

# Asia-Pacific Tech Monitor

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**Partnerships and regional collaborations:** Integrating climate finance with the technology mechanism for climate change



**APCTT**  
Asian and Pacific Centre  
for Transfer of Technology



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# Asia-Pacific Tech Monitor

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The **Asia-Pacific Tech Monitor** is a quarterly periodical of the Asian and Pacific Centre for Transfer of Technology (APCTT) that brings you up-to-date information on trends in technology transfer and development, technology policies, and latest technology innovations.

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## Introductory Note

A paradigm shift towards a low-carbon economy and resilient adaptation strategies is imperative to address climate change. With respect to this, climate finance plays an important role. The effectiveness of climate finance, however, depends not only on mobilizing funds but also on ensuring their appropriate distribution and utilization.

Technology can be crucial to further objectives of transparent and equitable climate finance. Blockchain technology is revolutionizing supply chain management by fostering transparency and traceability of performance regarding environmental, social, and governance parameters. By ensuring inclusive growth, these technologies help to report the progress of corporations and businesses to relevant stakeholders, investors, and end users. Advanced predictive models empower communities to better prepare for extreme weather events, strengthening infrastructure, including resilience of buildings and financial estimation of damage. The latest climate data-as-a-service platforms and climate data marketplaces provide invaluable insights for informed decision-making regarding climate change impacts, loss estimation, and insurance dissemination for better allocation of funds.

Furthermore, as exemplified by the case study of Singapore featured in this issue, a symbiotic relationship exists between climate finance and digital technologies that facilitate green transition. Another article highlights the role of entrepreneurship in steering the green transition journey, exploring the efforts to promote innovation in the Association of Southeast Asian Nations (ASEAN). The article also provides examples of promising climate-focused start-ups for renewable energy, electric mobility, sustainable digital platforms, agriculture and food technology, and energy efficiency.

This issue of Tech Monitor explores technologies that support efficient climate finance distribution and management, as well as the recent developments in policies advancing finance for climate action. It presents case studies that demonstrate the mobilization of finance for green transition for cutting-edge technologies. It reiterates the pivotal role of technology in green transformation and advocates for efforts to harness its potential to accelerate our collective journey toward a sustainable future.

Preeti Soni  
Head, APCTT

## INTERNATIONAL

### Global Stocktake to access climate action

The global stocktake was designed under the Paris Agreement to assess our global response to the climate crisis and chart a better way forward. The global stocktake is held every five years and is intended to inform the next round of nationally determined contributions to be put forward by 2025.

The global stocktake started with a data collection phase in 2021, collecting a wide range of inputs from Parties, international bodies, and non-party stakeholders. A technical dialogue was carried out across three meetings in 2022 and 2023. The scope of technical discussion was very broad, including mitigation, adaptation, and support, as well as loss and damage and response measures. Cutting across all these topics were ambition and equity – all informed by the best available science.

The synthesis report of the technical dialogue summarizes 17 key technical findings from the discussions. Across the topics, the report makes clear that there is progress, but much more needs to be done. While there are well-known gaps, the technical findings highlighted existing and emerging opportunities and creative solutions to bridge these gaps. Good practices and proposals to accelerate implementation, action, and support, are highlighted in all areas.

The report lays a strong scientific and technical base for the conclusion of the first global stocktake in Dubai, in the United Arab Emirates, at the UN Climate Change Conference COP28. It compiles inputs from 137 non-Party stakeholders, and written submissions in total over 170,000 pages. The technical dialogue included plenaries, roundtables, and world café formats of meetings and discussions totaling about 252 hours.

During this final phase - the consideration of outcomes, a series of high-level events will be held to discuss the implications of

these technical findings. These discussions will inform a decision and/or declaration summarizing key political messages, and identifying opportunities, good practices, and challenges to enhance climate action and support.

Under Article 14 of the Paris Agreement, The Global stocktake was considered a five-year exercise to assess the collective progress toward achieving the purpose of the Paris Agreement and its long-term goals. The first stocktake synthesis report was released in September 2023. It is prepared by distilling over 1,600 documents from diverse sources. Further, the process includes technical consultations with scientists, governments, indigenous people, civil societies, and other stakeholders to review the information received. The final outputs will be shared during COP 28.

At COP 24 in 2018, in Katowice, Poland, it was agreed that the stocktake would inform firstly about the mitigation efforts against the agreed temperature rise of 2 degrees Celsius, where the efforts be should directed. Secondly, for adaptation, the progress made by countries to enhance resilience and reduce vulnerability. Thirdly, progress on the alignment of finances, technology transfer, capacity building, and efforts to address loss and damage.

The synthesis report brings the progress made since the Paris Agreement. The global temperatures are now expected to rise by 2.4-2.6 degrees C (4.3-4.7 degrees F) by the end of the century, compared to 3.7-4.8 degrees C (6.7-8.6 degrees F) in 2010. There has been incremental progress but there is a clear need for enhanced action. The report also charts a path forward for system-wide transformation that can slash emissions and ensure a climate-resilient future. The recommended pathway requires a scale-up of renewable energy, a shift in the way of energy consumption in transport and industry, a phase-out of unabated fossil fuels, reduction of non-CO2 emissions like methane. Further protection of nature, ending

deforestation, and sustainable agriculture are key measures for enhancing resilience and emission reduction.

The report underscores the need to direct global finance and mobilize significant resources to support a zero-carbon, climate-resilient, and equitable future. The stock take is expected to go beyond assessment and inform countries to step up Climate action during the upcoming COP 28.

<https://unfccc.int/>

### Global Sustainability Disclosure Standards

International Sustainability Standards Board (ISSB) in June 2023, issued the Sustainability Disclosure standards. These would be a primer to form a global baseline for sustainability-linked disclosures. These are formed on the agreed concepts of the International Financial Reporting Standards (IFRS), which are required in more than 140 jurisdictions. These have also incorporated the recommendations of the Task Force on Climate-related Financial Disclosures. The reporting has two parts, IFRS S1 which covers the general requirements for disclosure of sustainability-related financial information, and IFRS S2 which requires information about exposure to climate-related risks and opportunities. Both standards would be effective for annual reporting periods beginning on or after 1 January 2024, and relevant disclosures will begin to be published by 2025.

The standards require key entities to disclose the governance procedure to monitor and manage sustainability-related and climate-related risks and opportunities, their strategy for management of these risks, the process to identify, monitor, and prioritize these risks, and the performance relative to the identified risks and opportunities. Adoption of these standards should produce consistent, comparable, and reliable corporate sustainability disclosures,

and therefore help in informing capital allocation decisions.

Each jurisdiction will decide whether entities will be required to comply with the new Standards, and whether to make them voluntary or mandatory. Some countries like the United Kingdom have signaled confirmation to adopt these standards. ISSB will support the adoption, with also help in required capacity-building initiatives to support implementation.

<https://www.insideenergyandenvironment.com/>

## Project Finance for Permanence (PFP) model

Project Finance for Permanence (PFP) is a tool to enable governments and local communities, in partnership with funders and NGOs, to take advantage of an array of financial instruments and secure long-term management and financing for networks of conservation areas. They are designed to withstand changes in national leadership and are adapted to the social, political, and environmental context of the particular place.

A national government presents investors with a plan to effectively manage its protected areas. The investors then create a “bridge fund” to help the government gradually assume the full cost of conservation over at least 10 years. The government has to achieve a series of performance-based milestones to keep drawing from the fund. The fund doesn't go into effect until investors gather enough commitments to close the government's funding gap, which means no investor risks backing a plan destined to fall short of its goal, and the government knows it has reliable funding as long as it keeps meeting the milestones.

This model has already been applied to conservation initiatives in Bhutan, Brazil, Canada, Colombia, Costa Rica, and Peru. Together, these projects have financed the protection of over 120 million hectares – all to the benefit of local communities, biodiversity, and the climate.

The most striking proof of the durability of the PFP model comes from Brazil. There, a PFP called Amazon Region Protected Areas (ARPA) for Life, launched in 2014 to fund the APRA program has withstood political changes over time. The program covers 62 million hectares in the Amazon, an area larger than France. That makes it the world's largest initiative for tropical forest conservation. The PFP agreement established in 2014 delivered \$215 million to secure the long-term protection of the conservation areas covered under ARPA.

A study analyzing the impact of the ARPA program on reducing deforestation and avoiding CO2 emissions in the Brazilian Amazon between 2008 and 2020. The study reveals that during the monitored period, protected areas and Indigenous lands in the Amazon reduced deforestation by 21% (based on the difference between observed deforestation and estimated deforestation that would have happened if the areas were not protected). The protected areas supported by ARPA prevented nearly 260,000 hectares of deforestation.

<https://europeansting.com/>

## G20 Delhi Declaration focuses on Climate Action

India headed the G20 presidency starting from December 1, 2022. The leader's summit under the theme of G20 -Vasudhaiva Kutumbakam, took place in New Delhi on September 9-10, 2023. The participating nations agreed on a set of principles for global action that formed the Delhi Declaration. The preamble of the declaration begins with the common acceptance that “We are One Earth, One Family, and we share One Future”. The declaration emphasizes the effective implementation of the 2030 Agenda for sustainable development, and the importance of pursuing low carbon emission, climate resilient, and sustainable development pathways. Life-style for Environment (LiFE) is advocated.

The need for improvement of supply and production capacities to prepare for future

health is a listed priority. On the financial front, the urgent and effective management of debt vulnerabilities in developing countries and scale-up of finance to meet SDG goals and climate change efforts is reiterated. The need for better and bigger reforms in Multilateral Development Banks is stressed. Further, the improvement of Digital public infrastructure and improvement in digital services are other important principles that were agreed. The preamble also advocates closing the gender gap, participation of women, and better integration of perspectives of developing countries into its key priorities.

Regarding the global economic situation, the declaration appreciated the steps taken by the Financial Stability Board (FSB) and Standard Setting Bodies (SSBs). The private sector is encouraged to create inclusive sustainable and resilient value chains and further facilitate Foreign Direct Investments (FDIs) toward sustainable business models. There is recognition of start-ups and MSMEs for driving innovation and creating employment. The start-up 20 engagement group formed during the presidency would continue its efforts to support and grow startups. The declaration recognizes The Jaipur Call to Action formed to promote MSME's access to information and their integration in international trade. Adoption of the G20 Generic Framework for mapping Global Value Chains (GVC) and High-Level Principles on Digitalization of Trade are initiatives welcome for the growth of trade.

The declaration recognizes and appreciates existing policies, frameworks, and consensus achieved in the fields of health, education, climate resilience, financial stability, international trade, biodiversity protection and others. This is followed by the offerings the G20 presidency achieved in the year.

India's presidency initiated and supported some initiatives towards climate action, SDGs, and the environment. The analytical framework for SDG-aligned finance, voluntary recommendations for scaling up the adoption of social impact investment instruments, and improvements to

nature-related data and reporting received supported. The declaration also supports the G20 Report on Macroeconomic Risks Stemming from Climate Change and Transition Pathways, future work is encouraged in this field. There is a commitment to implement the G20 High-Level Principles on Lifestyles for Sustainable and to launch and implement "Travel for LiFE" and support the development of smart destinations that are responsible and sustainable.

Taking action towards waste management, the launch of the Resource Efficiency and Circular Economy Industry Coalition (RECEIC) is appreciated. For cleaner energy, there is affirmation for the 'G20 High-Level Voluntary Principles on Hydrogen' and the initiative to establish the Green Hydrogen Innovation Centre steered by the International Solar Alliance (ISA). Noting the importance of sustainable biofuels in zero and low-emission development strategies the declaration supported the setting up of a Global Biofuels Alliance.

The declaration also encourages efforts to triple renewable energy capacity globally and calls for collaboration for zero and low-emission technologies, including abatement and removal technologies, in line with national circumstances by 2030. The participating nations took voluntary pledges to; Promote renewable Energy to Accelerate Universal Energy Access, Advance cooperation initiatives to develop, demonstrate, and deploy clean and sustainable energy technologies and solutions, and other efforts for innovation and agreed to a voluntary Action Plan on Doubling the Rate of Energy Efficiency Improvement by 2030.

The declaration also shares insights from a report prepared by the Indian presidency on 'Low-cost Financing for the Energy Transitions' that estimates the world needs an annual investment of over USD 4 trillion, with a high share of renewable energy in the primary energy mix. There is a need for USD 5.8-5.9 trillion in the pre-2030 period required for developing countries, in particular for their needs to implement their NDCs. Further, the declaration calls on all

parties to set an ambitious, transparent, and trackable New Collective Quantified Goal (NCQG) for climate finance in 2024. In support of the G20 Independent Review of MDBs Capital Adequacy Frameworks (CAFs) prepared by Italy in 2021, the declaration encourages MDBs to collaborate in areas such as hybrid capital, callable capital, and guarantees.

It then underscores the importance of maximizing the effect of concessional resources, such as those of the multilateral climate funds, to support developing countries implementation of the Paris Agreement and call for an ambitious second replenishment process of the Green Climate Fund for its upcoming 2024-2027 programming period. The upcoming G20 2023 Sustainable Finance report, with the Transition Finance framework, is awaited.

The Gandhinagar Implementation Roadmap and the Gandhinagar Information Platform were formed to support G20's ambition to reduce land degradation by 50% by 2040 on a voluntary basis, as committed under the G20 Global Land Initiative (GLI). While to support life underwater the Chennai High-Level Principles for a Sustainable and Resilient Blue/Ocean-based Economy were put together.

<https://www.mea.gov.in/>

## PHILIPPINES

### Climate Change Expenditure tagging

The government of the Philippines allocated USD 8.2 Million or 9 per cent of the total National budget for climate adaptation and mitigation towards meeting unconditional Nationally Determined Contribution (NDC) targets.

Data from Climate Change Expenditure Tagging (CCET), which is a tool of the government to monitor, track, and report the national and local budgets and investments on climate change adaptation and mitigation programs shows this is 60 percent higher than the previous year's climate budget.

The Philippine Development Plan (PDP) for the 2023-2028 period devoted an entire chapter to climate change and disaster resiliency for the first time. This pioneering chapter identifies key objectives for climate action, including increasing climate and disaster risk resilience of communities and institutions, enhancing ecosystem resilience, and enabling the transition to a low-carbon economy.

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*PH committed to 'whole-of-world' climate action under PBBM | Philippine News Agency (pna.gov.ph)*

## INDIA

### Renewable Energy Technology Action Platform (RETAP)

The U.S. Department of Energy (DOE) and the Ministry of New and Renewable Energy (MNRE), Government of India launched the new U.S.-India Renewable Energy Technology Action Platform (RETAP) under the Strategic Clean Energy Partnership. This would help in the expansion of collaboration on new and emerging technologies to accelerate the clean energy transition.

RETAP was established to take bilateral collaboration further with a result-oriented, time-bound technology focus. It is intended to advance new and emerging renewable technologies with a view toward deployment and scaling. RETAP's initial focus is green/clean hydrogen, wind energy, long long-duration energy storage, and to explore geothermal energy, ocean/tidal energy, and other emerging technologies as mutually determined in the future. The work is guided by five themes; Research and development, Piloting and testing of Innovative Technologies, Advanced Training and skill Development, Policy and Planning for Advancing

RET and enabling technologies and Investment, and Incubation and Outreach programmes.

Going forward, DOE and MNRE intend to enhance RETAP collaboration, including potentially through the creation of a RETAP Steering Committee, joint working groups, and collaboration among subject matter experts.

<https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1953550>

## Global Biofuel Alliance

At the G20 summit, in September 2023, Indian Prime Minister Narendra Modi along with leaders of Singapore, Bangladesh, Italy, USA, Brazil, Argentina, Mauritius, and UAE launched the Global Biofuel Alliance. The alliance aims to triple global biofuel production by 2030 by facilitating international cooperation and intensifying the use of sustainable biofuels. It would also facilitate global biofuel trade and provide technical support for the national biofuel program.

The alliance is headed by the three leading biofuel producers namely India, Brazil, and the United States. It received the support of 19 countries and 12 international organizations including the Asian Development Bank, the International Energy Agency, the International Energy Forum, the United Nations Industrial Development Organization, the World Bank, The International Renewable Energy Agency, the World Economic Forum, and the World Biogas Association.

The consultations for the formation and purpose of the alliance took place throughout the G20 presidency. It is envisioned to offer capacity-building exercises across the value chain, technical support for national programs and promoting policy lessons-sharing. It will facilitate mobilizing a virtual marketplace to assist industries, countries, ecosystem players and key stakeholders in mapping demand and supply, as well as connecting technology providers to end users. It will also facilitate the development, adoption, and implementation of internationally recognized standards, codes, sustainability

principles, and regulations to incentivize biofuels adoption and trade.

<https://indianexpress.com>

## Green Credit Program

The Ministry of Environment, Forest and Climate Change (MoEFCC) issued a notification for draft Green Credit Programme Implementation Rules 2023. The Green Credit Programme is proposed to be launched at the national level to leverage a competitive market-based approach for Green Credits thereby incentivizing voluntary environmental actions of various stakeholders.

Green Credits will arise from a range of sectors and entities, ranging from small-scale ones— such as individuals, Farmer Producer Organizations, cooperatives, forestry enterprises, and sustainable agriculture enterprises; to those being developed at the level of Urban and Rural Local Bodies, private sectors, industries, and organizations.

Green Credits will be tradable outcomes and will act as incentives. In the beginning, Green Credits will be made available to individuals and entities, engaged in selected activities and who undertake environmental interventions. These Green Credits will be made available for trading on a domestic market platform. An activity generating Green Credits under the Green Credit Programme may also get Carbon Credits from the same activity under the carbon market.

<http://www.indiaenvironmentportal.org.in>

## New Clean Energy Schemes

Ministry of Power, India has formulated a Scheme on Viability Gap Funding for the development of Battery Energy Storage Systems with a capacity of 4,000 MWh.

In the Union Budget 2023-24, customs duty exemption has been extended to the import of capital goods and machinery required for the manufacture of lithium-ion cells for batteries used in electric vehicles up to 31.03.2024.

In addition to the measures announced in the Union Budget 2023-24, the major steps taken by the Government to accelerate the Indian economy's transition to one powered by green energy are given.

Major schemes and the steps announced in the Union Budget 2023 aimed at promoting clean energy and sustainable living are given below:

- The outlay of Rs. 19,700 crore for the Green Hydrogen Mission to facilitate the transition of the economy to low carbon intensity, reduce dependence on fossil fuel imports, and make the country assume technology and market leadership in this sunrise sector. The target is to reach an annual production of 5 MMT by 2030.
- The allocation of Rs. 35,000 crore for priority capital investments towards energy transition net zero objectives, and energy security.
- Viability gap funding for 4,000 MWh battery energy storage systems and formulation of a detailed framework for pump storage projects.
- Investment of Rs. 20,700 crore including central support of Rs. 8,300 crore for strengthening of interstate transmission system for evacuation and Grid Integration of 13 GW renewable energy from Ladakh.

Notification of Green Credit Programme under the Environment (Protection) Act for encouraging behavioral change

- PM Programme for Restoration, Awareness, Nourishment, and Amelioration of Mother Earth to promote alternative fertilizers and balanced use of chemical fertilizers.
- 500 new 'waste to wealth' plants to be established under the new GOBARdhan (Galvanizing Organic Bio-Agro Resources Dhan) scheme with a total investment of Rs 10,000 crore.
- One crore farmers to be facilitated to adopt natural farming over the next 3 years. For this, 10,000 Bhartiya Prakritik Kheti Bio-Input Resource Centers are to be set up, creating a national-level



distributed micro-fertilizer and pesticide manufacturing network.

- 'Mangrove Initiative for Shoreline Habitats & Tangible Incomes', MISHTI, for mangrove plantation along the coastline and on salt pan lands, wherever feasible, through convergence between MGNREGS, CAMPA Fund and other sources.
- Amrit Dharohar, a scheme to encourage optimal use of wetlands, and enhance bio-diversity, carbon stock, eco-tourism opportunities and income generation for local communities.
- Coastal shipping is to be promoted as the energy-efficient and lower-cost mode of transport, both for passengers and freight, through PPP mode with viability gap funding.
- Allocation of adequate funds to scrap old vehicles of the Central Government and support to States in replacing old vehicles and ambulances

<https://pib.gov.in/>

## CHINA

### Standards of the hydrogen energy industry

China's first national-level construction guideline for the standards of the hydrogen energy industry chain was jointly released on Tuesday by several ministries and departments, in a bid to implement the national deployment of the industry and give full play to the leading role of standards for its development.

The guideline builds a standard system for the production, storage, transport and use of hydrogen energy. The goals of the guideline include accelerating the formulation of relevant technical standards and improving the international standardization of hydrogen energy.

The guideline clarifies the key tasks of domestic and international hydrogen energy standardization work in the next three years and deploys two major actions - core standard development and international standardization promotion.

China is currently the largest hydrogen producer in the world, with an annual output of 33 million tons, accounting for about 30 percent of global production, according to Xinhua.

The country's hydrogen energy market is expected to reach 43 million tons by 2030, according to an estimate from the China Hydrogen Alliance.

<https://www.globaltimes.cn/>

### Standards for carbon peaking and carbon neutrality

China's Ministry of Industry and Information Technology released a draft of 2023 guidelines on the development of standards for carbon peaking and carbon neutrality in the industry sector. The ministry is accepting comments on the draft through June 22, 2023. The draft guidelines provide frameworks for standards for carbon peaking and carbon neutrality in industry and include a list of standards under development and revision.

The guidelines detail that by 2025, China will develop most of the standards for carbon peaking and carbon neutrality in industry. The country would develop over 200 standards immediately needed to achieve carbon peaking.

It will expedite the consideration and development of standards for carbon dioxide emissions management and assessment, promote further emissions reduction in industry, and lead the low-carbon and high-quality development of relevant industries.

The standards for carbon peaking and carbon neutrality in the industry are classified into five categories: basic and general standards, calculation and verification standards, technology and equipment standards, monitoring standards, and management and evaluation standards.

Basic and general standards include standards for terminology, data quality, labeling of greenhouse gas emissions and emissions reduction, carbon labeling of products, and low-carbon evaluation labeling. While for Calculation and

verification standards include there will be standards for the calculation and verification of greenhouse gas emissions, product carbon footprints, and qualifications required for organizations and persons performing the verification.

Concerning Technology and equipment standards include standards for greenhouse gas emission control at source, emission control in production processes, and end-of-pipe treatment, including carbon capture, utilization and storage (CCUS), and direct air capture (DAC). Standards for monitoring, and evaluation, and management would also be set.

The draft guidelines include a list of published standards and standards under development and revision for carbon peaking and carbon neutrality in the industry. For example, standards for carbon neutrality in the electronics industry and technical standards for the evaluation of low-carbon electronic products are now under development.

<https://enviance.com>

### Coal Carbon Capture Facility

Chinese state-owned power generator China Energy Investment Corporation has started operations at Asia's largest coal-linked carbon capture, utilization, and storage (CCUS) facility.

The facility adjoined to the group's Taizhou thermal coal power plant in the country's eastern Jiangsu province, has the annual capacity to store 500,000 tons of carbon dioxide.

Carbon capture has become a focus area for China's major power generators, as the country pursues a plan to hit its carbon emissions peak by 2030. Last year, state-owned oil and gas giant Sinopec launched a 712,000-tonne-per-year CCUS project - the country's largest - at one of its oil refineries in Shandong province.

China has around 40 CCUS demonstration projects in operation or under construction, with a total annual capture capacity of around 3 million tons per year.

<https://www.reuters.com/>

## Renewables Ultra-high voltage (UHV) power transmission project

Construction of a new ultra-high voltage (UHV) power transmission project, which will send power from northwest China to the central province of Hunan, began in Tengger Desert in Ningxia Hui Autonomous Region.

The Ningxia-Hunan UHV power transmission project will deliver power generated at the bases in the Gobi Desert in Ningxia, including 9 gigawatts (GW) of photovoltaic power, 4 GW of wind power and 4.64 GW of supplementary coal power. The power generated by renewable energy will take up more than half of the total transmission capacity.

The project will be operational by 2025, with a total investment of 28.1 billion yuan (about \$3.9 billion).

Once put into operation, the Ningxia-Hunan UHV power transmission project will deliver over 36 billion kWh of electricity from Ningxia to Hunan annually, and reduce more than 16 million tons of carbon dioxide emissions.

China plans to build 455 gigawatts of solar and wind power generation capacity in the Gobi and other desert regions by 2030. The country has pledged a carbon emission peak by 2030 and realize carbon neutrality by 2060.

<https://news.cgtn.com/news/2023-06-12/China-s-1st-renewable-power-project-in-Gobi-Desert-starts-construction-1kzH3Y5tEtO/index.html>

## REPUBLIC OF KOREA Carbon Neutrality Master Plan

The Korean Government published the 1st National Basic Plan for Carbon Neutrality and Green Growth in April 2023. The Basic Plan, established under Article 10 of the Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis (the "Framework Act on Carbon Neutrality"), is a national plan for responding to the climate crisis

and promoting sustainable development. With annual reduction targets and implementation measures for each sector (e.g., industry and transportation sectors), the Basic Plan will be updated every five years over the next 20 years, from 2023 to 2042.

In addition, this Basic Plan will facilitate the establishment of subordinate plans (e.g., measures to adapt to the national climate crisis, and basic plans for carbon neutrality and green growth for local cities, provinces, counties, and districts) and will have a substantial impact on other mid to long-term administrative plans (e.g., the basic plan for supply and demand of electric power, the comprehensive national territorial plan, and the basic plan for resource circulation).

Further, the Basic Plan provides 37 mid-to long-term GHG reduction policy objectives by sector and proposes 45 policy objectives in six major sectors (i.e., climate adaptation, green growth, just transition, regional leadership, training personnel and raising awareness, and international cooperation) to lay the foundation for transitioning into a carbon-neutral society.

It maintains the mid to long-term reduction targets at 40% but adjusts each sector's reduction and absorption/removal targets. In particular, the reduction rate in the industrial sector will be reduced from the current NDC targets (from 14.5% to 11.4%), while the reduction contribution for the transition sector (44.4% to 45.9%).

Towards energy, the plan aims to achieve 32.4% of total power generation using nuclear power plants and 21.6% (+α) of power generation from renewable energy by 2030. For industrial transition to a low-carbon development, the plan sets objectives for technological development especially related to green technologies and an overhaul of systems such as the Korean Emissions Trading Scheme. It intends to strengthen tax support for carbon reduction technologies and provide support for carbon neutrality-related policy financing, loan projects, and standard development.

To achieve the updated NDC in the transport sector, the plan considers deployment

of 4.2 million electric vehicles and 300,000 hydrogen vehicles by 2030. It would also initiate a review of the Life Cycle Assessment of internal combustion vehicles, reform the automobile tax, and support the development of lightweight materials and low-carbon fuel technologies.

Concerning waste, the plan guides establishing a waste reduction target for the national and local governments, with the introduction of a resource efficiency rating system. There are also directions for expansion of the unit price of recycling. The government also announced policy directives and objectives for agriculture, buildings, and other related sectors.

<https://www.kimchang.com>

## Green Partnership launched

Climate Action is a priority area of collaboration for the EU and the Republic of Korea, which initiated a Green Partnership. Both sides intend to cooperate in carbon pricing tools such as the exchange of information, technical consultations, and particularly on their respective Emission Trading Systems.

They aim to exchange and mutually learn on how to measure, report, and verify emissions, as well as model future policies in light of their enhanced 2030 targets and 2050 net-zero. To develop climate-resilient societies, both sides aim to cooperate and exchange respective policies on adaptation to the changing climate.

Both sides intend to promote the alignment of finance flows with the Paris Agreement's long-term goals and the Global Biodiversity Framework, as well as exchange on the new post-2025 climate finance goal under the Paris Agreement and both sides' net zero GHG emissions goals and climate-resilient development.

Towards environmental protection, both sides would work together to implement the Kunming-Montreal Global Biodiversity Framework including effective monitoring and review mechanisms, as well as ambitious resource mobilization, targets, and access and benefit sharing.

Both sides work together on greater sustainability in the supply chains and collaborate on a Zero-pollution Vision for 2050, jointly aiming for eradicating air, water and soil pollution. They would also work together in the context of multilateral initiatives, in particular the Glasgow Leaders' Declaration on Forests and Land Use, the Global Forest Finance Pledge and the Global Alliance for Circular Economy and Resource Efficiency, and Clean and Just Energy Transition

Further, they would enhance collaboration in the realm of renewable energy (in particular offshore energies), prioritizing the development of renewable and low-carbon hydrogen, and energy efficiency as a future growth engine and a key means of de-carbonization. They also agreed to collaborate on an energy transition to scale up technologies and policies to achieve a just transition, away from unabated coal-fired power generation, aligned with their respective targets and international commitments.

They reaffirmed their stance to end public financing for new overseas coal-fired plants and cooperation on green mobility and technologies such as Carbon Capture and Utilization and Storage (CCUS) and batteries. To cooperate on research, demonstration projects, and market deployment of promising safe and sustainable low-carbon technologies they intend to explore the possible association of the Republic of Korea to Horizon Europe, the EU's R&I Framework Programme (2021-2027).

<https://www.consilium.europa.eu/>

## THAILAND

### Thai Climate Initiative or ThaiCI Fund

The Thai Climate Initiative or ThaiCI Fund serves as a financial mechanism to support climate protection in Thailand. It is implemented under the Environmental Fund, it receives up to EUR 6.5 million in funding from the International Climate Initiative (IKI), of the Federal Ministry for Economic Affairs and Climate Action (BMWK), GIZ

including assistance for technical support and the seed funding to finance climate projects. The primary focus of the fund is to provide financial support for climate mitigation and adaptation projects, enhance the operational capacity of the Environmental Fund, and strengthen the capabilities of climate project implementors.

ThaiCI aims to attract small-scale stakeholders including government agencies, local administration authorities, academic institutes, non-governmental organisations (NGOs), and the private sector. The ThaiCI Fund will primarily provide subsidies through calls for proposals for mitigation and adaptation projects. The 1<sup>st</sup> ThaiCI call for proposals will tentatively be announced by the end of 2023. It is also expected that ThaiCI will open

ThaiCI is one of the four components of the Thai-German Cooperation on Energy, Mobility and Climate Programme (TGC EMC). TGC EMC aims to foster cooperation towards Thailand's goal of reaching carbon neutrality by 2050 with a budget of 26 million EUR supported by the IKI funding line of the Federal Ministry for Economic Affairs and Climate Action of Germany (BMWK) and implemented by GIZ over five years (2023-2027).

[https://www.thai-german-cooperation.info/en\\_US/the-environmental-fund-launches-thaici-fund-to-elevate-climate-finance-in-thailand/](https://www.thai-german-cooperation.info/en_US/the-environmental-fund-launches-thaici-fund-to-elevate-climate-finance-in-thailand/)

### Taxonomy for transport and energy Projects

The Bank of Thailand (BOT) and the Securities and Exchange Commission (SEC), as co-leads of the Thailand Taxonomy Board released the draft Thailand Taxonomy Phase I. The Thailand Taxonomy Phase I focuses on the economic activities relating to the energy and transportation sectors, which contribute to the highest proportion of carbon emissions. The objective of the Taxonomy is to standardize economic activities to use it as a benchmark or assess economic activities that are climate-aligned. The Taxonomy can also be one of the alternatives to be used as a credible reference for access to financial

tools and services that support transition activities towards climate resilience.

Throughout the consultation, BOT and SEC received valuable and useful comments earlier in the year, from various stakeholders including governmental and private sectors, civil society, academic sector and international organizations. Most of the feedbacks agree with the concept that the Thailand Taxonomy Phase I would initially prioritize the economic activities that contribute significantly to greenhouse gases. Other views and suggestions were also submitted. For example, some respondents proposed that a red list of activities be created, and the scope of Thailand Taxonomy be expanded to cover other economic activities (i.e., manufacturing and agriculture) in the next phase. The Thailand Taxonomy Board has brought all comments into consideration and incorporated them in the final Taxonomy.

<https://www.bot.or.th>

## UZBEKISTAN

### National Action to Increase Resilience to Natural Disasters

In August 2023, with the resolution of the Cabinet of Ministers National Action Plan on the risks of climate change and natural disasters was adopted.

The document approves the National Action Plan of the Republic of Uzbekistan to increase resilience to natural disasters and climate change in 2023–2030.

The plan covers disasters like earthquakes, landslides and rockfalls, strong winds, snow avalanches, drought, mudflows, floods, natural fires and man-made risks associated with natural phenomena.

The main goal of the National Action Plan is to develop comprehensive measures to increase resilience to natural disasters and climate change. In this regard, it is planned: development of new legislative norms, republican and regional strategies, strengthening the participation and responsibility of local authorities in this direction; identification and assessment of

the risks of natural disasters, raising public awareness of such phenomena; attraction of public and private investments, localization of production of rescue and other special equipment on the principles of PPP, etc.

The roadmap for the implementation of the National Action Plan was also approved, containing 26 main activities.

<https://www.uzdaily.uz/>

## Center for Innovation and Technology opened

The Iranian Center for Innovation and Technology opened in Tashkent. The centre aims to introduce knowledge-based, technological, and creative products of Iran to Uzbekistan, and facilitate scientific interactions and cooperation between the two countries.

Vice President for Science, Technology and Knowledge-based Economy, Rouhollah Dehqani Firouzabadi, and Uzbekistan's Minister of Higher Education, Science, and Innovation, Ibrokhim Abdurakhmonov, officially inaugurated the centre in an online ceremony. The two sides signed a technological cooperation agreement worth \$10 million in the field of energy under the support of the House of Innovation and Technology.

The private sector has invested about \$4 million to establish the iHiT Tashkent. Exporting technological products of Iranian knowledge-based companies is one of the important and key programs of the Vice Presidency for Science and Technology, and in this regard over the past years, with the support of the Vice Presidency for Science and Technology, the Iranian Houses of innovation have been set up in several countries to develop the global market for knowledge-based products.

These centres have already been set up in countries such as Russia, Turkey, China, Syria, Kenya, Armenia, and Iraq.

The centres will be a platform for the development and promotion of Iranian knowledge-based companies, startups, and creative industries by supporting

innovative ideas and holding technological and innovative events. The centres are mainly formed with the investment and support of the private sector to provide the necessary infrastructure for their exports through innovation houses.

The country's progressing process of development has accelerated with the emphasis on the formation of the technology and innovation ecosystem and the approval of laws for supporting knowledge-based companies and boosting Iran-made products. According to the latest statistics, more than 8,000 knowledge-based companies are operating in the country.

<https://www.tehrantimes.com/>

## BANGLADESH Smart Vision for Bangladesh 2041

The government has taken a youth and start-up-focused approach to encourage the impressive growth of the country's Information Technology (IT) industry and achieve the goal of becoming a "Smart Bangladesh" by 2041.

One of several initiatives being implemented to expand the use of IT in education is the Bangladesh Association of Software and Information Services (BASIS) "School of Future" project, an extension of the Sheikh Russel Digital lab project 2021. Under the project, the digital record service ClassTune has been implemented at more than 300 schools across the country.

Furthermore, the IT industry is enjoying tax holiday facilities till 2024 to encourage investment. There is also a 10% cash incentive for foreign investors. Moreover, the government is providing project equity facilities for ICT start-ups, and also financial support to the mid-and top-level industries in the sector

The government has also established an ICT national task force and ICT incubation centres alongside 39 Hi-Tech, software and IT parks.

The government has plans to implement over 1,100 software applications in various

areas, as well as to train more than 650,000 registered freelancers. As much as 16% of total global freelancers are already from Bangladesh

The government and private sector are also working together on some projects, including the Learning and Earning Development Project (LEDP) and the Top-up IT training program covering 10,000 IT and science graduates, the ITES foundations skill program targeting 20,000 non-science graduates, and training activities by the BASIS institute of technology and management (BITM) with support from the World Bank.

A modern software testing center is being set up at IDB Bhaban in Dhaka. The testing center aims to verify and validate software systems in government offices, to create awareness, elevate the software testing industry in the country, and build resources to support the desired growth in the software testing arena.

As a part of the government policy implementation platform, the association has set seven goals to achieve a "SMART Bangladesh" by 2041.

The goals are as follows: training skilled human resources, developing the domestic market, increasing foreign markets, contributing more to GDP, creating a thriving ecosystem for startups, formulating policies to help grow intangible assets, and promoting the overall industry.

<https://www.dhakatribune.com/>

## Green Foreign Policy

To address the deteriorating global climate, Dhaka introduced a new strategy focused on forging vibrant 'green partnerships.' Through diplomatic outreach, "green partnerships" foster capacity development, technological development, and cooperation to share best practices and technical knowledge among partner countries. As Bangladesh envisions a green future, articulated in the Mujib Climate Prosperity Plan (MCP), forging robust ties and linkages with countries facing similar hazards and climate threats will guide Bangladesh in navigating the climate crisis.

Climate change has recently gained prominence in Bangladesh-Denmark ties, raising the prospect of a green partnership. Recognizing the “gross unfairness” of the disproportionate impacts of climate catastrophes on developing countries, Denmark’s government pledged USD 13 million to countries battered by climate change. The bilateral meeting also finalized the Bangladesh-Denmark Joint Action Plan for the period 2023 to 2026.

Denmark and Bangladesh have reached an agreement on green and clean investment and technology for sustainable development, which was agreed during the Second Bangladesh-Denmark Political Consultations. Denmark expressed interest in broadening the fields of cooperation to energy efficiency, renewable energy, circular economy, sustainable water management, climate adaption, ocean conservation agro-food processing, and Information and Communication Technology (ICT).

Recently, two Danish companies – Copenhagen Infrastructure Partners (CIP) and Copenhagen Offshore Partners (COP) – broached a USD 1.3 billion

investment proposal to the government of Bangladesh to produce 500 megawatts of offshore wind energy. Denmark is a trailblazer in the arena of wind power development and the country’s electricity sector is reliant on wind power, comprising 53.6 percent of the total electricity consumption in 2022.

Bangladesh’s government ratified the Bangladesh Delta Plan (BDP) 2100 in collaboration with the water management consultancy firm Dutch Water Sector and with integrated finance mechanisms with the Netherlands. BDP entails a long-term mega plan spanning 100 years that strives to buffer the negative effects of climate change and disasters in Bangladesh while ensuring long-term food security and spurring economic growth. Under the framework of the Delta Plan and using private-public modalities, the Netherlands is engaging in technical cooperation with Bangladesh in critical areas including land reclamation, flood defense, river dredging, and capacity development. The Netherlands has pledged support of USD 8.90 million for the implementation of the Delta plan.

Under the realm of a green partnership, the country is also exploring untapped potential in expanding Bangladesh-Thailand relations. Thailand is reorienting its economic model to a Bio-Circular-Green or BCG economy model, to more efficiently harness its resources. The BCG model is a process of conservation of natural and biological resources through the development of high-value products and services. The know-how of the BCG model drawn from Thailand will help Bangladesh in crafting an indigenous version of the model. The climate policies and priorities of the two countries align well and these policy similarities should be channeled into a more integrated partnership.

Bangladesh strives to promote a multi-sited and multi-pronged climate change strategy that emphasizes interwoven linkages across geographical boundaries for addressing critical climate change issues. In this context, the Bangladeshi government is forging robust bilateral ties with countries across the world to augment its climate diplomacy and must continue to do so, prioritizing South-South partnerships.

<https://southasianvoices.org/>

# Technology scan

## Integrating climate finance with technology

### UNITED KINGDOM

#### DNA Sampling Tech for Biodiversity Frameworks

To address Biodiversity, companies and investors have invigorated a cohort of startups offering tools to help monitor biodiversity levels.

One such startup, based in London, is Nature Metrics, which works on DNA sampling tech and collects samples of water or soil to measure the number of species at a given site, cross-checking the samples against DNA databases. It has one DNA lab in the UK and another in Canada.

It offers kits for water samples, with which it can detect fish species as well as algae, along with soil samples, with which it can detect mammals, fungi, and the soil microbiome. Companies and asset managers can use DNA sampling to monitor the effect their activities have on the biodiversity of the places they operate in.

Nature Metrics works with companies building infrastructure projects wanting to assess the impact of their project on the ecosystem around it, as well as with water utility companies, mining businesses, and conservation charities. It's worked on projects around the world, from Mozambique to the UK. It recently secured £9.8m in funding.

There is a large and expanding possibility for large-scale nature monitoring and reporting; other firms are developing other biodiversity monitoring approaches, including as acoustic and satellite monitoring systems. Interest in biodiversity monitoring increased after the launch of the Global Biodiversity Framework at COP15, in Montreal, at the end of 2022. Under the framework, aimed at halting biodiversity loss by 2030, governments will introduce policies requiring large companies and banks to report and reduce the damage they do to ecosystems.

The demand for monitoring technologies is set to increase as the Taskforce on Nature-related Financial Disclosures

(TNFD), an international initiative to develop biodiversity disclosure frameworks for businesses.

<https://sifted.eu/>

#### Climate Intelligence

As climate-related physical and transition risks become more prevalent, companies need to embed climate considerations into risk mitigation and put effective climate strategy and adaptation at the core of long-term business resilience.

Cervest's proprietary CI platform provides science-based climate risk insights, including exposure metrics and globally comparable risk ratings for assets and asset portfolios. Known as Cervest Ratings™, these can determine combined risk or hazard-specific risk that climate change effects including droughts, flooding, wildfires, or extreme temperatures can have on any asset. Assets can be selected from Cervest's pre-mapped catalog of over 600 million assets or uploaded manually. The platform's collaboration tools enable easy sharing of portfolios and insights across teams and organizations, and seamless integration into reports and presentations.

Accenture Ventures Project Spotlight initiative has entered into a collaboration agreement with Cervest, an AI-powered climate intelligence (CI) platform, that will expand Accenture's capabilities to deliver on-demand access to historical, current, and predictive views of combined climate risks to assess and address asset and portfolio vulnerabilities for clients across industries.

Accenture will combine its industry-leading capabilities in ESG intelligence with Cervest's Earth Science AI™, data modeling, and machine learning capabilities available through its CI platform and EarthScan™ product. This collaboration will help clients assess and mitigate physical asset risk based on different climate scenarios enabling them to better plan for resilience and inform net zero strategy,

while also making climate-related disclosures more transparent.

Having a single source of truth for climate risk-related insights, backed by the latest climate science data, will expand the network of solutions available to enterprises looking to embed sustainability at the core of strategy & operations. Those businesses that adopt measurement and management strategies that integrate carbon data and ESG insights into core business decision-making will be better positioned to reinvent and build business resilience while mitigating risks and capitalizing on opportunities of the advancing transition to net zero.

Cervest's Unified Climate Intelligence™ (UCI) platform is enabling enterprises, public bodies, and financial institutions to measure interconnected climate risks and opportunities on built and natural capital assets – across physical and transition risks. Powered by cutting-edge Earth Science AITM and globally comparable climate risk ratings, Cervest's flagship product EarthScan provides UCI-driven insights that chief risk and sustainability officers use to increase asset resilience and meet climate-related financial disclosure requirements. By connecting and de-risking decisions on every built and natural asset through UCI, Cervest is powering a Climate Intelligence Network™ whose climate-aligned decisions will drive a chain reaction of adaptation actions to build a more resilient world.

Our changing climate threatens every physical asset and natural resource our world depends on, costing us billions today and affecting every enterprise around the world – a figure projected to cost trillions soon.

Humans have made billions of uninformed climate decisions over the last century. Despite decarbonization efforts, climate volatility is already 'locked in' for decades to come.

To adapt to and mitigate the consequences of this, we need to make billions of climate-intelligent decisions, fast.

Unprecedented technology, unprecedented foresight. Until now, organizations couldn't quantify, interpret, or integrate climate risks into core decisions – the risks are just too complex, multi-dimensional, and computationally intensive.

<https://newsroom.accenture.com>

## INDIA

### ESG Blockchain automation tool Technology

TRST01 (TrayamBhu Tech Solutions Pvt. Limited), a leading blockchain climate-tech company, announces the launch of Footprint- the World's 1st ESG Blockchain automation tool.

It is a cutting-edge ESG automation tool designed to help organizations monitor, measure, analyze, and report their environmental, social, and governance (ESG) performance. This will be the first Global ESG automation tool product using the web3 interface (Blockchain). The Footprint ESG automation tool has been developed to meet the growing demand for transparency and accountability in an organization's sustainability practices. With the tool's advanced features and functionalities, businesses can easily track their ESG performance and report their progress to stakeholders, investors, and customers.

Another essential feature of Footprint is its supply chain management reporting. The tool allows companies to track and report their suppliers' ESG performance, providing a comprehensive view of their supply chain sustainability practices. This feature is crucial as companies increasingly recognize the importance of responsible sourcing and sustainable supply chain practices. Footprint by TRST01 has been designed keeping in mind an organization's triple bottom line – People, Planet, and Prosperity. This simple easy-to-use tool helps companies track and report on their ESG

performance, supporting their efforts to reduce their environmental impact, promote social responsibility, and foster economic growth.

Footprint by TRST01 follows the latest ESG reporting standards, including the Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Task Force on Climate-related Financial Disclosures (TCFD), and Carbon Disclosure Project (CDP). It is also in sync with the United Nations Sustainable Development Goals (SDGs) to provide a comprehensive view of an organization's ESG performance. One of the critical features of Footprint is its industry-specific content that offers customized materiality topic arrangement. This feature enables companies to report the most relevant ESG metrics and critical issues for more meaningful engagement with investors, customers, and other stakeholders.

The ESG automation tool is blockchain-enabled, providing a secure and transparent way to verify the accuracy, authenticity, and reliability of the ESG data. This is particularly important as companies face increasing scrutiny and pressure to disclose accurate ESG information.

<https://www.expresscomputer.in>

### Bio soluble packaging

Although detrimental to the environment, plastic packaging is used tremendously by consumers due to its high durability. Most of this waste ends up in landfills and water bodies, causing harm to biodiversity. Mumbai-based Neha Jain has come up with an eco-friendly alternative.

She has made low-cost packaging that can dissolve in water. These are made using seaweed.

During her research, she came across a unique species that could change the face of plastic consumption in the country — seaweed. It is a species of marine plants and algae found in the ocean and does not require energy to be grown or even fertilizer, fresh water, or soil.

In 2020, she started converting various species of seaweed into low-cost packaging and launched Zerocircle, a material science startup. The team procures seaweed from farms in Gujarat and Tamil Nadu. They turn it into a powder and make handbags, bags for clothes, film for food, and more plastic alternatives.

The packaging is soluble and dissolves in the ocean without leaving any microplastic causing no harm to the biodiversity.

<https://www.thebetterindia.com/>

## REPUBLIC OF KOREA

### Composite Column Construction Technology

Over the years, the Korean administration has supported more productive yet eco-friendly methods in construction sites. Since it enables a healthier setting, lowers the carbon footprint, enhances the construction business image, reduces the need for excess resources, and delivers long-term sustainable results.

Traditional construction process doesn't hold much significance in the present age which is inclined towards sustainability. In recent years, South Korea has made investments in research and development space for green growth. The country's investment in green technology crosses \$408.65 billion in 2021. During that period, 115 green companies were successfully built.

South Korea's Ministry of Trade, Industry, and Energy (MOTIE) has approved the concrete-filled composite column technology by POSCO. The Pohang-based steel-making company, POSCO will be allotted a green technology certificate as its concrete technology has been verified as environment friendly. Green technology checks whether the construction ensures minimal harm to the environment, lesser toxic emissions, and energy utilization or not.

It's the Green Certification Review Committee's role to identify candidates or companies suitable for green

technology certificates in South Korea. The committee is overseen by the Ministry of Trade, Industry, and Energy along with a few other evaluation partners and ministries.

POSCO initially came up with concrete-filled composite column technology in 2019. It was swiftly recognized for its efficiency by experts. This concrete-filling composite column method is a column built using cold-forming quality steel that ultimately benefits by improving compressive potency via the composite effect of concrete and steel.

This POSCO technology reduces the amount of waste by 53%. By applying the concrete-filled composite column method construction agencies can save up to 59% on waste treatment costs. Compared to the reinforced concrete column, the POSCO technology degrades carbon dioxide emissions by about 47%.

However, what awaited was a nod from the government for its eco-friendliness level which has been fulfilled now. The green technology certificate is evidence that the company's concrete technology emits comparatively less carbon and pollution.

The South Korean steel manufacturer along with its planning, procurement, construction, and operation subsidiary, POSCO Engineering and Construction (E&C) have switched reinforced concrete methods with the new concrete-filled composite column method for underground parking facilities.

It is anticipated that POSCO will continue to expand the application of low-carbon construction methods and devote time to developing similar technologies. Construction work can be quite disturbing for nature.

POSCO and its concrete technology are cordial towards efficient usage and the environment. The company looks to transform not just the South Korean construction industry but plants and infrastructure as well.

<https://www.koreatechtoday.com/>

## UNITED STATES

### Solar Nanogrids for Electricity On The Go

After a natural disaster, communities go an average of 52 hours without power. That's why Sesame Solar Nanogrids were designed to be set up by one person in 15 minutes and start generating power immediately.

Sesame Solar's Mobile Nanogrids are grid-independent energy structures that look like construction trailers or shipping containers on a flatbed truck. This means the Nanogrids can be easily transported to areas that have been impacted by a natural disaster or power outage.

Each Nanogrid is fueled by solar power, green hydrogen, and battery storage, offering weeks of energy autonomy by combining these complementary forms of renewable energy generation and storage in a closed-loop, carbon-free, reliable system.

The solar arrays are installed on the side panels of the nanogrid. With the patented technology, one can simply "Open Sesame" and the side panels are electronically unfolded to face the sky and start generating power. The solar capacity ranges from 4-20 kW.

Nanogrid contains a battery to capture the energy generated by solar and green hydrogen energy. Depending on the configuration, Nanogrids can produce between 3-20 kW of power, with total battery storage of 15-150 kWh.

The Nanogrids are intentionally designed for multi-use case scenarios and can double as facilities for mobile clinics, offices, emergency response centers, mobile retail pop-ups, remote military applications, and more. Each Nanogrid can be tailored to a community's specific needs and power essential community functions after a disaster strikes.

The company's primary use case is disaster response, but our Nanogrids can also be used to power EV charging,

telecommunications, media and entertainment, and more.

Sesame Solar, based in Jackson, Michigan, USA manufactures portable solar power and energy storage systems for emergencies or work scenarios where they provide mobile power. The Nanogrids have a 1-year warranty, and we pass along component warranties that range from 5 to 20 years.

The US Air Force uses Sesame Solar Nanogrids as Mobile Medical units and Command and Security units for remote missions such as recovering a downed aircraft.

Santa Barbara County Office of Emergency Services is using Sesame Solar Nanogrids powered by solar and green hydrogen for Mobile Community Power after wildfires, floods, and power outages and for events and community education in non-disaster applications.

Sesame Solar Nanogrids are easily transported by forklift, truck, train, ship, plane, or helicopter. The Nanogrids can be hitched and pulled by a  $\frac{3}{4}$  or 1-ton truck

<https://cleantechnica.com/>

### Soil Carbon Capture

Boomitra is a Silicon Valley-based startup working to accelerate atmospheric carbon removal using agricultural soil and doing it from anywhere in the world. The team has developed a way to measure and monitor carbon levels in the soil using artificial intelligence-based algorithms without the need to take a physical soil sample. The team uses satellites to remotely certify and monitor a field's soil organic carbon on field sizes as small as two hectares, enabling onboarding of farmers of nearly any size around the world. It operates as an agricultural carbon marketplace that connects farmers selling carbon credits with large corporations and governments who buy them.

This has the potential to enable the expansion of the entire carbon market industry since the current soil carbon



measurement practices include sending people out to a farmer's field to take soil samples and then quantifying the samples in a lab. A process that is both costly and time-consuming.

Given the remote nature of Boomitra's solution, the team can now measure nearly any field, even those as small as two hectares. This means that farmers in markets like India and Mexico who would otherwise be shut out of carbon markets because of their field sizes (which make regular soil samples prohibitively expensive) are now able to participate in this part of the agri-sustainability revolution.

<https://www.yara.com/>

## AI to predict the impact of natural disasters

Natural disasters are unavoidable and can wreak absolute havoc on cities and towns, regardless if they're in developing or developed countries. But what if we had more time to prepare before disaster strikes? And, what if we could predict what areas would suffer the most?

That's exactly the challenge solved by One Concern, a platform that uses social and economic data as well as AI to uncover a city or town's weaknesses.

With this hyper-local data, the platform enables policy-makers to make policies before disaster strikes to protect entire cities, and vulnerable populations, or "geofence" different segments of society who may be at greater risk. The platform also enables users to make smarter, more informed, and quicker decisions, during and after a disaster strikes.

One Concern gets smarter through 'collective intelligence' where human knowledge and expertise are incorporated into the overall platform, enabling AI-driven recommendations to be delivered in real-time.

While the ultimate goal of the platform is to avoid any loss of life, the technology also helps to reduce property damage, and business interruption and protect employees.

Behind One Concern's design, each line of code is a fundamental invention. The team has filed for more than fifteen patents across multiple disciplines of science and technology.

Their model's Seismic Concern and Flood Concern have been successfully trailed in San Francisco, Los Angeles, and Seattle as well as the State of Arizona, respectfully.

<https://theindexproject.org/post/one-concern>

## Parametric Reinsurance Platform

Arbol, a global climate risk coverage platform, in collaboration with The Institutes RiskStream Collaborative, a blockchain and emerging technologies consortium, has unveiled dRe, a blockchain-powered parametric reinsurance platform.

The platform is the first on-chain data calculation tool for reinsurance, its creation marks a significant milestone for parametric reinsurance.

Arbol's dRe Lifecycle Dashboard is a smart contract-based system that enables efficient and transparent parametric loss calculations for severe storm catastrophe transactions.

Leveraging validated weather data from leading decentralized climate data networks, dClimate, and Chainlink's industry-standard decentralized oracle network, the platform triggers a smart contract based on wind speed and location for specific peril events.

The system automates claim initiation, notifications, and loss calculations, resulting in rapid payouts, streamlined data flow, and heightened transparency.

The platform was developed in collaboration with The Institutes RiskStream Collaborative, employs technologies by Kaleido, and leverages RiskStream's Canopy platform—the industry's first end-to-end reusable blockchain framework.

With its flexible design, dRe can adapt to various perils such as rain, heat, or wind, and the potential for non-parametric insurance event notifications.

<https://www.reinsurancene.ws/arboll-and-the-institutes-riskstream-collaborative-announce-partnership/>

## Innovative Green Finance Market

Zero Circle can help you recognize the value of sustainability reporting and has put in place a road map for stakeholders to support their reporting as an aspect of the company's risk management approach. The first step in starting up is to teach oneself the ropes of economic viability, environmental conservation, and social equality. The next step is setting and achieving sustainability goals and implementing sustainability-focused policies and practices.

More significant establishments and corporations have a windfall of funds to support sustainability activities. At the same time, small and mid-sized organizations need more resources and ample funding to have a favorable impact on their communities. Smaller and mid-sized organizations are big on carrying through sustainability initiatives and need assistance figuring out how these ideas will positively impact their stakeholders and their organizations.

Zero Circle is a sustainable finance platform that focuses on green financing. It is dedicated to assisting companies in identifying suitable financing options that offer access to green financing solutions and drive positive development.

Zero Circle focuses on discovering sustainable and diverse suppliers and ensures you stay ahead of the curve. This intuitive platform helps you find the perfect suppliers to meet your business needs.

<https://www.newenergy nexus.com/>

## FRANCE AI assistant for ESG analysis

Iceberg Data Lab (IDL), the green FinTech firm that provides scientific environmental data solutions for financial institutions, has launched 'Barbatus', the world's first ESG AI assistant.

This new product has been launched in response to the increasing complexity of ESG reporting frameworks. It will simplify the process of ESG data analysis for clients, ultimately leading to better comprehension of the environmental impact of their investments and speeding up their sustainability transition processes.

IDL, established in 2015, caters to the growing need for reliable and science-based environmental company data among financial institutions. The company provides simplified data through its proprietary impact calculation platform, offering a comprehensive lifecycle analysis of the environmental impact of portfolio companies. This spans across Scope 1, 2, and 3, upstream and downstream.

Barbatus is a revolutionary product that uses generative AI technology to provide real-time, text-based, and fully sourced explanations in response to queries about the ESG data of portfolio companies. It is designed to extract and provide structured information from unstructured text within IDL's extensive dataset, covering over 2,300 different products and services.

The ESG AI assistant offers a plethora of solutions for professionals in the financial services industry. It allows ESG analysts to interpret results more effectively, enhance benchmarking, and better understand how corporates can reduce their environmental impact. CSR teams can also use Barbatus to analyze their own or their sector's environmental impact in response to regulators' requests.

<https://fintech.global/>

### Climate Neobank Green-Got

Finance has an incredibly powerful role in Europe's green transition and unlocking that will prove monumental in the race towards creating more sustainable societies. French startup, Green-Got, wants to facilitate that.

Founded in 2020 by Maud Caillaux, Andréa Ganovelli and Fabien Huet, Green-Got offers a sustainable approach to banking and finances. The neobank offers its customers alternative and 100%

transparent and ecological bank accounts which, with each payment, contribute free of charge to the financing of the de-pollution of the oceans, the afforestation or the development of renewable energy.

The vision is to change the world of traditional finance by redirecting financial flows towards transition. So far, the firm has already stored or avoided more than 12k tons of CO2e through its banking platform.

Whilst the amount of money going towards climate has increased by 60% since 2013, there is still a massive gap in global climate financing. Green-Got's platform directs financial support to high-impact environmental projects. The online payment and savings account enables users to pay anywhere in the world with a card made of natural wood or recycled plastic.

In addition, Green-Got has engineered its carbon calculator for its users to measure and control the CO2e emissions linked to their spending.

The neobank has just raised €5 million, including €1.9 million in crowdfunding in less than 80 minutes, to change how people manage their money. With this new funding, the climate-led fintech team plans to address the green finance market in other European countries like Belgium and develop their offer with personal saving accounts and accounts for sole traders.

<https://techcrunch.com/>

### Green energy Management Solutions

On a global scale, consumers spent \$24 billion on green electricity in 2022 and it is projected to grow this year as the demand for clean energy. This coincides with the increased concerns over climate change and the desire from organizations and individuals to reduce their carbon emissions. However, they are rarely informed where this energy comes from.

Energy companies are allowed to market tariffs as 'green' if they have sourced enough energy certificates to cover

the energy consumed by their customers on that tariff within 12 months. Furthermore, energy companies are not required to disclose from where they have bought certificates or how they have been assigned to their customers. As per a recent survey, only under 5% of leading utilities worldwide disclosed the sources of renewable energy behind their green offers last year.

Granular Energy, through its software, provides clean energy management solutions for utilities, energy managers, traders, and large energy buyers worldwide. It seeks to address a lack of transparency in this market that is holding back funds from being directed toward technologies that deliver clean energy at the times and locations it is most needed.

Granular Energy is creating solutions to track where energy comes from hour by hour, creating an important price signal for energy storage and flexibility, alongside more clean energy generation. It aims to create a world where every organization has access to affordable, reliable, and clean energy.

London-based Granular Energy has secured €7.5 million in seed funding, in a round led by impact venture capital firm Norrsken VC (that recently backed Material Evolution), with support from All Iron Ventures, Box Group, Valo Ventures, and participation from existing investors Seedcamp, Revent and Powerhouse Ventures.

<https://techfundingnews.com/>

### CANADA Low carbon Concrete

Tongyang Inc., a South Korean concrete manufacturer under Eugene Group, is expected to speed up its environmental, social, and governance (ESG) management initiative by producing low-carbon concrete.

The company signed a contract with Canada's CarbonCure Technologies Inc. which specializes in eco-friendly concrete technology and established a CarbonCure

system for the first time in the industry that enables low-carbon concrete production.

The key feature of CarbonCure technology is injecting liquefied carbon dioxide into the concrete production process to increase strength. When liquefied carbon dioxide is sprayed during the concrete mixing process, crystallized carbon dioxide reacts with cement to form calcium carbonate, enhancing the strength of the concrete.

This allows for a reduction in cement usage by about four to six percent while maintaining the same strength. The incorporated carbon dioxide in the concrete can be permanently stored within the concrete, maximizing the environmental carbon reduction effect.

<https://pulsenews.co.kr/>

## Technology selection for renewables

Clir Renewables, the market intelligence platform for wind and solar, has announced the launch of Clir Insight for Asset Development, a new product that leverages 200 GW of data to improve technology selection and operation and ensure mitigation of risk.

In an increasingly competitive market, developers are faced with a dynamic risk profile, considerable practical challenges, and uncertainty for the successful execution of renewables projects. Leveraging over 200 GW of industry operations and risk data, Clir's new offering supports developers throughout asset development to evidence major technology selection and contracting decisions, improve the accuracy of energy yield loss assumptions and guide future operations and maintenance strategies.

Clir Insight for Asset Development navigates equipment selection and contracting by identifying technical manufacturer issues, timelines for operational maturity, relative attritional loss risk by technology type, controllable availability by manufacturer and expected loss factors given site conditions.

Site loss factors and production vary by region and manufacturer, impacting energy yield loss assumptions. By employing new technologies with access to environmental and extreme weather data, grid and technology availability, degradation metrics, trends in equipment failure rates and repair intervals, and sub-optimal performance, developers can gain invaluable access to bespoke, accurate, and extensive market intelligence to ensure greater certainty in their financial and operational decision-making.

By leveraging data for accurate assumptions, renewables developers can create a more transparent and reliable project trajectory. This can support them in the process of securing the necessary initial funds for project construction while ensuring positive returns on investment in the operational phase.

<https://renewablewatch.in/>

## SINGAPORE Li-Ion Recycling technology

Singapore-based lithium-ion battery recycling technology company Green Li-ion has developed Green Lithium Multicathode processor (GLMC) technology. It has modular battery recycling units that manufacturers and recyclers can integrate into existing onsite processes. Once installed, they can process four to six metric tons of end-of-life batteries per day (up to 20 electric vehicle [EV] batteries or 70,000 smartphone batteries) to produce precursor cathode active material (pCAM) at battery grade, the firm says.

The first Green Li-ion commercial operation is scheduled to start production in this year's fourth quarter at a plant operated by Aleon in Oklahoma. The company says it also is "rapidly expanding its presence in Southeast Asia, Europe, and North America." Its hydrometallurgical process has been designed to help extract lithium, nickel and other metals from end-of-life lithium-ion batteries. The company received investment from Twin

Towers Ventures (TTV), an investment arm of Petronas Ventures.

<https://www.recyclingtoday.com/>

## Multi-bank working capital solutions platform as a service

TASConnect is a bank, industry and Enterprise Resource Planning system (ERP) agnostic Software as a Service Platform (SaaS) platform connecting complex enterprise ecosystems to unlock sustainable economic value with visibility and control.

Approved invoices are pulled directly from Lenovo's ERP system, which are then straight-through processed to the respective banks for financing via the TASConnect platform. TASConnect collects a usage-based fee based on the volume of such financed invoice flows through the platform.

The platform significantly enhances efficiencies in accounts payable and accounts receivable financing programs; enabling access to increased working capital sources; automating and simplifying complex workflows; and allowing businesses to control their programs securely and sustainably.

A wholly owned subsidiary of SC Ventures Holdings Limited, and incubated by SC Ventures, the fintech and investment arm of Standard Chartered, TASConnect has an initial capital of US\$10m.

TASConnect has invested heavily in cybersecurity measures that follow the culture of bank compliance for data security. Furthermore, the cloud-based platform is hosted on Amazon Web Services, known to be extremely secure, robust, and reliable in disaster recovery modes and data security modes.

<https://sbr.com.sg/>

## GERMANY Home Energy Management

A Germany based startup 1KOMMA5° has developed 'Heartbeat' their energy

manager that enables users to optimize the energy demand at their homes, and their app which gives real-time access to energy flows and historical data, keeping all energy system information in one place.

The company has raised an impressive €215 million. 1KOMMA5° has expanded its reach into six new markets. This strategic move sets the stage for continued expansion into Spain, Italy, Austria, and Switzerland by the end of 2023. By entering these markets, 1KOMMA5° aims to provide sustainable energy solutions to a wider customer base and spearhead the development of a cleaner, greener future.

By 2024 1KOMMA5° announced that Heartbeat will be compatible with existing energy devices, expanding their reach and impact. This breakthrough development marks a significant milestone in the creation of the largest virtual power plant, solidifying its position in shaping a sustainable energy future.

With their climate-neutral energy solutions for homes, individuals are expected to reduce their carbon footprint while enjoying energy cost savings. Collaborating with experienced regional expert companies across 40 locations in Germany, Sweden, Finland, and Australia, 1KOMMA5° mission is to ensure that the best possible sustainable energy solutions are accessible to all, paving the way towards a cleaner, greener future.

<https://www.eu-startups.com/>

## ITALY

### Invisible Solar Panels

Italian company Dyaqua, which has developed a way to produce solar panels so that they resemble the barrel clay tiles common on the roofs of buildings in Italy, has said the technology is important for the sustainable redevelopment of historical sites.

The lighting company Dyaqua saw an opportunity as there were growing concerns with heritage buildings. The product is called Invisible Solar Panels. The panels consist of common monocrystalline silicon cells that are placed

underneath ceramic housing and made from “non-toxic” materials. The ceramics have been modified to appear opaque to human eyes while still allowing sun rays to pass through and power the cell.

Since archaeological sites and usual heritage buildings have a high energy consumption. Therefore, solar energy is very important to lower the environmental impact of these beautiful places and support them in spreading culture.

Every component of the manufactured-to-order panels is meant to be recyclable, and the company has said that they are “artisan made”, so the panels have minor differences between each one, adding to the “classic” look.

Invisible Panels can also be used for siding or pavement and were designed to be functional as well, providing surface protection akin to typical housing tiles. The company also said that the photocatalytic properties of the ceramic housing allow the tiles to self-clean. Dyaqua said it aims to make the panels sustainable.

The panels can also “withstand a high static load” and the company stated that they have been tested against chemical solvents and other “atmospheric agents”.

Each panel weighs about two kilograms and has a peak power of 7.5-watt peak (Wp), an expression of its peak energy capacity. Meant to be used on new structures as well as for the replacement of old tile, the system can be applied to a variety of building types.

The tiles were prototyped for years before being launched in 2016. In 2018 as a power method for the Pompeii Archeological Park through its Smart Archaeological Park program, which attempted to integrate sustainable technologies into the archaeological site. The project aim is to turn Pompeii into the first smart archaeological park, creating an international reference model for other cultural heritage sites.

The company is experimenting with similar systems using different materials like wood, stone, and concrete.

<https://www.dezeen.com/>

## JAPAN

### Fusion Technology

Nuclear fusion is the source of the sun’s energy. Kyoto Fusioneering is involved in the development of fusion energy as a next-generation technology for the massive-scale production of safe, reliable energy. In recent years, the decarbonization trend has triggered a rapid acceleration of R&D activities by government research facilities around the world, including Japan, aimed at realizing nuclear fusion power generation. There has also been an upsurge of R&D activities in this area by startups and other private sector organizations funded by leading investors and business corporations.

Kyoto Fusioneering is a startup established to carry out R&D of solutions needed for the development of nuclear fusion energy and to provide plant engineering services. It was established in 2019, with Emeritus Professor Satoshi Konishi of Kyoto University, a leader in the field of fusion energy research, as a co-founder. The company has a proven track record of developing key components for fusion power generation and has been selected as one of the key conceptual designers for STEP, the U.K. government-led fusion reactor development program.

To create an eco-friendly society, the company is working hard to provide a diverse range of decarbonization solutions through collaborative projects with partners, cross-industry cooperation, and innovative technological initiatives. Kyoto Fusioneering is an opportunity to accumulate nuclear fusion knowledge and expertise.

<https://www.mitsui.com>

## GLOBAL

### Carbon Emissions Reporting tool

The SME Climate Hub has launched a new reporting tool that allows businesses to publish an annual carbon emissions report to maintain their committed

status to the SME Climate Hub and the United Nations Race to Zero campaign. Through the new tool, available for free to all committed businesses, companies are asked to report annual greenhouse gas emissions, list actions taken to reduce business and value chain emissions and provide comments on progress.

The reporting tool is based on the simplified disclosure framework for SMEs developed by the Carbon Disclosure Project (CDP). Exponential Roadmap Initiative and Normative provides a public and downloadable report that businesses can use in their public communications and annual accounting. Reporting provides businesses with the opportunity to share their climate action progress with customers, financiers and other stakeholders, and helps set themselves apart from competitors as climate leaders.

<https://smeclimatehub.org/>

## Tackle Cattle Methane Emissions

CH4 Global, Inc., today announced a new proprietary methane reducing digestive aide feed formulation for beef feedlot cattle called Methane Tamer™ Beef

Feedlot. The product is the first in a line of ruminant animal and farming technologies being developed under the Methane Tamer™ brand, and will first be commercially available to partners in Australia, with worldwide expansion following in future years.

With our patented innovations in operational efficiencies and formulation, CH4 Global has developed the highest quality, lowest cost and most efficacious product designed for and with the end user. This natural product includes the entire Asparagopsis plant, as used in independent peer reviewed animal feed studies, and is not a synthetic replication of only one of the active ingredients or an extract from Asparagopsis.

The new formulation reduces formation of methane in the animal rumen, with the help of a star ingredient, Asparagopsis seaweed. When processed correctly, Asparagopsis has been scientifically proven to reduce methane emissions in cattle by up to 90% without negative effects on animal welfare or beef quality taste or texture. Our proprietary formulation contains superior-quality Asparagopsis and other natural ingredients to support intake by

feedlot cattle and easy inclusion in the feeding regimen.

Benefits:

- Up to 90% reduction of enteric methane emissions from beef feedlot cattle.
- Supports feed efficiency and weight gain.
- Aids in digestion.

The product will be made available to our existing commercial partners CirPro and Ravensworth, along with other partnerships currently under negotiation with commercial scale feedlots and food producers to radically reduce the methane footprint without altering the production process, and the opportunity to deliver premium, low-methane food.

CH4 Global, founded in 2018, is on an urgent mission to bend the climate curve, through collaboration with strategic partners worldwide. It delivers market-disruptive products that enable the food industry value chain to radically reduce GHG emissions. CH4 Global is headquartered in Henderson, NV, with current subsidiaries in Australia and New Zealand.

<https://www.prnewswire.com/>

## SYMBIOSIS OF CLIMATE FINANCE AND TECHNOLOGICAL INNOVATIONS TO FOSTER THE ENERGY TRANSITION

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### Abstract

As climate change intensifies, it becomes increasingly critical to address its impacts through climate finance and technological innovation. This article delves into the symbiotic relationship between climate finance and digital technologies, focusing on their role in the decarbonization of the energy sector. By examining the case of Singapore, a nation facing unique constraints, we elucidate the significance of innovations in climate finance and digital technologies in increasing cleaner energy generation, greener technologies, and interconnection infrastructure. We further elaborate the discussion to other countries. Despite a promising future, integrating climate finance with technology mechanisms encounters formidable challenges, including the need for clearer incentives, inadequate pace and scale of investments, shortage of quality skilled human capital, considerations of ecological impacts, and alignment with short-term investor perspectives. To surmount these hurdles, concerted efforts from both public and private sectors are crucial to facilitate climate finance in steering the transition towards a sustainable and decarbonized energy future.

and hydroelectric projects. However, the pace and extent of this transition can vary from country to country due to factors like policy frameworks, available resources, and infrastructure.

While there is a pressing necessity to address climate issues, many decisions around climate actions are still driven by financial considerations (Giglio, Kelly, & Stroebe, 2021). For instance, the pricing of risk mitigation measures, the attitudes of investors towards transitions, and government decisions for taxation plans. Climate actions need to be supported by funding mechanisms such as investments, subsidies, and loans, collectively known as climate finance. The Global Commission on Adaptation has presented that an investment amount of \$1.8 trillion would provide \$7.1 trillion in benefits, in return (Global Commission on Adaptation, 2019). Nonetheless, existing studies have presented that there is a significant financial shortfall to execute the transition plans and develop green technologies (Bhandary, Gallagher, & Zhang, 2021). Indonesia's struggle to secure funding for coal retirement (Sudarshan Varadhan, 2023) is one of the many examples that mirrors the broader challenge of financing sustainable transitions. With Western nations bogged down with their own economic issues, thus showing reluctance, concerted efforts are required to garner support for this crucial shift. Bridging this gap necessitates concerted efforts from governments and public endorsement. A recent study by the National Bureau of Economic Research has shown that providing the public with information regarding the mechanics of climate policies and the allocation of climate finance results in increased public support, particularly for measures with initially low levels of support, such as carbon taxes. Therefore, it is important to understand how climate finance can be applied to facilitate technological innovation and

### Introduction

In recent decades, climate change has become a pressing global concern, driven by natural processes and human activities. This has led to unprecedented ecological shifts, including but not limited to extreme weather events, wildfires, biodiversity loss, disruptions to the Earth's life support systems, and rising sea levels (Pörtner et al., 2022; Clarke, Otto, Stuart-Smith, & Harrington, 2022). To date, the Paris Agreement has been ratified by 193 nations, and 194 Parties have submitted their Nationally Determined Contributions (NDCs). With the inclusion of these newly revised NDCs, the combined effect of current and announced net zero

commitments is anticipated to lead to a further reduction in emissions by 2030. This has the potential to cap global warming at 2.1°C, preventing a more severe increase beyond 2.8°C, as outlined in the initial NDCs (IRENA, 2022). In the ASEAN region, although the member states have established their NDCs for Greenhouse Gas (GHG) emission reduction (Figure 1), there is a substantial gap in achieving net zero emissions for the power sector as the share of low-carbon technologies is less than 25% (Handayani et al., 2022). Several ASEAN member countries have set renewable energy targets and are taking steps to increase the share of renewable energy in their respective energy mixes. This includes investments in solar, wind,

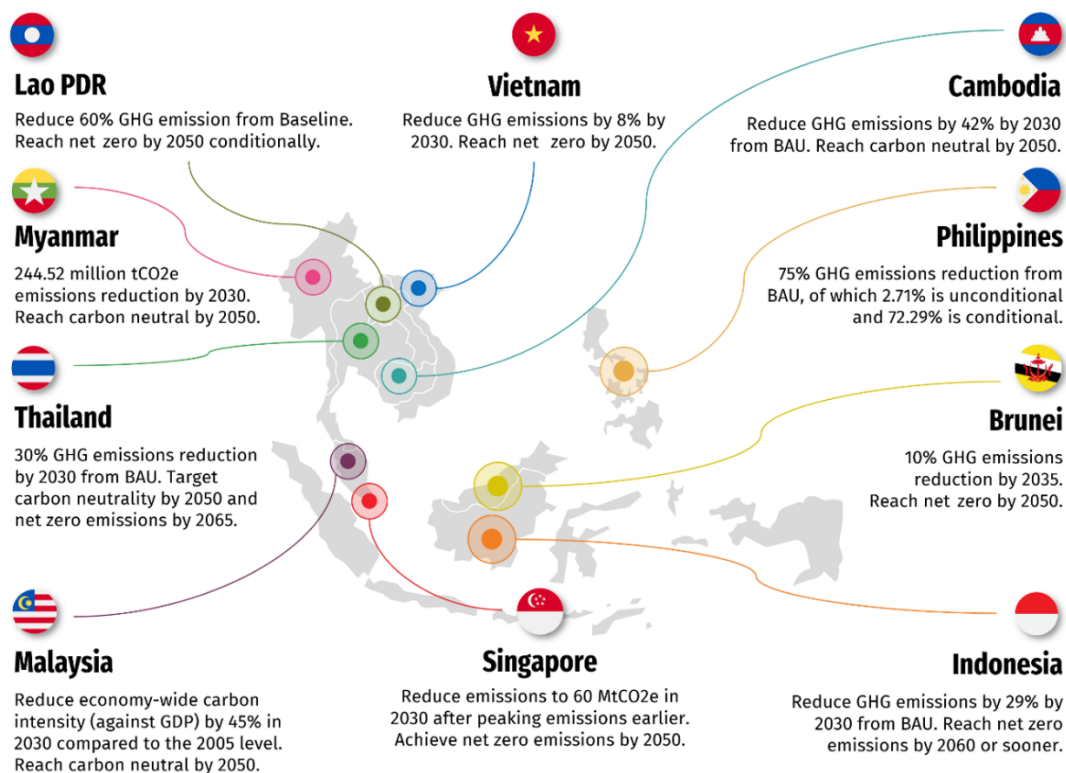


Figure 1. Nationally Determined Contributions set by ASEAN member states. Built using information from the ASEAN Centre for Energy (2022).

foster the transition toward a decarbonized economy.

### Climate finance and technology innovation

Various financial instruments such as carbon markets, national climate funds, and green bonds can be employed to support climate action programs (Figure 2). Climate finance provides the essential

funding for advancing research, development, and implementation of clean and sustainable technologies. In return, technology innovations benefit climate finance by creating opportunities for profitable investments. For instance, advancements in the above-mentioned technologies attract investors as clean energy projects become more economically viable. Furthermore, smart grid

systems and energy-efficient technologies powered by advances in digital technologies, or fourth industrial revolution technologies enhance the feasibility of low-carbon projects, drawing investors' interest towards these initiatives.

In this article, we examine the symbiosis between climate finance and technological advancements, illustrating their role in driving the energy transition, with

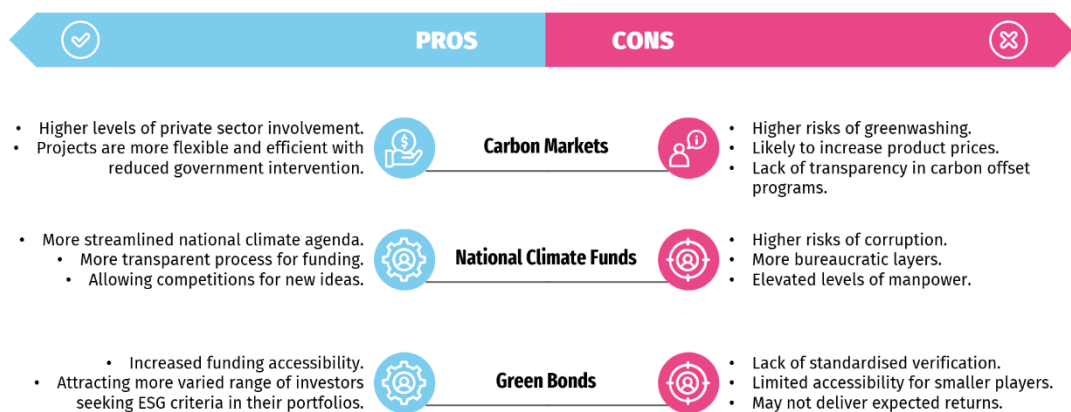


Figure 2. Pros and Cons of various climate financial instruments.

a case study on Singapore. We focus on energy transition technologies as the power sector is responsible for the highest proportion of global CO2 emissions (IEA, 2022a).

### Trend of energy transition technologies

Climate finance serves as a linchpin in expediting the transition of existing power grids to an interconnected system with low-carbon energy technologies. It allocates resources to bolster the development and amplification of renewable

energy infrastructure, such as solar and wind farms, hydropower dams, and green hydrogen plants. Furthermore, climate finance could also be used to fuel research and development endeavors, making these technologies more efficient and cost-effective. For instance, a recent study on the China Southern Power Grid found that power system planning by adapting hydropower operation can cut total system costs by 7% (US\$28.2 billion) and result in an annual water savings equivalent to three times the capacity of the Three Gorges Dam (Liu & He, 2023).

In the past few years, despite being slowed down by the COVID-19 pandemic, the capacity of renewable electricity capacity has been growing (IEA, 2022b). The main types of renewable energy technologies include photovoltaic (PV) solar, wind, hydropower, and bioenergy (Figure 3). The implementation of clean energy technologies was one of the key drivers (Figure 4) for CO2 emission reduction in 2022 (IEA, 2023a). These advancements have been facilitated by climate finance, which operates on various fronts including incentivizing the generation of cleaner energy, providing support for green initiatives and management,

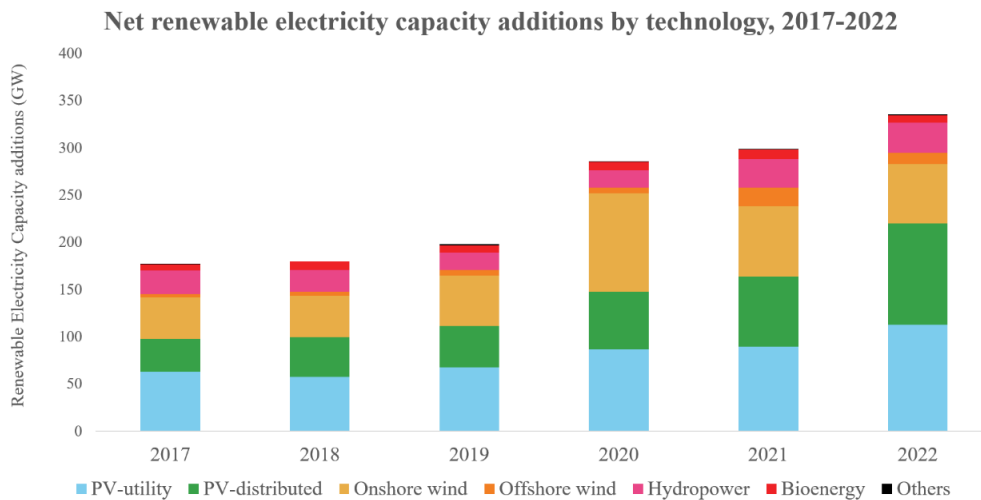


Figure 3. Net renewable electricity capacity additions by technology, 2017-2022. Built using data from IEA (2022b).

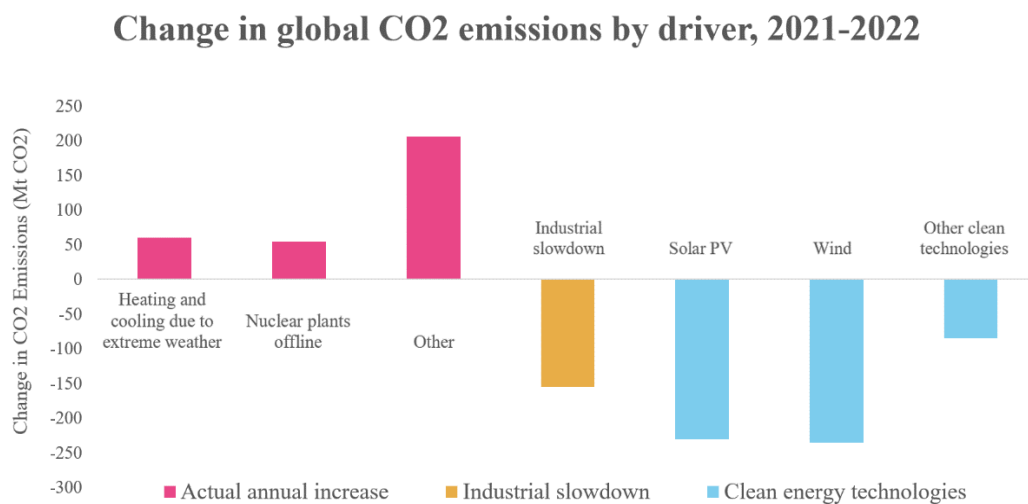


Figure 4. Change in global CO2 emissions by drivers, 2021-2022. Built using data from IEA (2023a).



and fostering regional partnerships and collaborations. This can be showcased using Singapore as an example.

### Case study on Singapore

Singapore is an island country with limited land and resources. Due to its geographical location, it experiences low levels of wind speed, and tidal and hydro actions, making it a challenge to leverage the use of natural resources to its advantage. With the energy sector currently contributing more than half of total carbon emissions (IEA, 2020), Singapore must explore

alternative strategies to secure its energy resilience while maintaining sustainable practices. Here, we present how climate finance, encompassing government funds, grants, tax incentives, public and private investments, and carbon pricing, acts as a driving force for technological innovations and nurtures Singapore's transition towards sustainable energy practices.

### Government funds and energy-efficient technologies

Government-established funds can serve as a catalyst for the adoption and

integration of energy-efficient technologies within various industries. The National Environment Agency (NEA) of Singapore has launched the Energy Efficiency Fund (E2F) to support businesses in adopting more energy-efficient technologies with different types of grants. (NEA, 2023) Examples include energy-saving lighting, boiler systems, compressed air systems, and air-conditioning systems (Figure 5).

Consequently, as of January 2022, NEA-funded initiatives facilitated the execution of 27 projects centered on energy-efficient technologies (NEA, 2023). This translated to an estimated yearly mitigation of

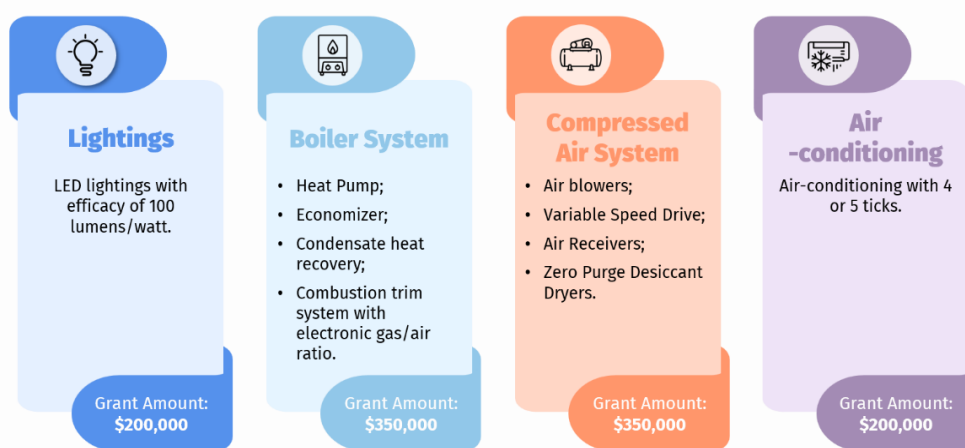


Figure 5. Examples of Energy-efficient Technologies pre-approved by NEA. Built using information from NEA (2023).

approximately 1,600 metric tons of carbon emissions, equivalent to the environmental effect of removing 500 cars from the road.

### Cleaner production and environmental management supported by Government grants

Climate finance plays a crucial role in promoting Singapore's cleaner production and environmental technologies. In transportation, it can drive the shift to electric and hybrid vehicles, along with investments in public transport infrastructure like electric buses and charging stations. In the context of electricity generation, green loans and funds can support technologies that capture

carbon emissions from the combustion of natural gas.

The Singapore Economic Development Board (EDB) has introduced a suite of initiatives and incentives (Singapore Economic Development Board, 2023) designed to foster sustainable economic endeavors within Singapore. One notable initiative, the Resource Efficiency Grant for Emissions (REG(E)), is specifically tailored to incentivize enhancements in energy efficiency within the domains of manufacturing facilities and data centers. Situated within the broader framework of the Enhanced Industry Energy Efficiency package, REG(E) represents a collaborative effort involving the Energy Market Authority (EMA), EDB, and NEA, with each entity launching distinct initiatives aimed

at providing robust support to companies in their pursuit of heightened energy efficiency and concomitant reduction of carbon emissions.

### Transitions to greener technologies motivated by carbon pricing

Climate finance also encourages transitions in electricity generation technologies. The introduction of a carbon tax acts as a strong motivator for expediting the retirement of high-carbon technologies (Xu, Pan, Li, Feng, & Guo, 2023), particularly evident in the context of fuel-powered plants. Through the imposition of a tax on each unit of carbon emissions released, operators of such facilities face direct financial repercussions for their

environmental footprint. This creates a notable economic deterrent for ongoing operations, prompting them to explore cleaner and more sustainable alternatives. The financial weight of the carbon tax compels power plant operators to reevaluate the viability of maintaining aging coal-based infrastructure in comparison to transitioning towards greener, more efficient options like renewable energy sources. Furthermore, the revenue generated from a carbon tax can be strategically reinvested into renewable energy projects, providing further impetus for the shift away from coal.

In Singapore, the carbon tax rate was set at \$5 per ton for 2019 to 2023, serving as an intermediary phase to facilitate business adaptation. In 2022, NEA declared an increment in carbon tax rates: \$25 per ton in 2024 and 2025, \$45 per ton in 2026 and 2027, aiming for \$50 to \$80 per ton by 2030 (Tseng, 2022). This means Singapore's electricity generators, which rely heavily on natural gas, would face increased operating costs. Under this context, one of the key generators in Singapore, Sembcorp Industries, is embarking on the construction of a hydrogen-ready power facility with a capacity of 600 megawatts (Mitsubishi Power, 2023). This power plant is anticipated to commence operations in 2026. This new power facility will be able to enhance the efficiency of power

generation resources as well as set the stage for a reduction in carbon emissions through the implementation of hydrogen fuel blending techniques.

### Renewable energy technologies facilitated by government-funded projects

Singapore has also been promoting clean energy technologies. In 2016, Singapore's National Water Agency, Public Utility Board, in collaboration with the Economic Development Board, initiated a pilot project at Tengeh Reservoir involving a one-megawatt-peak (1 MWp) floating solar photovoltaic (PV) array (Dörenkämper et al., 2021). Another example is the advancements in energy storage technologies, which have been crucial in making renewable energy sources more reliable and able to meet fluctuating system demands. In October 2020, Singapore deployed its first large-scale Energy Storage System (ESS) through a collaboration between EMA and Singapore Power Group (SP Group). This ESS provides a capacity of 2.4 megawatts, sufficient to provide energy for over 200 four-room Housing & Development Board (HDB) households daily (EMA, 2020).

### Tax incentives for electric vehicle adoption

The Ministry of Transport established an Electric Vehicle (EV) Early Adoption

Incentive (EEAI) capped at \$20,000 to encourage the early adoption of EVs. This entails a 45 percent reduction in the Additional Registration Fee for owners registering fully electric vehicles from January 2021 to December 2023 (Ministry of Transport, 2020). To date, over 8,000 EVs including taxis have received rebates from this initiative. The Land Transport Authority (LTA) and NEA have jointly announced that early EV adoption will be extended to 2025 with a lower rebate from 2024 (LTA, 2023). Similarly, on a global scale, electric vehicle sales grew by 10 times (Figure 6) from 2017 to 2022, reaching a record high of more than 10 million.

### Partnerships and collaborations

Climate finance fortifies regional cooperation and partnerships for grid interconnection infrastructure developments. It supplies the vital financial resources needed for joint projects among member countries, enabling collective investment in cross-border energy networks. These networks facilitate the exchange and optimization of renewable energy resources across borders. In addition, climate finance spurs private sector involvement by mitigating investment risks and offering incentives for companies to participate in infrastructure projects. This drives innovation, facilitates

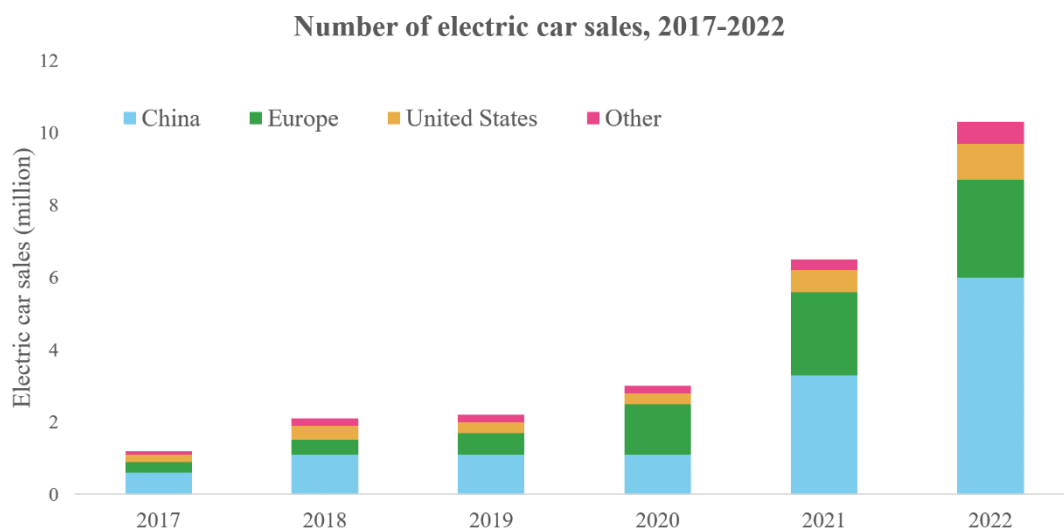


Figure 6. Number of electric car sales, 2017-2022. Built using data from IEA (2023b).

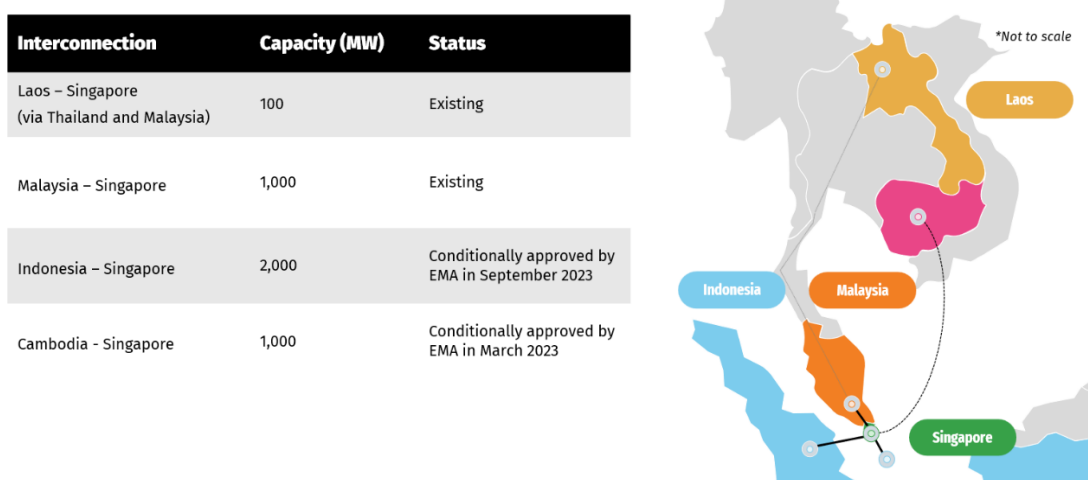


Figure 7. Singapore’s existing and planned grid interconnections. Built using information from EMA (2022a, 2023a, 2023b).

technology transfer, and attracts expertise, enhancing the efficiency and effectiveness of interconnection infrastructure development. Currently, the total capacity of ASEAN’s exiting interconnection projects accounts for 7,720 MW in 2020 (ASEAN Centre for Energy, 2021). This number will be doubled or even tripled to 18,369 to 21,769 MW in the foreseeable future (ASEAN Centre for Energy, 2022).

For Singapore, natural gas currently makes up about 95% of the country’s electricity demand (Chen, 2020). Due to the lack of natural resources, Singapore’s transition towards a net zero power sector requires access to renewable energy sources from other countries. Although there are several existing and planned interconnection projects linked to Singapore (Figure 7), more opportunities need to be explored to ensure a resilient power grid to achieve net zero emissions. In alignment with this objective, the EMA has initiated a request

for proposal aimed at procuring up to 4GW of low-carbon electricity imports by the year 2035 (EMA, 2022b).

This not only showcases Singapore’s dedication to sustainable energy solutions but also emphasizes the need for a cooperative approach to achieve ambitious climate goals. The procurement process requires engagement with various stakeholders, including global renewable energy providers, local utilities, regulators, and financial institutions. Through this initiative, Singapore will be able to gain access to cutting-edge technologies and expertise and also create a platform for knowledge exchange and capacity building. Here, climate finance is urgently required as a strong incentive for Singapore’s local electricity importers and foreign electricity providers. Financial tools like green bonds and investment funds offer avenues for these businesses and investors to support regional interconnection projects.

Furthermore, Singapore can draw valuable insights from existing long-distance electricity interconnection projects around the world (Table 1). Learning from successful models in regions like Europe, North America, China, and India, Singapore can adopt best practices in regulatory frameworks, technical standards, and collaborative approaches. Emulating the strategies that have proven effective in maximizing the efficiency and reliability of cross-border energy networks will be crucial in achieving its net zero emissions goals.

### Technological advancement enhances climate finance growth and innovations

In earlier sections, we discussed the potential of climate finance to stimulate technological innovations. In return, technological advancement also

Table 1. Examples of existing Long-distance Interconnection Projects in other countries.

Interconnection	Capacity (MW)	Distance (km)	Reference
Suldal, Norway – Northumberland, UK	1,400	748	(Zakeri et al., 2018)
Lincolnshire, UK – Jutland, Denmark	1,400	765	(Viking Link, 2023)
Quebec, Canada – New England, USA	2,000	1,480	(Imdadullah, Alamri, Hossain, & Asghar, 2021)
Nuozhadu, China – Guangdong, China	5,850	1,451	(Hennig, Wang, Magee, & He, 2016; Xue et al., 2009)
Xiluodu, China – Guangdong, China	6,400	1,251	(Shao, Lu, Lu, Zou, & Liu, 2011)
Biswanath, India – Agra, India	6,000	1,728	(Oni, Mbangula, & Davidson, 2016)

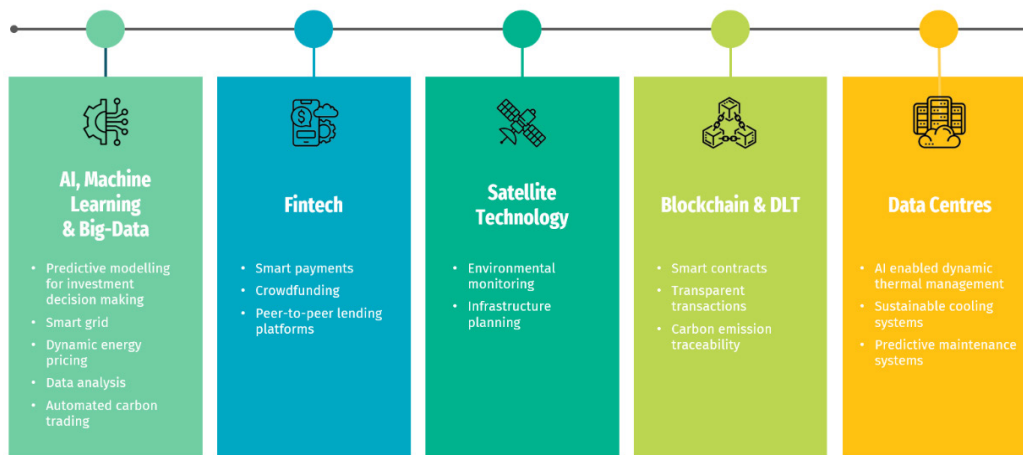


Figure 8. Examples of technologies that enhance climate finance growth and innovations.

contributes to the growth of climate finance. In this section, we discuss several emerging innovations (Figure 8) that optimize allocation of resources, improve transparency and accountability, and open up novel avenues for investments in climate-related initiatives.

### Blockchain and Distributed Ledger Technology (DLT)

Blockchain is an immutable digital ledger that operates in a decentralized manner, recording transactions across numerous computers (Natarajan, Krause, & Gradstein, 2017). In the context of Climate Finance, it has the potential to establish trustworthy and secure frameworks for monitoring carbon credits, guaranteeing accurate recording of emissions reductions. Additionally, it enables peer-to-peer energy exchange, enabling direct trading of renewable energy between individuals and businesses.

### Artificial Intelligence (AI) and Machine Learning

AI involves learning from data to execute tasks that conventionally demand human intelligence through learning from data. Machine learning, a subset of AI, centers on algorithms assimilating data to render predictions or decisions. When applied to climate risk assessment, AI and machine learning enhance investment

decision-making by offering deeper insights. They excel at scrutinizing extensive datasets to pinpoint trends, evaluate climate-related threats to assets, and streamline resource allocation for projects related to climate change.

### Fintech

Fintech covers various financial technologies, such as digital payment systems, mobile banking, and peer-to-peer lending. These solutions within the realm of fintech have the potential to enhance the accessibility and efficiency of climate finance transactions. They simplify the issuance of green bonds, enable crowdfunding for sustainable initiatives, and streamline the allocation of climate-related subsidies and incentives.

### Energy-as-a-Service

The energy sector is experiencing a profound transformation towards Energy-as-a-Service (EaaS), a community-driven model (Hall et al., 2021). Unlike traditional centralized generation, EaaS manages a customer’s energy assets comprehensively, creating smart energy communities for efficient market integration (Figure 9). This shift offers benefits for both customers and the deployment of low-carbon technologies. In response to the climate crisis, energy providers are seeking innovative ways to supply clean power in modern, connected cities. EaaS presents a strategic opportunity for these companies.

Several scenarios could unfold: established firms may resist change, using policy and regulation to impede progress; consumers may increasingly turn to localized energy solutions, causing inefficiencies in the wider system; new players like industrial conglomerates, tech giants, and oil & gas majors could disrupt the value chain. Early collaboration and partnerships will be crucial for companies venturing into EaaS. As providers gain experience, horizontal and vertical integration may occur through mergers and acquisitions. This transformation holds promise for a more sustainable and efficient future in the energy sector.

### Data Centers

Singapore currently boasts the second-largest data center market in the Asia-Pacific region. It houses 81 facilities with approximately 900 MW of operational capacity, with an additional 200 MW either in the planning stages or actively under construction (Baxtel, 2023). As the demand for climate-related information grows, data centers become essential hubs for aggregating, storing, and disseminating Environmental, Social, and Governance (ESG) data. Their high computing power and analytics capabilities enable the development of advanced climate models and risk assessments. Moreover, data centers facilitate real-time monitoring of environmental metrics, allowing for more accurate and timely decision-making in

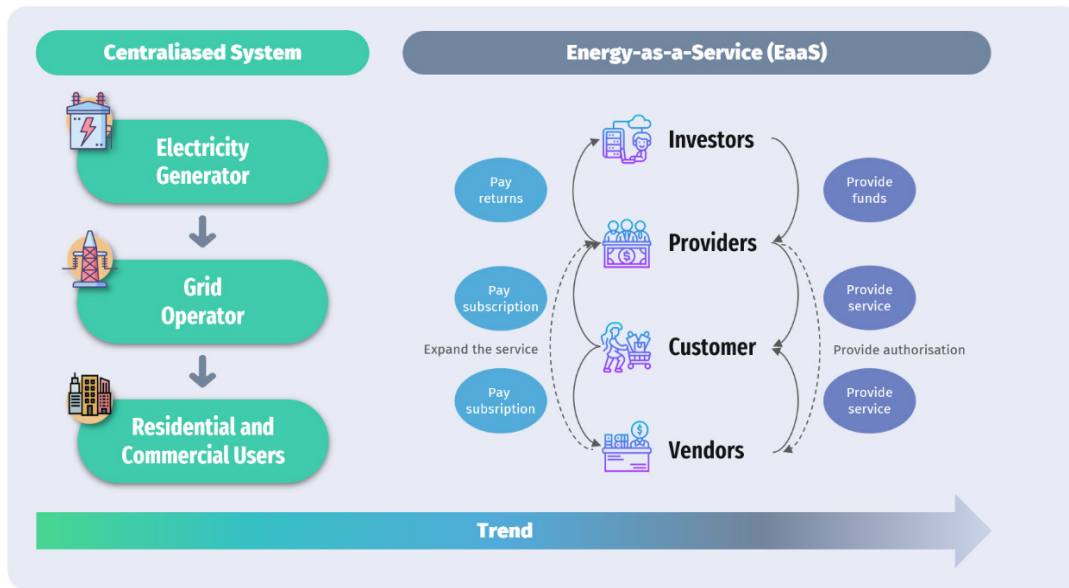


Figure 9. Centralised System and Energy-as-a-Service. Built using information from (Deloitte, 2023)

climate finance investments. Additionally, they support the validation and verification processes crucial for carbon trading and emissions reduction projects. By harnessing the capabilities of data centers, stakeholders in climate finance can make more informed and impactful investment choices, ultimately driving progress towards a more sustainable and resilient future.

However, studies have found that data centers in Singapore account for approximately 7% of the total electricity consumption (IMDA, 2016; Kandasamy, Ho, Liu, Wong, & Toh, 2022). Due to the energy-intensive nature of the development and operation of digital technologies and infrastructure, operators should prioritize sustainability and social responsibilities and undertake sustainable management measures (Figure 10). Balancing the

benefits with responsible energy practices is essential in maximizing data centers' positive impact on climate finance.

### Challenges and Recommendations

In earlier sections, we discussed the concerning potential for greenwashing within climate finance, emphasizing the need for transparency and accountability in fund allocation for genuine climate change

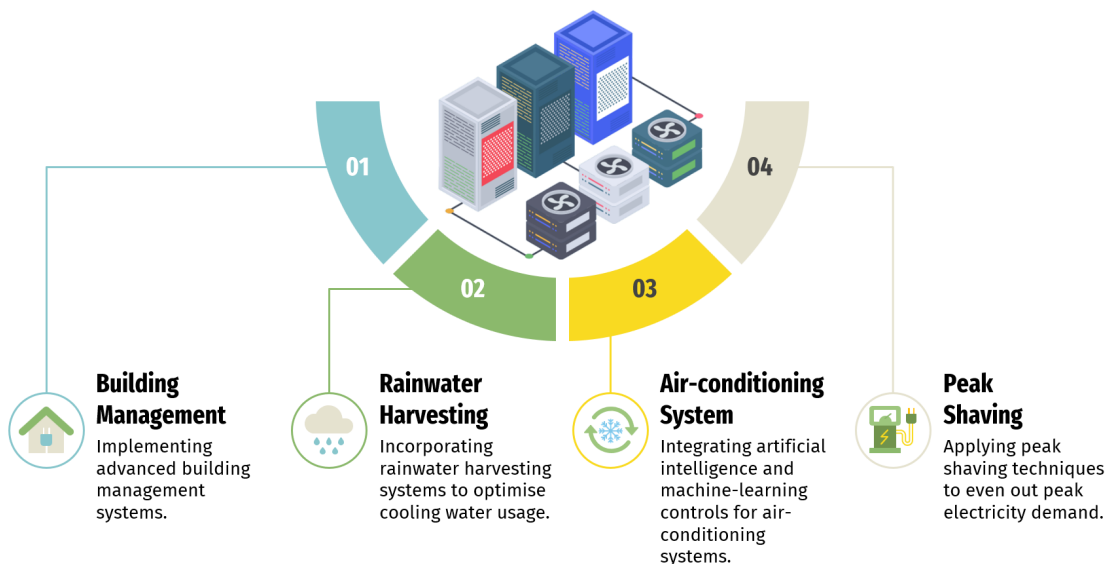


Figure 10. Examples of sustainable management measures for data centres.

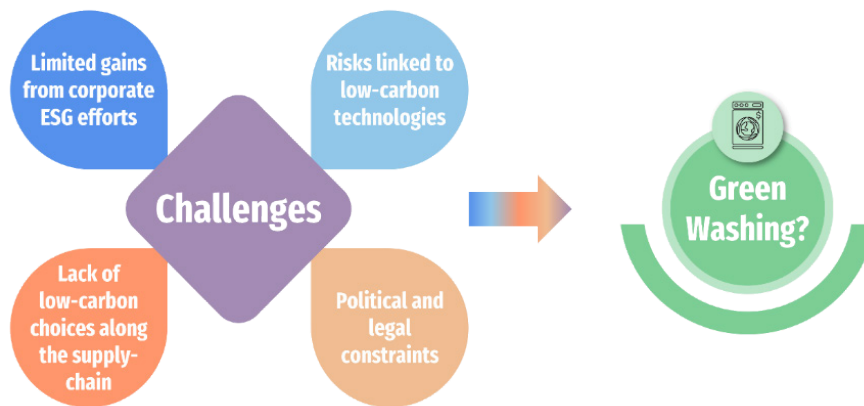


Figure 11. Challenges associated with applying climate finance.

mitigation. Effectively applying climate finance to drive technological innovations faces various hurdles as shown in Figure 11.

Firstly, there is limited, intangible gains from corporate ESG efforts, alongside apprehensions regarding risks linked to low-carbon technologies (Bhandary et al., 2021). The discrepancy between the extended payoff periods of climate projects and the short-term focus of most private investors presents another critical challenge. The scarcity of reliable data further compounds the problem, obstructing the thorough evaluation of climate-related projects. Secondly, there is a shortage of feasible low-carbon, adaptation, and resilience initiatives and sources along the supply chain. For instance, food

industry leaders like McDonald's struggles to meet its net zero pledges - the company's emissions in 2021 exceeded its 2015 baseline by 12% (McDonald's Corporation, 2023). Beyond financial and technological constraints, political and legal obstacles can also impede private investments (Chawla & Ghosh, 2019).

These barriers are especially pronounced in the absence of effective policy coordination and could lead to greenwashing. To facilitate true improvements and progress, technology-driven self-help tools could be considered to assess greenwashing objectively. Blockchain technology, for instance, provides a transparent and immutable ledger for tracking and verifying sustainability-related information. Artificial intelligence, particularly in natural language

processing, enables algorithms to analyze textual and numerical data, uncovering discrepancies in sustainability reporting. Additionally, IoT and sensor technologies facilitate real-time monitoring of environmental performance metrics, providing an objective basis for evaluating claims. By leveraging these technologies, we can objectively assess greenwashing practices, fostering genuine progress in climate finance towards achieving global climate goals. Addressing these multifaceted challenges necessitates a concerted effort from both public and private sectors, involving the development of clear incentives, enhanced data availability, and strategic policy coordination to facilitate the flow of private capital towards

### Climate Finance

Provides funding for development and transitions in sustainable technologies.

### Technology Innovation

Enhances climate finance by making green projects economically viable, traceable, transparent, and attractive to investors.

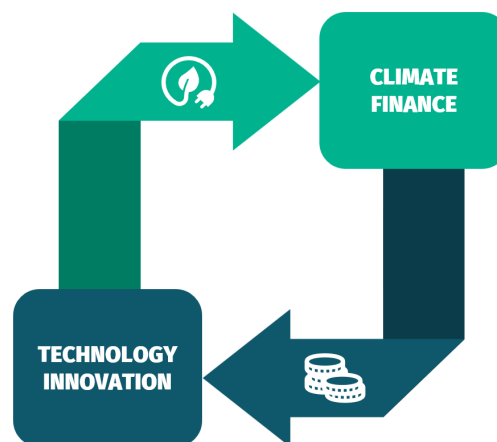


Figure 12. The symbiotic relationship between climate finance and technological innovation.

climate change mitigation and adaptation endeavours.

## Conclusion

In the face of escalating climate change impacts, there is a need to understand the nexus between climate finance and energy transition technologies. This article has assessed the role of climate finance in fostering technological advancements. Through a focused case study of Singapore's, we underscore the criticality of climate finance in steering the nation towards resilient and sustainable energy solutions.

The symbiotic relationship between climate finance and technological innovation is evident in their benefits. Climate finance provides funding for research and development in sustainable technologies, empowering advancements in renewable energy, carbon capture, and energy-efficient solutions. In return, these innovations enhance climate finance by making clean energy projects economically viable, transparent, and attractive to investors (Figure 12). It is crucial to bridge the gap between short-term investor outlooks and the long-term payoff timelines of climate projects to successfully navigate the shift toward a sustainable, decarbonised energy future.

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# TECH-BASED ENTREPRENEURSHIP: DRIVING THE GREEN TRANSFORMATION IN ASEAN

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### Abstract

The Association of Southeast Asian Nations (ASEAN) is at a critical juncture in its development: one of the most pressing issues is the imperative for a comprehensive and sustainable green transformation. An essential driving force behind the advancement of the circular economy and the green transformation in ASEAN is technological innovation, through the creations of green-tech startups and new ventures that create and operate environmentally sustainable business models and whose contribution combines social and economic development. Several promising examples are emerging across ASEAN. While creating opportunity for new green businesses is important, it is also necessary to enhance the building blocks of vibrant innovation and tech ecosystems for the green transformation, especially skills development and the removal of barriers to entry for under-represented groups, such as women green entrepreneurs, who lack equal access to STEM and technology jobs.

## 1. Why the Green Transformation Matters for ASEAN

The Association of Southeast Asian Nations (ASEAN) is at a critical juncture in its development, facing a unique set of challenges and opportunities in the 21st century. One of the most pressing issues that this diverse and dynamic region confronts is the imperative for a comprehensive and sustainable green transformation. ASEAN spans an area of immense ecological diversity and significance, comprising tropical rainforests, vital marine ecosystems, and abundant natural resources. These natural assets have not only shaped the region's unique biodiversity but also provided the foundation for its economic development. Agriculture, fisheries, and forestry are critical sectors, providing livelihoods for millions.

In recent decades, the region has experienced remarkable economic growth, lifting millions out of poverty and positioning itself as a global economic powerhouse (ASEAN Secretariat, 2021a; Kimura et al., 2019; Tonby, Choi, et al, 2019). Yet, this growth has come at a cost to the environment. Dependence on resource-intensive industries such as agriculture, mining, and manufacturing has put pressure on natural resources and ecosystems. ASEAN's rapid industrialization, urbanization, and increasing consumption have strained its ecosystems, heightened pollution levels, and exacerbated climate change impacts. If climate change is not addressed, it could result in a decrease of regional GDP by 11% by the year 2100, as well as the potential displacement of 87 million individuals residing in flood-prone areas in Indonesia, Malaysia, Myanmar, Thailand, and Vietnam (ASEAN Secretariat, 2019). In addition,

some of the major cities of ASEAN need to improve their environmental performance: for example, Jakarta, has topped the list as the world's most polluted city in August 2023, having consistently ranked among the 10 most polluted cities globally since May 2023, according to data by Swiss air quality technology company, IQAir. With a population of over 10 million, Jakarta's consistently high pollution levels pose a significant public health risk and highlight the urgent need for comprehensive measures to address air quality issues, as well as initiatives like the Nusantara Project to create a more sustainable and healthier urban environment for its citizens (Xu and Nadiman, 2022).

### Regional Efforts towards a greener ASEAN and its challenges

Recognizing the urgency of these challenges, ASEAN has been steadily evolving its green policies and sustainability initiatives, striving to harmonize economic development with environmental preservation. In the past years, ASEAN has made progress to address challenges of climate change, for example via the development of an ASEAN Circular Economy Framework in 2021 (ASEAN Secretariat, 2021b). This strategy delineates five interconnected focal areas, which encompass the harmonization of standards and the mutual recognition of circular products and services, the facilitation of open trade for circular goods and services, the enhancement of green innovation, a focus on sustainable finance and investments guided by ESG (environmental, social, and governance) criteria, and the optimization of energy utilization. This strategy also explicitly acknowledges the role of technological innovation as a key driver of the green transformation, in particular through its strategic priority No 3 "Enhanced Role of Innovation, Digitalization and Emerging Technologies".

Many regional examples of these technological innovations are currently being developed. Developments in biodegradable materials, renewable energy sources and waste management solutions are simplifying the transition for businesses towards eco-friendly practices (Anbumozhi, Ramanathan et al., 2020). Some examples include the creation of biodegradable plastics using advanced biotechnology and materials science to transition from plastic to bioplastics and the use of Artificial Intelligence (AI) to automate waste sorting processes, increasing efficiency and reducing contamination in recycling streams. The rise of electric vehicles (EVs) is also gradually gaining momentum, with the ASEAN region poised to become a hub for both EV manufacturing and a significant consumer market (Schröder, Fusanori, et al., 2021). Technological advancements have enabled the production of more affordable and efficient EVs. For instance, in 2020, Thailand produced over 2,000 electric vehicles, a significant increase from previous years, and the number of EVs sold in the country has been steadily growing. To support the adoption of EVs, Thailand has invested in expanding its EV charging infrastructure. As of 2021, there were over 1,300 EV charging stations across the country, making it easier for EV owners to charge their vehicles conveniently (Thananusak et al., 2020).

Nevertheless, ASEAN still confronts a multitude of challenges to accelerate the green transformation. For instance, the region experiences high costs for renewable energy technology and needs up to US\$ 987 billion to achieve the short-term energy transition target in 2030 to achieve a net zero scenario in 2050 (IRENA & ACE, 2022). These high costs can be an important barrier to adoption, therefore innovations to accelerate investments in renewable power and upgrade e infrastructure, such as electricity networks and battery storage, is critical.

Other challenges towards green innovation and entrepreneurship are related to uneven access and connectivity. While urban areas often enjoy robust

connectivity, rural regions may lack adequate infrastructure. This digital divide hinders access to online education, market information, and networking opportunities for aspiring green entrepreneurs (Ajmane Marsan, 2022). ASEAN must continue to expand its investments in skills development, with a particular focus on rural and peripheral areas where skills are most lacking. Creating incubation and mentorship programs is essential for nurturing green entrepreneurship, which can be led by universities and government agencies and enterprises.

During the recent ASEAN Summit in September 2023, ASEAN leaders recognized the urgent need to strike a balance between economic growth and sustainable use of natural resources and protection of the environment. Making the most of this balance, in particular by making sure that the digital and green transformation reinforce and complement one another, is the challenge that ASEAN is confronted with. Especially as the digital economy of the region is growing at a very fast pace (according to some estimates, the digital economy could even account for 1 trillion USD by 2030 (Google et al 2021) and is progressing towards more integration in the digital space, for example through the initial negotiations of ASEAN Digital Economy Framework Agreement (DEFA) (Sefrina, 2023). In the journey towards this double transition, not only ASEAN governments but also ASEAN businesses have a major role to play.

## 2. The Importance of ASEAN Tech based entrepreneurs and consumers for the Green Transformation

The green transformation requires collective efforts by governments, citizens, and the business sector alike. Within business sector actors, tech-based green entrepreneurs have a pivotal role to play. Tech based green entrepreneurs are entrepreneurs who develop tech-based business models to develop greener products and services for ASEAN consumers (Ajmane

Marsan, Sabrina & Ooi, 2021). They create and operate environmentally sustainable businesses whose contribution combines social and economic development. By creating jobs and promoting sustainable practices, green entrepreneurs allow a long-term impact for both local society and economic growth (Ajmane Marsan and Singh, 2023).

One important (but often overlooked) driver of the shift toward sustainability in ASEAN arises from the increasing awareness of environmental concerns among both consumers and enterprises. Millennials and Generation Z are emerging as increasingly significant consumer demographics within the ASEAN region and are projected to account for roughly 75% of the total consumers by 2030 (WEF, 2023). These younger and tech-savvy demographics are starting to acknowledge the enduring economic advantages associated with embracing sustainable practices, while at the same time being comfortable with digital technologies, and therefore driving the growing demand for products that are sourced and manufactured sustainably.

## 3. Investment opportunities are growing for ASEAN green tech startups

According to the ASEAN Investment Report 2022, the number of start-ups in ASEAN that have raised more than \$1 million in funding almost tripled between 2015 and 2021. Three ASEAN Member States combined (Singapore, Indonesia and Malaysia) account for 83 per cent of start-ups that have raised more than \$1 million in funding in the region. However, other ASEAN Member States are also witnessing fast growth (Viet Nam, Philippines and Thailand especially).

Investors have started to recognize opportunities emerging in the green tech space, with more than \$1 billion in capital invested in green technology companies by 2020 (ASEAN Investment Report, 2022). Investments in the renewable energy sector witnessed the largest increase in

investments. This sector together with the construction industry accounted for 75% of international project finance activities in 2021. EV is another area that witnessed one of the fastest growth in investments.

Despite this growth, there is still significant room for more investments in green tech startups across ASEAN, with sectors like forest conservation still relatively under-invested but growing especially in Indonesia and Malaysia (Bain and Temasek 2022). Another example of the remaining growth potential of investments in green tech startups is given by the fact that of the 100 most funded startups in ASEAN, only 3% were active in the clean energy sector for example (ASEAN Investment Report 2022).

Moreover, according to a recent report by the Asian Development Bank (ADB 2022), a capital investment of 172 billion USD in the green transformation in Southeast Asia, could generate up to 30 million jobs and significantly contribute to achieve SDGs targets. In particular, the study identifies five areas that are particularly promising: i) clean energy transition; ii) circular economy models; iii) healthy and productive oceans; iv) sustainable urban development and transport models and v) productive and regenerative agriculture.

Another sector that is particularly promising is smart farming and agrotech, which is seen as an effective way to raise production and increase efficiencies in less developed rural areas (Statistica, 2022; Litan and Singh, 2022). For instance, in Vietnam, the startup known as Mimosatek has harnessed the power of technology to address crucial agricultural challenges. Through the implementation of a cloud-enabled device equipped with sensors, this innovative startup has provided farmers with a transformative tool to monitor the growth of their crops and receive real-time alerts about drought conditions. Following a successful pilot program, Mimosatek's technology is now poised for broader implementation throughout the Mekong Delta, a region of significant agricultural importance in Vietnam. This expansion promises to empower more

farmers, enhance agricultural productivity, and mitigate the risks associated with drought, ultimately contributing to food security and economic stability (ASEAN Investment Report, 2023).

#### 4. Interesting tech-startups solutions are emerging in ASEAN

Thanks to the enabling factors described above (from favorable demographic trends to investment flows), numerous promising tech startups are emerging to address a wide range of challenges in climate change and green tech. These startups are not only driving economic growth but also contributing to the region's green transformation, social progress, and digital revolution and contributing to the transition towards an ASEAN knowledge economy. The next sub-section present examples of tech-based green startups from different ASEAN countries, operating across the spectrum of green technology fields: from renewable energies to electric vehicles, smart grid, agri-food tech, and digital tech & plastic-free logistics.

##### 4.1 Innovative Renewable Energy Solutions

One of the foremost areas where technology is catalyzing the green transformation in ASEAN is the energy sector. Startups and entrepreneurs are harnessing cutting-edge technologies to accelerate the adoption of renewable energy sources (G20 Digital Innovation Network, 2022). Solar, wind, and hydropower technologies are being deployed with greater efficiency and cost-effectiveness, significantly reducing the region's reliance on fossil fuels. Advancements in solar panel efficiency, energy storage solutions such as Carbon Capture Utilization and Storage (CCUS), and grid integration technologies are making energy sources more reliable and accessible (Afifi, F., Venkatachalam, et al., 2023). As a result, ASEAN countries are experiencing a notable shift towards sustainable power generation, a critical step in reducing greenhouse gas emissions and mitigating climate change.

##### Xurya Daya (Indonesia)

This Indonesian renewable energy startup is pioneering the method of switching to solar through design, installations, operations and maintenance of rooftop solar power plants with a lease scheme ("zero-down method") that offers more flexibility and affordability for a company looking to move to renewable energy option. It has installed more than 133 solar roof projects in diversified industries in multiple areas of Indonesia.

Source: <https://xurya.com/en/>



##### 4.2 EV adoption

With a growing urban population, the role of these startups in shaping the future of transportation becomes increasingly vital for fostering livable and sustainable cities in ASEAN. In 2023, ASEAN leaders issued a declaration aimed at cultivating a regional EV ecosystem, showcasing their political commitment to developing the region's EV supply chain and positioning it as a global EV manufacturing hub. However, there are several challenges that are still need to be address including higher costs compared to conventional vehicles and charging infrastructure readiness (Nugroho, 2023).

##### Etran (Thailand)

Start-up developer of clean energy electric vehicle provides products including EV motorcycle that for food delivery and power stations across Bangkok, providing more than 1000 motorcycles for rent and ownership since 2021. The company also innovates Thailand's first EV motorcycle design for food delivery.

Source: <https://www.etrangroup.com/en/>



### 4.3 Digital Platforms for Sustainability

Digital platforms and e-commerce are pivotal in promoting sustainable consumer choices. Tech-based entrepreneurship in ASEAN has given rise to online marketplaces and apps that facilitate the discovery and purchase of eco-friendly products. These platforms provide consumers with information about product origins, certifications, and sustainability ratings, empowering them to make green choices. Additionally, influencers and content creators on social media are leveraging their digital presence to advocate for sustainability, further amplifying the impact of tech-based initiatives in promoting eco-conscious consumer behavior (ASEAN Consumer, 2022).

#### Grocerdel (Cambodia)

Cambodia online supermarket that connects local, small farmers for the consumers, and promotes the sustainable agriculture products. Grocerdel offers multiple options of the high-quality agriculture products with delivery service to the costumers. Founded 2019, Grocerdel offers more than 2,000 products through its website and app. The company has made farm-to-fork possible by working with more than 300 farmers across Cambodia and leveraging technology to improve the service offerings as the company grows.

Source: <https://grocerdel.asia/>



### 4.4 Agriculture and Food Technology

In the agricultural sector, technology is driving entrepreneurship focused on sustainable farming practices. Precision agriculture, IoT-enabled farming, and data-driven decision-making are enhancing crop yields while minimizing resource use. Startups are developing innovative agricultural technologies that reduce water consumption, minimize chemical inputs, and promote soil health (Litania and Singh, 2022). Moreover, food technology has been growing in recent years, with ASEAN countries especially Singapore, leading the innovation, research, and development for alternative food consumption and products (Hui, 2022). In 2019, US\$423 million was invested in Southeast Asia's agri-food tech (Ellis, 2020).

#### Urban Tiller (Singapore)

The world's first and only B2B leaf protein company from Singapore, with a mission to accelerate the adoption of plant-based foods by supplying novel ingredient Rubisco (one of the most abundant and sustainable form of protein available in green leaves). By leveraging alternative protein products, Urban Tiller continues to bring innovation and technology to create new sources of value for its partner farms.

Source: <https://urbantiller.sg/home>



### 4.5 Smart Grids and Energy Efficiency

Tech-driven innovation extends to the development of smart grids and energy-efficient solutions. Some of the solutions include smart meters, sensors, and data analytics to optimize energy distribution, reduce transmission losses, and

empower consumers to make informed decisions about their energy consumption. These innovations not only enhance the reliability of the energy supply but also contribute to a more efficient utilization of resources. Smart buildings and eco-friendly urban planning are becoming prevalent, promoting energy conservation and sustainability in rapidly urbanizing ASEAN cities and often are aimed at the rural communities (Kimura et al., 2022)

#### Smart Grid (Indonesia)

Smart Grid technology has been installed in Java-Bali from 2020 (targeting 25 smart grid system by 2024) to increase energy efficiency and better utilization of renewable energy to reduce CO2 emission. The main features of the smart grid include innovative design of floating solar photovoltaic (PV) power plans, combined with the existing hydropower plant.

Source: <https://opengovasia.com/smart-grid-systems-to-power-indonesia/>



## 5. The Way Forward towards Green Tech Entrepreneurship in ASEAN

ASEAN is still at the beginning of its journey towards the green transformation and the transition into a knowledge economy. ASEAN tech-based green startups can provide a major contribution. While promising developments are happening, for entrepreneurs and startups to flourish, grow and scale-up, it is necessary to further develop innovation ecosystems across the region. In particular, two building blocks of green-tech entrepreneurship need particular attention: skills development and inclusive innovation.

## Nurturing Skills and Tech Talent for Green Entrepreneurship

Globally, there is an increasing demand for skills related to the green economy. According to LinkedIn Green Skills Report 2022, the number of green talents in the workforce has increased by more than 38% since 2015, with entrepreneurs driving green skills globally (for instance, every 2 out of 100 entrepreneurs in India are categorized as “highly skilled in green”) (LinkedIn Economic Graph, 2022). Green entrepreneurship combined with technology therefore has emerged as a powerful avenue to support this positive change. However, nurturing, upskilling and re-skilling talents for green entrepreneurship comes with its unique set of challenges and imperatives in ASEAN.

Education and skills development, especially with a focus on creating a talent pool, that is equipped to excel in technology and creativity-driven industries, remain a challenge. The enrolment rate in higher education across the ASEAN region is lower, on average, compared to other countries in the Asia Pacific, and so is the quality of universities and higher education institutions (aside from Singapore) (Ajimone Marsan, 2022). Countries such as Malaysia and Vietnam, have begun to boost their investment in education and are giving significant priority to technology and innovation within higher education. However, worries about graduate employment and skill mismatch, particularly the shortage of STEM graduates, continue to persist (ASEAN Secretariat-SHARE, 2023).

To advance both green entrepreneurship and tech talents, it is essential to ensure access to relevant education and training. Green entrepreneurs need to acquire expertise and proficiencies in sustainable methodologies and technologies, and this can be achieved through specialized educational initiatives or mainstreaming green skills in Technical and Vocational Education Training (TVET). Including green skill components in all training programs and offering specialized green technology courses in addition to the traditional ones,

would enhance graduates’ work opportunities (ASEAN Secretariat-ILO, 2021). For example, these strategies are currently being developed or implemented in Cambodia (through the National Technical Vocational Education and Training Policy 2017-2025) and the Philippines (through the Green Jobs Act 2016). Moreover, under the coordination of ASEAN Ministries of Labor, coordination mechanisms exist to support green jobs development at regional level.<sup>1</sup>

## Inclusive Transition in Green Transformation

The transition to a green economy is not just a technological shift; it is a societal transformation that must be underpinned by inclusivity and equality. Without inclusive strategies, there is a risk of encountering resistance, particularly from groups that fear job loss and worsening economic conditions. Such resistance could place significant pressure on governments to slow down or halt green initiatives altogether (Ajimone Marsan, 2022).

Some groups of individuals face substantial disparities and challenges.

Women, in particular, continue to face barriers to access (Ajimone Marsan and Sey 2021). Firstly, when it comes to entrepreneurship opportunities, women often encounter barriers that limit their entry into the world of business ownership, including those in the green sector. Across ASEAN, according to the Global Entrepreneurship Monitor (GEM) data, in the six countries covered (Philippines, Indonesia, Viet Nam, Thailand, Malaysia and Singapore), women are less likely to have an established business and when going into entrepreneurship are more driven by necessity rather than opportunity when compared to men. The situation remains similar when looking specifically at sectors related to energy and the green transition. For instance, women’s representation on energy company boards in Southeast Asia is below 50%, ranging from 10.7% in Thailand to 29.7% in Vietnam (Han et al., 2022). Access to capital remains a barrier for

women entrepreneurs in ASEAN. According to the latest World Economic Forum ASEAN Survey (WEF 2022)<sup>2</sup>, only 22% of women (compared to 28% of men) receive credit from commercial banks when in need of loans.

Additionally, women have traditionally been underrepresented in STEM fields (Science, Technology, Engineering, and Mathematics), which are pivotal in driving green tech entrepreneurship (Ajimone Marsan and Singh, 2023). This gender gap in STEM skills further exacerbates the challenges women face in pursuing careers in environmentally-focused industries.

Furthermore, women’s access to leadership positions remains limited across the ASEAN region, with men predominantly occupying these roles. This lack of representation not only perpetuates gender disparities but also hinders the diverse perspectives and innovative ideas that women can bring to the green economy (Ajimone Marsan and Sey, 2021).

On the business demographic front, micro, small, and medium-sized enterprises (MSMEs) represent a significant portion of the ASEAN economy. However, these smaller enterprises tend to invest in and adopt digital technology at a considerably lower rate compared to their larger counterparts. This digital divide within the business community can be a significant impediment to women’s participation in the green economy transition (Ajimone Marsan and Ruddy, 2020).

Promoting gender equality within the realm of green entrepreneurship is not just a matter of social justice; it is a strategic imperative. Research consistently indicates that women entrepreneurs often prioritize social and environmental outcomes in their businesses (Ajimone Marsan, Sabrina & Ooi, 2021). Harnessing this orientation toward sustainability can greatly contribute to the success and impact of green ventures. Moreover, governments should actively engage in efforts to dismantle barriers and biases that hinder the

<sup>1</sup> Final-Adopted-ASEAN-Labour-Ministers-Joint-Statement-on-Green-Initiative....pdf

<sup>2</sup> New ASEAN Survey: Digitalization Advances Financial Inclusion for Women and Micro Business Owners but More Is Needed > Press releases | World Economic Forum (weforum.org)

participation of women and other marginalized groups in the green economy. This includes implementing gender-sensitive policies, providing funding and support for women-owned businesses, and actively promoting the representation of women and underrepresented groups in leadership roles within the green sector (Ajmone Marsan and Singh, 2023).

Inclusivity within the green economy must also extend to other underrepresented groups, including ethnic minorities and individuals with disabilities. These groups often face unique challenges in accessing green jobs and entrepreneurial opportunities, and policy measures should be devised to address these disparities. Such policies should create an enabling environment that not only encourages the growth of green jobs and enterprises but also actively promotes inclusivity for underrepresented groups.

## 6. Conclusion

In conclusion, the ASEAN region stands at a pivotal juncture in its pursuit of a comprehensive and sustainable green transformation. This transformation is propelled by the dynamic synergy of technology-driven entrepreneurship, serving as a beacon of hope in addressing the pressing environmental challenges of the 21st century. The adoption of innovative green technologies by startups and entrepreneurs has emerged as a potent catalyst for change, reshaping the economic landscape while promoting sustainable practices. These green entrepreneurs are not only generating jobs but also driving societal and economic development, to place ASEAN on a sustainable path.

As technology-driven startups and entrepreneurs continue to lead the charge towards a greener future, they are forging a transformative alliance with sustainability. Their endeavors are aligning economic growth with environmental preservation, driving progress in areas like renewable energy, circular economy practices, and sustainable agriculture. In this dynamic landscape, education, skills development, and women inclusion remain pivotal imperatives, ensuring that

the benefits of the green transformation are accessible to all segments of society.

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# Tech Events

2023

13–17 Nov  
Johor Bahru,  
Malaysia

**Asia-Pacific Climate Week 2023**  
Website: <https://unfccc.int/APCW2023>

22–23 Nov  
London,  
UK

**Fintech World Forum**  
Place: Kensington Conference and Events Centre  
Website: <https://fintechconferences.com/>  
Phone: +442037735519  
Email: [infor@fintechconferences.com](mailto:infor@fintechconferences.com)

27–29 Nov  
Brooklyn,  
NY

**Fourth ACM International Conference on AI in Finance**  
Place: 4 MetroTech Center, Brooklyn, NY 11201  
Organizer: Association for Computing Machinery (ACM)  
Website: <https://ai-finance.org/>

22–24 Nov  
Brussels

**Global Credit Risk Management in Banking & Financial Market**  
Place: Radisson Collection Hotel, Grand Place  
Email: [loyee@arema-intl.com](mailto:loyee@arema-intl.com)  
<https://creditriskevents.arema-intl.com/>

13–17 Nov  
Frankfurter

**26th Euro Finance Week**  
Place: Steigenberger Icon Frankfurter Hof  
Organizer: Euro Finance Group  
Email: [andreas.scholz@dfv.de](mailto:andreas.scholz@dfv.de)  
Website: <https://www.dfv-eurofinance.com/events/euro-finance-week-2023/>

20 Nov–12 Dec  
Dubai,  
UAE

**UN Climate Change Conference**  
Place: United Arab Emirates 2023  
Organizer: UNFCCC  
Website: [UN Climate Change Conference - United Arab Emirates Nov/Dec 2023 | UNFCCC](https://unclimatechangeconference.org/)

01–04 Dec  
Shenyang,  
China

**5th International Conference on Smart Power & Internet Energy Systems**  
Website: <http://www.icspies.org/>

04–05 Dec  
Dubai,  
UAE

**Sustainable Innovation Forum**  
Place: Madinat Jumeirah Conference Centre  
Organizer: Climate Action, UK  
Website: [Sustainable Innovation Forum 2023 | COP28 \(climateaction.org\)](https://www.sustainableinnovationforum.org/)

07–09 Dec  
Lisbon,  
Portugal

**4th International Conference on Advances in Energy Research and Applications (ICAERA 2023)**  
Website: <https://icaera.com/>  
Phone: +1-613-834-9999  
Email: [info@\[icaera.com](mailto:info@[icaera.com)

16–17 Dec  
Florida,  
USA

**World Finance Banking Symposium**  
Place: Florida International University  
Organizer: Florida International University  
Website: <https://www.world-finance-conference.com/conference.php?id=24>

2024

29 Jan–02 Feb  
Abu Dhabi,  
UAE

**World Environmental Education Congress (WEEC) 2024**  
Place: Abu Dhabi National Exhibition Centre (ADNEC), United Arab Emirates  
Website: <https://www.weec2024.org/en/>  
Phone: +3901 1 436 6522  
Email: [secretariat@weecnetwork.org](mailto:secretariat@weecnetwork.org)

08–09 Feb  
Colombo,  
Sri Lanka

**The 8th International Conference on Climate Change 2024**  
Organizer: The International Institute of Knowledge Management

Phone: +94 117 992 022  
Fax: +94 112 835 571  
Email: [isanka.gamage@tiikmedu.com](mailto:isanka.gamage@tiikmedu.com)  
Website: <https://climatechangeconferences.com/>

20–23 Feb  
Bangkok,  
Thailand

**Asia Pacific Forum on Sustainable Development 2024**  
Place: United Nations Convention Centre, Bangkok Thailand  
Organizer: Economic and Social Commission for Asia and the Pacific  
Contact: [escap-apfsd@un.org](mailto:escap-apfsd@un.org)  
Website: <https://www.unescap.org/events/apfsd11>

25–27 Feb  
Nha Trang,  
Vietnam

**10th International Conference on Environment and Renewable Energy**  
Website: <http://www.icere.org/>  
Conference Secretary- Ms. Alice Lin  
Email: [icere@ieet.ac.cn](mailto:icere@ieet.ac.cn)  
Tel: +86-18117801445

27–29 Feb  
London,  
UK

**International Energy Week**  
Place: Intercontinental London Lane  
Organizer: Energy Institute  
Website: <https://www.ieweek.co.uk/>  
Email: [ieweek@energyinst.org](mailto:ieweek@energyinst.org)

27 Feb–01 Mar  
Moscow,  
Russia

**Climate World 2024**  
Place: Expocentre Moscow, Russian Federation  
Website: <https://www.climate-expo.com/>  
Phone: +43 1 230 85 35  
Fax: +43 1 230 85 35 - 50  
Email: [office@euroexpo-vienna.com](mailto:office@euroexpo-vienna.com)

26–28 April  
Madrid,  
Spain

**4th World Conference on Climate Change and Global Warming**  
Organizer: Universidad Complutense de Madrid Facultad de Bellas Artes  
Website: <https://www.ccgconf.org/registration/>

16–18 April  
Abu Dhabi

**World Future Energy Summit**  
Organizer: Relx  
Website: <https://www.worldfutureenergysummit.com/>

15–17 May  
Bangkok,  
Thailand

**Future Energy Asia: Exhibition and Summit**  
Place: Queen Sirikit National Convention Center  
Email: [info@futureenergyasia.com](mailto:info@futureenergyasia.com)  
Website: <https://www.futureenergyasia.com/conference/call-for-papers/>

10–12 June  
Sarwak,  
Borneo

**Asia Pacific Hydrogen Summit**  
Website: <https://hydrogenapac.com/>  
Venue: Borneo Convention Centre Kuching, Sarawak  
+608-2555189

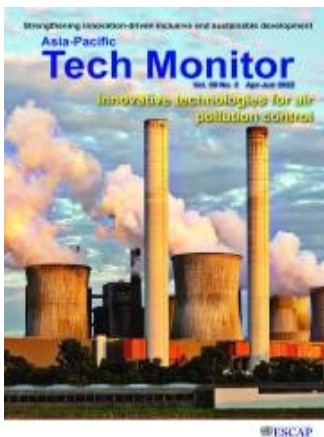
26–28 June  
Turin,  
Italy

**SPE Europe Energy Conference**  
Organizer: Society for Petroleum Engineers  
Website: <https://www.spe-events.org/europeenergyconference>

03–05 July  
Bangkok,  
Thailand

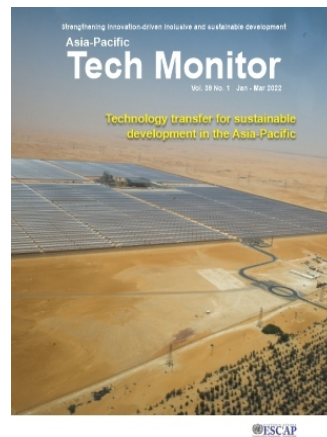
**Asean Sustainable Energy week, 2024**  
Organizer: Informa Markets  
Contact: 428 Ari Hills Building 18th Floor, Phaholyothin Road, Samsennai, Phayathai, Bangkok 10400, Thailand  
+66 2036 0500, +66 2036 0588, +66 2036 0599  
Email: [asew-th@informa.com](mailto:asew-th@informa.com)  
Website: [https://www.asew-expo.com/2024/en/why\\_visit.asp#:~:text=The%20show%20will%20be%20held,the%20center%20of%20Bangkok%2C%20Thailand](https://www.asew-expo.com/2024/en/why_visit.asp#:~:text=The%20show%20will%20be%20held,the%20center%20of%20Bangkok%2C%20Thailand)





Apr-Jun 2022

**Innovative technologies for air pollution control**



Jan-Mar 2022

**Technology transfer for sustainable development in the Asia-Pacific**



Jan-Mar 2023

**Technologies for decarbonizing transport systems**



Apr-Jun 2023

**Innovative technologies for disaster risk reduction**

The *Asia-Pacific Tech Monitor* has been the flagship periodical of APCTT since 1993. It is an online quarterly periodical featuring theme-based articles that provide trends in technology transfer and development, innovation and technology policies, market, data and analysis with respect to relevant issues, case studies, good practices and innovative technologies. Each issue of Tech Monitor focuses on a special theme and the articles are written by authors/experts of national and international repute. The periodical aims to enhance the technology intelligence of relevant stakeholders from member States of ESCAP to meet the challenges of today's dynamic business and technological setting.

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