently leverage and scale technology interventions to enhance environmental sustainability, an ecosystem approach would be required that brings together networks, knowledge, capital, and innovation would be required. This could include: (i) driving collaboration in the development and deployment of innovative technologies through industry coalitions or partnerships with climate innovators; (ii) strengthening demand signal for emerging climate-tech solutions through initiatives that aggregate demand and/or enable market creation (examples include First Movers Coalition and Frontier Climate); and (iii) developing innovative financing modalities (such as blended finance structures, partial risk guarantee funds, etc.) for early-stage climate-tech funding to reduce the perceived risk of private investors.

Such an ecosystem approach entailing the key stakeholders, including enterprises, policymakers, and public and private investors, would accelerate the deployment of climate technologies, and enable climate resilient growth and achievement of environmental sustainability. This would facilitate the transition to a global net-zero economy by 2050 and bring us closer to achieving the goals of the Paris Agreement. ■

[13] Clean Technology Fund

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