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Climate, Energy and Sustainability in ASEAN–India Relations: Shared Challenges, Divergent Capacities and a Framework for Deeper Cooperation

Anbumozhi Venkatachalam

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Anbumozhi Venkatachalam*

Abstract: This paper examines the evolving ASEAN-India partnership on environment, climate change, and energy transition within the Indo-Pacific's broader regional governance landscape. It argues that despite marked disparities in economic development, institutional maturity, and national energy portfolios, ASEAN and India demonstrate growing structural convergence in resource governance paradigms, net-zero pathways, and climate mitigation strategies. However, functional engagement remains constrained by institutional fragmentation, absent dedicated climate financing vehicles, and underdeveloped market linkages. Drawing on new regionalism and functional spillover theories, the chapter identifies five core propositions: policy convergence, transition drivers, institutional gaps, regional market potential, and geopolitical context. It proposes an ASEAN-India Green Partnership Framework built on five mutually reinforcing pillars—regulatory convergence, regional green finance, carbon market integration, innovation ecosystems, and knowledge cooperation—to accelerate low-carbon, climate-resilient development across the Indo-Pacific.

1. Introduction

The Indo-Pacific region stands at a critical juncture in global environmental governance. As rapid industrialization, demographic growth, and urbanization accelerate across South and Southeast Asia, the imperative to decouple economic expansion from environmental degradation has become paramount. ASEAN member states and India represent two of the world's most dynamic regional economies, yet both are exceptionally vulnerable to climate-induced disruptions.

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Shaping new ASEAN–India environmental cooperation requires understanding it within broader theories of regional integration and international political economy. Traditional theories of regional economic or development cooperation emphasized trade liberalization and economic integration as primary drivers of cooperation. However, contemporary scholarship on "new regionalism" argues that regional institutions increasingly address multidimensional challenges—including climate change, environmental protection, public health, digital governance, and energy security—that transcend national boundaries (Börzel and Risse, 2016).

From this perspective, environmental governance for regional economic resilience constitutes public good. Public goods are characterized by non-excludability and non-rivalry; their benefits extend across national borders and cannot be confined to individual countries. Climate stability, biodiversity conservation, transboundary pollution control, disaster risk reduction, and regional energy security all exhibit these characteristics. Individual countries often underinvest in such goods because benefits are widely shared while costs are borne domestically, creating collective action problems.

Several past studies (ADB 2014, ERIA 2020, RIS 2023) further suggest that regional organizations reduce transaction costs associated with collective action. Through common rules, information sharing, regulatory harmonization, and dispute resolution mechanisms, institutions facilitate cooperation that would otherwise be prohibitively costly. ASEAN itself has historically performed this coordinating role in areas such as trade, disaster management, and economic integration. However, environmental cooperation remains comparatively weak because institutional arrangements have not evolved at the same pace as economic integration (Anbumozhi et al., 2022).

The concept of functional spillover, first developed in neo-functionalist theories of European integration, offers another useful analytical lens. It suggests that cooperation in one policy area creates

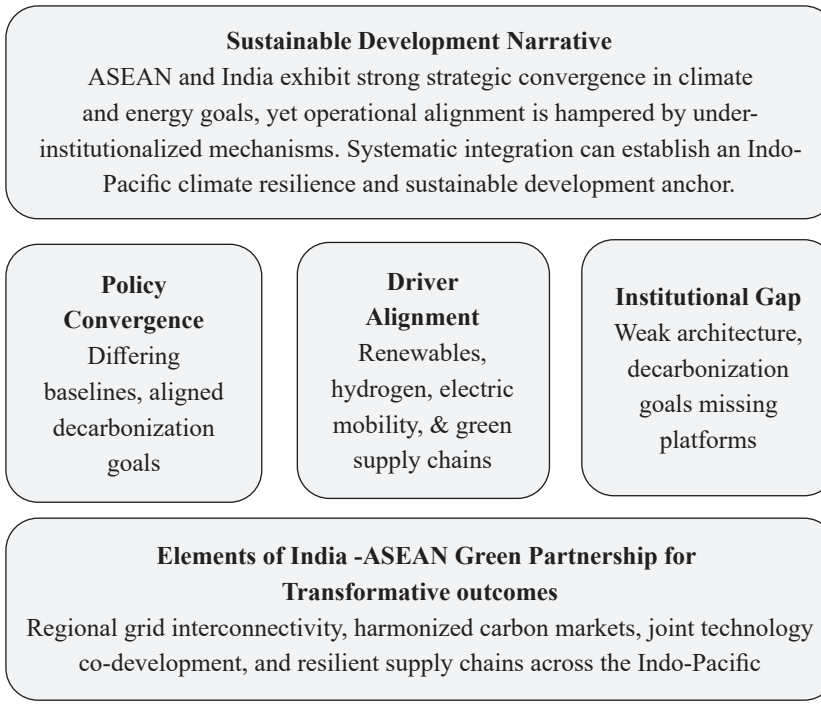
pressure for cooperation in related sectors. In ASEAN–India relations, expanding trade, investment, and industrial integration will generate stronger demand for cooperation on energy infrastructure, environmental standards, carbon accounting, digital governance, and sustainable finance. For example, renewable energy supply chains cannot operate efficiently without harmonized technical standards, interoperable electricity markets, common investment rules, and coordinated innovation policies.

At the same time, several institutionalist scholars caution that Asia differs fundamentally from Europe in its approach to regional governance (Markendaya, 2023). ASEAN's consensus-based decision-making, often described as the "ASEAN Way", prioritizes national sovereignty, non-interference, and flexible cooperation over legally binding supranational institutions. While this approach has contributed to regional stability, it also limits the development of enforceable environmental governance mechanisms. Consequently, ASEAN–India cooperation must reconcile increasing functional interdependence with enduring political preferences for decentralized governance.

This paper evaluates the fundamental hypothesis of regional cooperation and alignment that despite marked disparities in economic development, institutional maturity, and national energy portfolios, ASEAN and India demonstrate a growing structural convergence in their resource governance paradigms, net-zero pathways, and climate mitigation strategies. However, their functional engagement remains constrained by institutional fragmentation, absent dedicated climate financing vehicles, and under-developed market linkages which becomes an imperative for strengthening India-ASEAN green partnership.

Figure 1 illustrates the core analytical hypothesis. ASEAN and India show strong strategic convergence in sustainable development goals, climate risk mitigation, and the acceleration of low-carbon energy transitions, but operational alignment remains constrained by under-institutionalized mechanisms.

Figure 1. Core Analytical Proposition for India-ASEAN Cooperation Framework for Sustainable Development



Source: Author's own

To rigorously test this hypothesis, this paper investigates the following five core propositions.

a) Policy Convergence: India and ASEAN member nations (AMS) are progressively aligning with international climate targets such as Paris Agreement to be achieved by 2030, Sustainable Development Goals (SDGs) by 2030, and Net-Zero targets by the middle of the century, though their operational pathways reflect distinct socio-economic realities and structural energy dependencies.
b) Transition Drivers: Technological innovations in renewable energy deployment, grid electrification, green hydrogen synthesis, and battery

material supply chains offer untapped synergies for across ASEAN -India cross-border investment and technological co-development.

c) Institutional Gaps: Current ASEAN–India bilateral and multilateral architecture lacks dedicated funding vehicles, structured high-level policy dialogues, and binding regulatory frameworks for co-management of agreed cooperation frameworks.
d) Regional Market Potential: Systematic integration of cross-border power grids, regional carbon markets, climate finance mechanisms, and resilient infrastructure could dramatically reduce the aggregate economic cost of energy transition and resource governance for both ASEAN and India.
e) Geopolitical Context: Deepened climate and energy alignment between ASEAN and India provides a stabilizing force for Indo-Pacific energy security, supply chain resilience, and low-carbon trade architectures.

The remainder of this paper explores these propositions by first examining the environmental, climate, and energy transition challenges confronting the Indo-Pacific before assessing national strategies, regional policy frameworks, and future opportunities for ASEAN–India cooperation.

2. Global, Regional, and National Context of Environment, Climate, and Energy Transition Challenges

2.1 Global Context on the imperatives of Sustainable Development

The global community has entered what many scholars describe as the Anthropocene, an era in which human activities have become the dominant force shaping Earth's ecological systems. Rapid industrialization, urbanization, population growth, and unsustainable consumption patterns have significantly altered atmospheric composition, land use, freshwater systems, and biodiversity. According to the Intergovernmental Panel

on Climate Change (IPCC, 2022), global average temperatures have already increased by approximately 1.2°C above pre-industrial levels, resulting in increasingly frequent and severe climate-related disasters. Simultaneously, the Kunming–Montreal Global Biodiversity Framework recognizes that approximately one million species face extinction due to habitat destruction, pollution, invasive species, overexploitation, and climate change.

Environmental degradation extends beyond climate change. Water scarcity affects nearly half of the global population for at least part of the year, while land degradation threatens agricultural productivity and food security. Marine ecosystems experience increasing stress from overfishing, coastal development, ocean acidification, and plastic pollution. Air pollution remains one of the leading environmental causes of premature mortality worldwide, disproportionately affecting rapidly urbanizing regions of Asia.

Energy systems remain central to these challenges. Fossil fuels continue to account for nearly four-fifths of global primary energy consumption, making the energy sector responsible for approximately three-quarters of global greenhouse gas emissions. Achieving the objectives of the Paris Agreement therefore requires an unprecedented transformation of energy production, transmission, and consumption systems. Renewable energy technologies, electrification, energy efficiency improvements, green hydrogen, battery storage, and digital energy management have consequently become essential components of sustainable development strategies worldwide.

The 2030 agenda on Sustainable Development Goals (SDGs) underscore the interdependence of environmental protection, economic development, and social inclusion. Goals relating to affordable and clean energy, climate action, responsible consumption and production, sustainable cities, life below water, and life on land collectively highlight the integrated nature of sustainability challenges. Increasingly, governments recognize that climate policy cannot be separated from

industrial policy, innovation systems, trade competitiveness, and long-term economic resilience.

2.2 Environmental Degradation and threats to sustainable and inclusive development in ASEAN

The ASEAN region, home to over 600 million people, faces severe systemic ecological pressures that threaten long-term socioeconomic stability. As one of the world's fastest-growing industrial hubs, economic growth is being driven by an unsustainable resource use. Beneath the region's dynamic market performance lies a compounding crisis: ecological degradation, water scarcity, and mounting climate vulnerabilities that threaten to undo decades of socioeconomic progress.

a) Biodiversity: As a home to the world's second-richest ecosystem in biological diversity, Southeast Asia's rainforests and marine sanctuaries are among Earth's most critical natural assets. Yet, human encroachment and habitat destruction are triggering rapid extinction rates. Current estimates warn that up to 40 per cent of the region's genetic biodiversity risks permanent loss if current degradation rates continue. The disappearance of these species is not just an ecological tragedy; it erodes essential ecosystem services—such as natural pollination, pest control, and soil fertility—that local agriculture and rural livelihoods depend on.
b) Deforestation and Hydro-Climatic Feedback Loops: The destruction of Southeast Asia's natural cover goes together with climate modification. Continuous tropical deforestation at an alarming rate of 8,000 km^2 annually is altering weather patterns far beyond the forest canopy. Tree canopy loss breaks the local hydrologic cycle, directly contributing to a 7 per cent reduction in regional precipitation. This creates dangerous feedback loops: reduced rainfall triggers localized drought cycles, which in turn make remaining forests more vulnerable to fires and further decay. Forests do not merely react to climate—they actively shape regional rainfall. Losing tree cover directly starves surrounding agricultural zones of essential precipitation.

c) The Brewing Freshwater Crisis: Southeast Asia's economic trajectory relies heavily on water-intensive sectors, from semiconductor manufacturing to industrial agriculture. However, water management systems across the region are buckling under dual pressure, Groundwater reservoirs are being depleted faster than natural recharge rates can sustain.: Unchecked industrial effluent and untreated surface run-off are contaminating critical river basins. Forecast models project a 30 per cent shortfall in freshwater supplies required to sustain regional economic growth by 2050. Without dramatic infrastructure overhauls and stricter usage regulations, water scarcity will become a primary bottleneck to industry and urban development.

d) The Waste Proliferation Crisis: Southeast Asia faces a structural mismatch between population size and waste production. While the region accounts for 4 per cent of the global population, it generates 9 per cent of global waste. Current waste Share 9 per cent of total global waste is expected to expand rapidly to total waste Volume of 80 million tons/year, by 2050. The primary threat is to marine and coastal ecosystems, where rapid urbanization without matching municipal waste infrastructure has made the region an epicenter for oceanic plastic pollution, threatening coastal tourism, fisheries, and marine biodiversity.

e) Macroeconomic Vulnerability to Climate Disasters: The convergence of habitat loss, water stress, and pollution severely diminishes the region's natural resilience to extreme weather events. Typhoon intensity, severe flooding, and prolonged droughts are no longer isolated incidents—they are systemic financial shocks. Economic modeling by ADB and ERIA indicates that unchecked climate impacts could contract ASEAN's annual GDP by up to 6 per cent by 2050.

Addressing these interconnected threats requires a shift from reactive disaster response to proactive regional policy. Key priorities for ASEAN economies include strict forest conservation and restoration, investing in modern waste management systems to decouple economic growth from waste volume; regulating groundwater extraction and restoring surface

water bodies before supply deficits hit critical thresholds. Protecting Southeast Asia's ecology is no longer merely an environmental concern—it is an economic prerequisite for long-term stability and growth, wherein India ASEAN partnership could be a game changer.

ASEAN and India have progressively recognized this changing strategic landscape. India's Act East Policy and ASEAN's Outlook on the Indo-Pacific (AOIP) emphasize economic integration, connectivity, resilience, and sustainable development as mutually reinforcing objectives. Likewise, both have embraced the Paris Agreement, SDGs, and numerous multilateral environmental agreements as guiding frameworks for national development strategies. India has announced ambitious renewable energy expansion programmes and committed to achieving net-zero emissions by 2070, while several ASEAN member states have established carbon neutrality or net-zero targets extending to 2050 or 2065. These developments suggest increasing convergence in long-term policy aspirations despite considerable diversity in institutional arrangements and development priorities.

However, important structural challenges remain. Energy systems across ASEAN continue to depend heavily on fossil fuels, particularly coal and natural gas, while India's growing electricity demand presents major decarbonization challenges despite rapid renewable energy expansion. Institutional capacities differ substantially among ASEAN member states, resulting in uneven implementation of climate policies and environmental regulations. Financing gaps continue to constrain investments in renewable energy, climate adaptation, and resilient infrastructure.

2.3 Climate Risk and Vulnerability Mapping of ASEAN

As detailed in geographical risk assessments, the broader Indo-Pacific region experiences acute risk profiles comparable only to sub-Saharan Africa, with projected long-term GDP losses between 2 per cent and 8 per cent by 2100 (ADB, 2012). It has been estimated that India would experiences multi-hazard vulnerability including severe water

Table 1: Climate Risks and Socio-economic Impacts in India and ASEAN

Country / Sub-Region	Primary Climate Hazards	Dominant Socioeconomic Risk Factor
India	Water Insecurity, Urban Heat Stress, Coastal Flooding	Agricultural output shock and urban infrastructure stress
Indonesia and Philippines	Coastal Flooding, Urban Heat Stress, Food Insecurity	Vulnerability of low-lying coastal cities and island communities
Mekong Sub-Region	Water Insecurity, Food Insecurity, Coastal Flooding	Hydrological volatility affecting agriculture and power generation
Malaysia and Singapore	Coastal Flooding, Energy Insecurity, Urban Thermal Loads	Critical infrastructure protection and energy supply resilience

Source: Author's own

insecurity, agricultural heat stress, extreme urban thermal loads, and extensive coastal flooding along its major economic corridors by 2100. On the other hand, characterized by high exposure to coastal inundation, archipelagic Southeast Asian countries like Indonesia, Philippines will face severe tropical cyclones, marine ecosystem degradation, and urban heat island effects, while continental ASEAN member states which includes Vietnam, Thailand, Myanmar, Lao PDR, Cambodia would be Highly vulnerable to altered monsoon mechanics, basin-wide hydro-ecological shifts along the Mekong River, inland flooding, and agricultural yield instability. Table 1 illustrates the socio-economic risk of major climate hazards in India and ASEAN.

2.4. The Regional Energy Transition Paradox

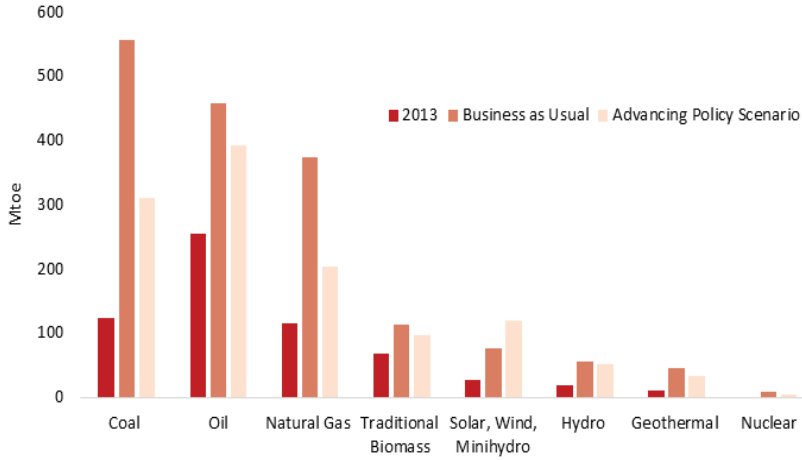
The energy sector accounts for 51 per cent of total greenhouse gas (GHG) emissions within ASEAN. The primary structural challenge facing the

region is a growing reliance on fossil fuels. Fossil fuel demand (coal, petroleum, and natural gas) is projected to quadruple by 2050 under business-as-usual scenarios, while the current share of renewables in the primary energy supply mix remains low at approximately 14 per cent.

ASEAN countries face challenges in developing and distributing energy resources, from their remote locations to those urban centers of production and consumption where they are needed most. Moreover, the economic and energy geography of Southeast Asian countries is highly uneven. The challenge of energy resource development, distribution and energy poverty of this region is rivaled by the difficulties associated with improving energy security and reducing carbon emissions. As of 2025, this region has at least 134 million people, or 22 per cent of the population without access to modern electricity. It is home to thousands of low-lying islands comprising major portions of Indonesia and the Philippines that are extremely disadvantaged in-terms of energy access. Following on from Paris Agreement, and the ratification of nationally Determined Contributions (NDCs), the countries in this region are paying more attention to advancing viable and scalable low-carbon energy transformation options.

In the business-as-usual scenario, the energy supply of these countries is projected to increase steadily from 619 million tons of oil equivalent in 2013 to 1,685 million tons of oil equivalent in 2040, growing at an annual rate of 4.7 per cent (Figure 2). This projected growth is higher than the trends observed between 1990 and 2013, which averaged 4.2 per cent per year. Carbon emissions during the period are estimated to grow at the rate of 4 per cent per year. The difference between the total energy use in the advancing policy scenario and the business-as-usual scenario shows approximately the potential of clean energy development and energy saving that could be achieved by these countries through the implementation of advanced policies on efficiency in electricity power production and consumption, transport, residential, and industry sectors. These policies are expected to contribute to a reduction of energy demand of 13 per cent by the end of 2030 and thus avoided carbon emissions of the same or larger magnitude.

Figure 2. Comparison of Future Energy Supply Scenarios in ASEAN in 2030



Source: ERIA (2025)

It is estimated that the overall low-carbon energy supply infrastructure investments to meet the NDC targets will steadily rise, and cumulatively US$ 2,100 billion is needed by the year 2030 for Southeast Asian countries (Anbumozhi et al., 2017). About 46 per cent of this requirement will be in the power sector, followed by energy efficiency by about 17 per cent. There is demand for low-carbon investment finance for many types of projects with diverse needs (Table 2). Each investment has its own distinctive risk profile, in which different factors – market, technical, regulatory – have different degrees of prominence. From an infrastructure financing perspective, there is an overreaching concern on low carbon investments, that the cash flows during the project's lifetime may be insufficient to pay back the amounts invested in real terms and earn a reasonable return, because of regulatory, market and financial barriers. Regulatory barriers include misalignment of energy policies with climate and social development policies. Subsidies remain as a market barrier that has implications on the energy prices and cost advantages of low-carbon energy production and consumption. Abrupt

fluctuations in exchange rates and rise in interest rates constitute financial risks related to new investments. Similarly, investors have different time horizons, and tolerance for risk. There is no easy solution to tackle these risks. A learning process is needed between the policy makers and the finance industry to de-risk investments. Policy makers of the region need to understand the types of risks and the regulatory and incentive mechanisms necessary to attract investments. The financial community needs to appreciate the distinctive nature of low carbon investments

Table 2. Financing Vehicles for Pooling Private Investments in Low-Carbon Energy Infrastructure

Category	Special Purpose Vehicles	Green Bonds	Pooled Vehicles
Description	Leasing scheme using debt facilities	Fixed income debt securities	Green infrastructure funds, private equity funds, and other listed vehicles
Actors	Provided by corporate banks or institutional investors or utilities	Issued by governments, international financial institutions or corporate banks	Issued by asset managers, investment banks or special private funds
Advantage	Equipment can be leased to end users to reduce the impact of cash flow, while giving access to large scale debt finance	High degree of security when backed by governments	Exposure to companies or assets for small investors
Typical application	Energy efficiency improvement or micro grid	All mature clean technologies such as wind and solar	All mature technologies, predominantly large-scale soil and wind power

Source: Author's own

from the sustainable development perspective and to develop suitable vehicles to finance low-carbon energy infrastructure projects in a way that aligns with varying sizes, operational models and investment objectives. Intermediaries, such as international financial institutions and private corporate banks can offer effective financial products as exemplified in Table 2.

3. India's Strategies in the Environment, Climate, and Energy Domains

India's environmental and climate policy has undergone a profound transformation during the past two decades. Traditionally, environmental protection was viewed largely as a regulatory issue concerned with pollution control, forest conservation, and natural resource management. Today, however, environmental sustainability has become an integral component of India's development strategy, industrial policy, energy security, and international diplomacy. The country seeks to reconcile rapid economic growth with environmental sustainability through a policy framework that integrates climate mitigation, adaptation, renewable energy expansion, digital innovation, and green industrialization.

As the world's most populous country and the third-largest emitter of greenhouse gases in absolute terms, India's actions are critical for achieving global climate objectives. Yet, India's per capita emissions remain substantially below those of advanced economies, highlighting the country's continued emphasis on climate equity and the principle of common but differentiated responsibilities under the United Nations Framework Convention on Climate Change (UNFCCC). Consequently, India's climate strategy aims not only to reduce emissions but also to promote inclusive development, poverty reduction, energy access, and economic competitiveness.

India's approach is increasingly characterized by a transition from incremental environmental regulation toward a comprehensive green development paradigm. Flagship initiatives such as the National Action

Plan on Climate Change (NAPCC), the National Green Hydrogen Mission, the International Solar Alliance (ISA), Mission LiFE (Lifestyle for Environment), and ambitious renewable energy deployment demonstrate the country's effort to combine domestic development objectives with global climate leadership.

3.1. Environmental Governance in India

Environmental governance in India rests upon an extensive institutional and legislative framework developed over several decades. Constitutional provisions, judicial activism, environmental legislation, and decentralized governance have collectively contributed to strengthening environmental management.

The Ministry of Environment, Forest and Climate Change (MoEFCC) serves as the principal agency responsible for environmental policy formulation, biodiversity conservation, pollution control, and climate policy coordination. Supporting institutions such as the Central Pollution Control Board (CPCB), National Biodiversity Authority, National Green Tribunal (NGT), and State Pollution Control Boards play important regulatory roles.

- India has enacted numerous laws addressing environmental protection, including:
- Environment Protection Act (1986)
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and Control of Pollution) Act
- Biological Diversity Act
- Forest Conservation Act
- Wildlife Protection Act

Together, these instruments provide the legal foundation for pollution control, biodiversity conservation, environmental impact assessment, and ecosystem management.

One notable feature of India's environmental governance has been the increasingly active role of the judiciary. The Supreme Court

and the National Green Tribunal have expanded the interpretation of environmental rights under Article 21 of the Constitution, recognizing a clean and healthy environment as an essential component of the fundamental right to life. Judicial interventions have significantly influenced air quality management, river conservation, forest protection, and industrial pollution control.

Forest conservation remains another major priority. India has expanded afforestation programmes through the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), Green India Mission, and various state-level initiatives. Although challenges remain regarding forest quality and biodiversity, these

Table 3: India's Lines of Credit to ASEAN Member States

(US$ million)

Country	Number of LoCs	Total amount, (US$ million)	Major sectors / project areas
Cambodia	4	102.12	Stung Tasal project, transmission capacity, water resources development
Lao PDR	4	153.83	Irrigation schemes, transmission and distribution, hydropower, electrification, renewable energy
Myanmar	10	475.57	Optical fibre, telecommunications, railway rehabilitation, refinery renovation, vehicle plant, transmission lines, petrochemical complex, farm mechanisation and irrigation
Vietnam	6	491.50	Textile machinery, hydropower support, equipment and supplies, strategic projects
Total	24	1,223.02	Infrastructure, energy, connectivity, irrigation, telecommunications and strategic projects

Source: EXIM Bank / Ministry of External Affairs / Department of Economic Affairs, Government of India.

programmes contribute both to carbon sequestration and ecosystem restoration.

At the same time, India has increasingly embraced circular economy principles. National initiatives promoting resource efficiency, waste segregation, plastic waste management, extended producer responsibility (EPR), and recycling seek to reduce material consumption while improving industrial competitiveness. These policies align closely with emerging ASEAN initiatives on circular economy, creating opportunities for future regional cooperation. India's development cooperation with ASEAN also provides opportunities in new areas in climate agenda (Table 3).

3.2. India's Climate Change Strategy

India's climate policy has evolved considerably since the adoption of the National Action Plan on Climate Change (NAPCC) in 2008. The NAPCC established eight national missions addressing solar energy, energy efficiency, sustainable habitats, water conservation, sustainable agriculture, Himalayan ecosystems, Green India, and climate knowledge generation. These missions have gradually expanded into a broader climate policy architecture encompassing mitigation, adaptation, resilience, disaster risk reduction, and green industrial transformation.

At the international level, India's updated Nationally Determined Contributions (NDCs) under the Paris Agreement demonstrate increasing ambition. The country has committed to:

- Reducing emissions intensity of GDP;
- Increasing the share of non-fossil electricity generation;
- Expanding forest and tree cover;
- Strengthening adaptation and resilience.

India's announcement of achieving net-zero emissions by 2070, made during COP26, marked a significant milestone in global climate governance. Although later than many developed countries, the commitment reflects India's development priorities while signaling a long-term transition toward carbon neutrality.

A particularly innovative initiative is Mission LiFE (Lifestyle for Environment), which recognizes that behavioral changes are essential complements to technological innovation. Rather than relying exclusively upon regulatory measures, Mission LiFE encourages sustainable consumption patterns, resource efficiency, and citizen participation in environmental protection. This approach aligns with the broader recognition that climate mitigation requires societal transformation alongside technological progress.

Adaptation occupies an equally important place within India's climate strategy. Climate change has intensified droughts, floods, cyclones, glacial melting, and heatwaves, threatening agriculture, infrastructure, and vulnerable populations. Consequently, adaptation measures increasingly emphasize climate-resilient agriculture, early warning systems, disaster preparedness, water resource management, and resilient infrastructure.

Digital technologies are becoming central to these efforts. Remote sensing, artificial intelligence, geospatial analysis, and high-performance computing enhance climate forecasting, disaster management, and agricultural planning. These technological developments provide important foundations for future regional information-sharing platforms across the Indo-Pacific.

3.3. India's Energy Transition

India's energy transition represents one of the largest structural transformations currently underway in the global energy system. Rapid economic growth, urbanization, industrialization, and rising living standards continue to drive electricity demand upward. Meeting this demand while reducing greenhouse gas emissions presents one of the country's greatest policy challenges.

Historically, coal has dominated India's electricity generation. Coal remains important because of domestic availability, affordability, and energy security considerations. Nevertheless, the environmental

costs associated with coal dependence have encouraged policymakers to accelerate renewable energy deployment.

The National Solar Mission has become a flagship initiative. Since its launch, India has emerged as one of the world's fastest-growing solar energy markets, supported by competitive auctions, declining photovoltaic costs, improved transmission infrastructure, and supportive government policies.

Wind power has similarly expanded, particularly in western and southern states, while hydropower continues to provide an important source of renewable electricity.

More recently, the Government launched the National Green Hydrogen Mission, recognizing hydrogen's strategic importance for decarbonizing difficult-to-abate sectors such as steel, fertilizers, chemicals, shipping, and heavy transport. India possesses considerable potential to become a major producer and exporter of green hydrogen owing to its abundant renewable energy resources and expanding manufacturing capabilities.

Battery storage and electric mobility constitute another important dimension of India's transition. The Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme, Production Linked Incentive (PLI) programmes for advanced chemistry cells, and investments in battery manufacturing seek to strengthen domestic industrial capacity while reducing transport emissions.

Grid modernization also plays a crucial role. As renewable electricity becomes increasingly variable, India is investing in smart grids, digital electricity management systems, energy storage technologies, and interstate transmission networks capable of integrating large volumes of renewable energy.

These developments position India not merely as a large renewable energy market but increasingly as a global manufacturing hub for solar modules, batteries, green hydrogen equipment, and clean technologies.

4. Common Sustainability Challenges to ASEAN and India

Several important regional frameworks guide ASEAN's sustainability paradigm. Major initiatives and efforts include:

- ASEAN Plan of Action for Energy Cooperation (APAEC)
- ASEAN Framework for Circular Economy
- ASEAN Strategy for Carbon Neutrality
- Agreement on Transboundary Haze Pollution
- ASEAN Agreement on Disaster Management and Emergency Response
- ASEAN Framework on Marine Debris
- ASEAN Sustainable Tourism Framework

Collectively, these initiatives demonstrate ASEAN's transition from environmental cooperation toward integrated sustainable development.

But significant challenges remain common to ASEAN member states, which is similar to the challenges faced by states of India.

Coal continues to account for a large proportion of electricity generation, making rapid decarbonization difficult without compromising energy security. Financing requirements for achieving net-zero pathways are enormous, requiring greater private sector participation and international climate finance. Land acquisition, transmission bottlenecks, regulatory uncertainty, and distribution company (DISCOM) financial constraints continue to affect renewable energy deployment. Furthermore, ensuring a just transition for coal-dependent communities remains a major socio-economic challenge. Consequently, both ASEAN and India's energy transition requires not only technological innovation but also institutional reform, market modernization, workforce development, and strengthened international partnerships.

Unlike India, ASEAN does not operate as a supranational authority. Instead, it functions through consensus-based regional cooperation among ten highly diverse member states that differ substantially in income

levels, governance systems, energy resources, industrial structures, and institutional capacities. This diversity presents both strengths and challenges. While flexibility allows member states to pursue nationally appropriate pathways, implementation often proceeds unevenly across the region.

The ASEAN Community Vision 2045 and ASEAN Socio-Cultural Community Blueprint increasingly recognize sustainability as central to regional integration. Environmental protection, climate resilience, energy security, disaster management, biodiversity conservation, and circular economy principles have become integral components of ASEAN's long-term development agenda.

One of ASEAN's most promising initiatives is the ASEAN Power Grid (APG), designed to integrate national electricity systems through cross-border transmission infrastructure. Several Studies indicate that regional electricity integration could reduce generation costs by optimizing renewable energy resources across countries. As highlighted, integrating renewable energy through regional transmission could save over US$ 25 billion over two decades, largely by replacing fossil-fuel generation with lower-cost renewable electricity. However, realizing these benefits requires significant investments in transmission infrastructure, regulatory harmonization, electricity market reforms, and regional governance.

Despite encouraging policy developments, ASEAN like India continues to face several structural barriers. First, investment gaps remain substantial. Achieving regional decarbonization will require trillions of dollars in energy, transport, industrial, and urban infrastructure. Second, regulatory fragmentation limits cross-border investment and regional electricity trade. Third, tariff and non-tariff barriers continue to affect low-carbon technologies, reducing opportunities for regional manufacturing integration. Fourth, institutional capacities vary considerably across member states, resulting in uneven policy implementation. Finally, digital readiness differs substantially across ASEAN. As illustrated

by the Agriculture Digitalization Index presented in Table 4, countries such as Singapore, Australia, Japan, and Korea possess advanced digital ecosystems, while several developing ASEAN members continue to face constraints in connectivity, affordability, and institutional capacity. Since digital technologies underpin smart grids, climate monitoring, precision agriculture, and disaster risk management, narrowing these digital divides will be essential for building climate resilience (Table 4).

However, differences remain. India benefits from a more centralized policy architecture capable of implementing nationwide programmers, whereas ASEAN's consensus-based governance requires coordination among sovereign member states with diverse priorities. India's domestic market enables large-scale deployment of renewable energy technologies, while ASEAN's comparative advantage lies in regional integration through initiatives such as the ASEAN Power Grid and cross-border energy cooperation.

These complementarities provide a strong foundation for deeper partnership. India's strengths in large-scale renewable deployment, digital public infrastructure, and green manufacturing can complement ASEAN's strategic geographic position, resource endowments, and regional institutional frameworks. Together, they have the potential to build resilient supply chains, integrated low-carbon markets, and collaborative innovation ecosystems that advance sustainable development across the Indo-Pacific.

5. Evolution of ASEAN–India Cooperation: Convergence, Divergence and Institutional Gaps

5.1 Evolution of ASEAN–India Cooperation

Despite differences in political systems, institutional arrangements, and stages of development, India and ASEAN exhibit remarkable convergence in their strategic responses to sustainability challenges. Both have embraced the Paris Agreement and the Sustainable Development Goals as guiding frameworks. Both recognize renewable energy as a driver of

Table 4. Characterization of Digitalization in India, ASEAN and East Asian Countries

Country	Agriculture Digitalisation Index	Availability				Affordability					Enabling Environment				
		2G coverage (%)	3G coverage (%)	4G coverage (%)	Digital Agriculture Availability Subindex	Mobile tariffs	Handset price	Mobile-specific tax	Inequality	Digital Affordability Subindex	Market Access Index	Access to electricity	Basic skills	Online Services Index	Nondigital Enabling Environment Subindex
Australia	86.6	51.4	96.9	88.8	**84.6**	82.5	100.0	87.5	69.3	**86.1**	65.0	100.0	97.2	94.7	**89.2**
Brunei Darussalam	81.2	96.6	95.3	90.7	**93.7**	59.7	71.0	97.5	54.6	**69.6**	94.0	100.0	63.2	63.5	**80.2**
Cambodia	71.6	99.7	97.8	77.6	**90.1**	48.6	36.8	76.2	76.8	**56.2**	96.3	91.6	40.9	45.3	**68.5**
China	59.6	62.9	12.1	14.5	**23.2**	78.7	63.7	86.9	44.0	**68.9**	91.5	100.0	64.7	90.6	**86.7**
India	62.3	87.2	35.1	17.6	**38.5**	71.8	61.8	66.3	65.5	**66.4**	99.6	95.2	48.0	85.3	**82.0**
Indonesia	56.4	62.6	48.5	11.7	**36.6**	64.0	37.9	85.9	62.3	**60.2**	64.1	98.5	59.3	68.2	**72.5**
Japan	83.6	3.4	93.0	90.6	**74.1**	72.9	87.1	87.5	96.8	**84.8**	99.0	100.0	77.6	90.6	**91.8**
Korea Rep.	83.1	11.6	98.9	99.9	**81.8**	71.0	68.1	81.4	62.0	**70.4**	99.9	100.0	88.8	100.0	**97.2**
Lao PDR	50.2	84.8	70.0	14.7	**50.8**	40.0	40.2	46.9	61.8	**45.8**	55.8	97.9	42.7	19.4	**54.0**
Malaysia	75.9	87.7	83.9	78.7	**82.6**	69.3	45.1	93.2	38.8	**60.7**	85.5	100.0	66.7	85.3	**84.4**
Myanmar	44.1	39.1	19.8	0.8	**16.1**	61.7	37.8	89.6	62.8	**60.3**	92.0	66.3	39.7	25.9	**56.0**
New Zealand	88.7	82.5	91.3	93.1	**90.3**	78.4	93.8	81.3	71.5	**82.2**	90.4	100.0	90.7	92.9	**93.5**
Philippines	59.9	88.0	57.0	14.1	**46.0**	43.8	46.1	85.0	42.3	**52.4**	94.9	94.9	62.2	72.9	**81.2**
Thailand	84.2	99.8	99.7	99.6	**99.7**	74.6	53.4	91.3	53.0	**67.3**	99.0	100.0	64.5	79.4	**85.7**
Vietnam	69.7	93.7	85.3	45.4	**71.0**	56.2	33.1	91.3	67.3	**58.5**	95.7	100.0	57.3	65.3	**79.6**

Source: Author's own based on ERIA

economic transformation rather than merely an environmental necessity. Both seek to enhance climate resilience through improved infrastructure, disaster risk reduction, and digital technologies. Furthermore, both view green industrialization, green hydrogen, battery manufacturing, and circular economy practices as sources of future competitiveness.

Because of it, the ASEAN–India relationship has evolved from a limited sectoral dialogue in the early 1990s into a Comprehensive Strategic Partnership that encompasses economic integration, political cooperation, connectivity, maritime security, digital transformation, and sustainable development. Initially driven by India's "Look East Policy" and subsequently strengthened under the "Act East Policy", ASEAN has become one of India's most important regional partners in the Indo-Pacific. Bilateral trade has expanded significantly, investment flows have increased, and institutional dialogues have deepened across multiple sectors. However, environmental cooperation, climate governance, and energy transition have emerged as major pillars only during the past decade.

Several milestones illustrated below maps the modular way of ASEAN-India cooperation. The establishment of the ASEAN–India Summit mechanism in 2002 provided the institutional foundation for regular high-level political dialogue. While early discussions focused primarily on trade liberalization, regional connectivity, and economic cooperation, environmental sustainability gradually entered the bilateral agenda as climate change gained prominence in global policy debates.

The creation of the ASEAN–India Green Fund in 2010 represented the first dedicated institutional mechanism supporting environmental cooperation. Although relatively modest in scale, the Green Fund financed collaborative projects related to biodiversity conservation, environmental education, sustainable resource management, and capacity building. More importantly, it signaled the recognition that sustainable development would become an integral component of ASEAN–India relations.

Following the adoption of the Paris Agreement in 2015, climate and energy cooperation accelerated. Both India and ASEAN member

states committed themselves to nationally determined contributions (NDCs), renewable energy expansion, and sustainable development goals (SDGs). Renewable energy technologies, particularly solar power, emerged as a major area of collaboration, supported by India's leadership in establishing the International Solar Alliance (ISA).

The Delhi Declaration of 2018 further broadened cooperation to include sustainable development, disaster risk reduction, blue economy initiatives, smart cities, and digital innovation. Sustainability was no longer treated as a standalone environmental issue but increasingly integrated into broader regional development and economic cooperation agendas.

The elevation of ASEAN–India relations to a Comprehensive Strategic Partnership in 2023 marked another significant milestone. The partnership recognized that climate change, environmental sustainability, and clean energy are essential elements of regional resilience and Indo-Pacific stability. It also opened opportunities for institutionalizing cooperation in renewable energy, climate finance, resilient infrastructure, and digital transformation.

5.2. Areas of Policy Convergence

Due to those framework conditions of cooperations, despite considerable diversity among ASEAN member states, important areas of policy convergence have identified in the areas of cooperation.

a) Environmental Governance: Both India and ASEAN increasingly recognize that environmental protection cannot be separated from economic development. Biodiversity conservation, forest restoration, sustainable land management, pollution control, circular economy strategies, and resource efficiency now occupy central positions within national development planning. The Kunming–Montreal Global Biodiversity Framework, Sustainable Development Goals, and various multilateral environmental agreements provide common normative frameworks guiding domestic policies.

b) Climate Change: Climate action has become a defining feature of development policy across the region. All ASEAN member states and India have submitted Nationally Determined Contributions under the Paris Agreement and increasingly integrate mitigation and adaptation within national planning frameworks. The following common priorities are evident (i) expansion of renewable energy (ii) building climate-resilient infrastructure (iii) strengthening adaptation planning (iii) disaster risk reduction (iv) sustainable urban development (v) climate-smart agriculture. Although implementation capacities differ considerably, policy objectives increasingly converge.
c) Energy Transition: Perhaps the strongest convergence exists in energy transition strategies. India and ASEAN increasingly recognize that renewable energy contributes simultaneously to energy security, industrial competitiveness, green employment generation, technological innovation and low carbon development. Solar energy, offshore wind, battery technologies, electric mobility, smart grids, and green hydrogen have become strategic priorities across the region.
d) Digital Transformation: Both India and ASEAN increasingly employ digital technologies to improve environmental management. Artificial intelligence, remote sensing, Internet of Things (IoT), satellite monitoring, digital public infrastructure, blockchain technologies, and geospatial information systems support: precision agriculture; climate modelling; early warning; environmental monitoring; Digitalization therefore represents an important enabling technology linking climate resilience and sustainable development.

5.3. Divergences, Market Barriers, and Structural Limitations

Notwithstanding increasing convergence, several structural constraints continue to impede deeper cooperation.

The first constraint concerns institutional asymmetry. India is a sovereign state capable of implementing nationally coordinated policies, whereas ASEAN is an intergovernmental organization comprising ten

highly diverse member states. Consensus-based governance promotes inclusiveness but often slows decision-making and limits policy harmonization.

Second, economic development remains highly uneven. Singapore possesses advanced technological and financial capabilities comparable to developed economies, whereas Cambodia, Lao PDR, and Myanmar continue to face substantial capacity constraints. Consequently, identical climate policies generate very different implementation challenges across the region.

Third, financing remains the principal bottleneck. Although public commitments to net-zero transitions have expanded rapidly, investment requirements far exceed available public resources. According to recent estimates by the International Energy Agency and Asian Development Bank, Southeast Asia alone requires several trillion dollars of additional investment to achieve low-carbon development pathways by mid-century. Mobilizing such resources demands institutional innovations capable of attracting private finance while reducing investment risks.

Finally, regulatory fragmentation continues to inhibit regional market integration. Table 5 describes the bottlenecks in sup scaling green investments in ASEAN and East Asia summit countries. Differences in technical standards, renewable energy certification, carbon accounting methodologies, electricity market regulations, and investment rules increase transaction costs and discourage cross-border investment. Without greater regulatory convergence, opportunities for integrated renewable energy markets and regional green value chains will remain underexploited.

These structural constraints illustrate that future ASEAN–India cooperation cannot rely solely upon voluntary project-based initiatives. Instead, it requires stronger regional institutions capable of coordinating policy, mobilizing finance, harmonizing regulations, and facilitating technological collaboration.

Table 5. Barriers to Upscaling Green Investment in ASEAN, India and East Asian Countries

Category	Obstacles	ASEAN	ASEAN+3	ASEAN+6-Mongolia and HK
Policy	Changing policies	56%	45%	50%
	Complex procedures	28%	27%	29%
Institutional	High initial investment cost	50%	45%	50%
	Longer recovery period	50%	45%	46%
	High collateral requirement	44%	45%	46%
	Insufficient credit and maturity	28%	27%	25%
	Lack of capacity to value assets	17%	14%	13%
Market	Currency risk	33%	32%	29%
	Insufficient profits	33%	32%	29%
	Unpredictable cash flows	28%	23%	25%
	Non-favorable interest rates	28%	23%	25%
	Rising interest rates	28%	23%	21%
	Technology advancement risks	22%	18%	17%
	Unstable consumer market	11%	9%	13%

Source: Author's own based on ERIA

6. Emerging Opportunities for Deepening India-ASEAN Cooperation

The accelerating transition towards low-carbon development is transforming the nature of India-ASEAN cooperation. Whereas previous phases of ASEAN–India engagement were largely driven by trade liberalization, investment promotion, and diplomatic engagement, the next phase is to be shaped by technological innovation, industrial transformation, and the provision of regional public goods. Climate change has fundamentally altered the calculus of regional cooperation by creating shared risks that transcend national boundaries while simultaneously generating new opportunities for economic modernization. Consequently, the challenge facing ASEAN and India is no longer whether cooperation should expand, but how new institutional arrangements can effectively support the transition towards sustainable and resilient development.

This section argues that six mutually reinforcing drivers will determine the future trajectory of ASEAN–India climate and energy cooperation: (i) regional renewable energy value chains; (ii) the emerging green hydrogen economy; (iii) cross-border electricity markets; (iv) climate finance; (v) carbon market integration; and (vi) digital public goods for climate resilience. Collectively, these drivers represent the building blocks of a new regional architecture capable of supporting decarbonization while strengthening economic competitiveness and geopolitical resilience.

6.1. Regional Renewable Energy Value Chains

The global energy transition is increasingly characterized by competition over manufacturing capacity, technological innovation, and control of strategic supply chains. Renewable energy technologies—including solar photovoltaic modules, wind turbines, batteries, electrolyzers, and power electronics—have become strategic industrial sectors rather than merely components of environmental policy. As countries pursue industrial decarbonization, comparative advantage will increasingly depend upon

the ability to participate in integrated regional value chains rather than solely on domestic resource endowments.

India and ASEAN possess highly complementary comparative advantages that could underpin a regional green industrial ecosystem. India has emerged as one of the world's largest renewable energy markets and has adopted an explicit industrial strategy through Production-Linked Incentive (PLI) schemes aimed at expanding domestic manufacturing of solar modules, advanced battery cells, and clean energy equipment. ASEAN economies, in contrast, occupy strategic positions within global manufacturing networks and possess important reserves of critical minerals such as nickel, cobalt, rare earth elements, and bauxite that are essential for battery technologies and renewable energy equipment.

Indonesia's nickel resources, Malaysia's electronics manufacturing capabilities, Vietnam's rapidly expanding renewable energy sector, Singapore's financial and logistics services, and Thailand's automotive industry provide complementary assets that can be linked with India's growing manufacturing base. Rather than competing for the same segments of global value chains, ASEAN and India could specialize in different stages of production, thereby increasing regional competitiveness while reducing dependence on geographically concentrated suppliers.

The experience of the COVID-19 pandemic demonstrated the vulnerability of globally fragmented supply chains. Similarly, geopolitical tensions have reinforced the importance of diversification and resilience. Developing ASEAN–India renewable energy value chains, therefore, serve not only climate objectives but also broader strategic goals relating to industrial security, technological sovereignty, and economic resilience.

Achieving such integration, however, requires coordinated industrial policies, harmonized technical standards, investment facilitation, and reductions in tariff and non-tariff barriers affecting environmental goods and services. The empirical evidence presented in the preceding chapters indicates that tariffs on low-carbon technologies remain uneven across

the region, increasing production costs and limiting economies of scale. Regional trade liberalization focused specifically on environmental goods would therefore generate substantial welfare gains while accelerating technology diffusion.

6.2. Green Hydrogen and of Industrial Decarbonization

Among emerging clean technologies, green hydrogen has attracted unprecedented policy attention because of its potential to decarbonize sectors that are difficult to electrify, including steel, cement, fertilizers, chemicals, maritime transport, and aviation. Unlike solar and wind energy, whose deployment primarily substitutes electricity generation, hydrogen has the potential to transform industrial production processes and international trade patterns.

During the G20 India presidency, India has positioned itself as a future global hub for green hydrogen production through the National Green Hydrogen Mission. Abundant solar and wind resources, a rapidly expanding renewable electricity sector, and relatively low production costs provide India with significant comparative advantages. Several ASEAN member states—including Indonesia, Malaysia, Brunei Darussalam, Vietnam, and Singapore—have similarly incorporated hydrogen into their long-term energy transition strategies.

However, the economics of hydrogen production illustrates why regional cooperation is indispensable. Hydrogen markets require coordinated investments across the entire value chain: renewable electricity generation, electrolyzer manufacturing, storage facilities, transport infrastructure, port modernization, certification systems, and long-term purchase agreements. Individual countries are unlikely to achieve sufficient economies of scale independently.

From an institutional perspective, hydrogen also represents a regional public good because market development depends upon common regulatory standards and mutual recognition of certification systems. Without harmonized standards governing carbon intensity,

safety protocols, and lifecycle emissions, international hydrogen trade will remain fragmented.

An ASEAN–India Hydrogen Partnership could, therefore, perform several functions. First, it could coordinate research and development through collaborative innovation platforms involving universities, research institutes, and the private sector. Second, it could establish common certification and sustainability standards that facilitate cross-border trade. Third, it could mobilize investment through blended finance mechanisms involving multilateral development banks and sovereign wealth funds. Finally, it could develop regional transport corridors linking production centres with industrial consumers.

Hydrogen cooperation would thus extend beyond energy policy to become an important instrument of industrial modernization and regional economic integration.

6.3. Cross-Border Electricity Markets as Regional Public Goods

Electricity market integration represents perhaps the most tangible opportunity for enhancing regional energy security while reducing the cost of decarbonization. Unlike fossil fuel systems, renewable electricity is geographically uneven. Hydropower resources are concentrated in the Mekong Basin, solar resources are abundant across tropical Asia, and offshore wind potential varies considerably among coastal economies. Regional interconnection allows these complementary resources to be utilized more efficiently.

The ASEAN Power Grid (APG), originally conceived as a network of interconnected national electricity systems, represents one of the region's most ambitious infrastructure initiatives. Economic modelling, undertaken by the ERIA and the ADB, demonstrates that integrated electricity markets could significantly reduce generation costs by optimizing renewable energy resources across borders. As highlighted in the presentation underpinning this chapter, regional integration could

generate savings exceeding US$ 25 billion over two decades, largely by replacing fossil-fuel generation with hydropower and other renewable resources (ERIA, 2020).

India's own experience with interstate electricity markets and cross-border power trade with Bhutan, Nepal, and Bangladesh provides valuable institutional lessons. Market coupling, standardized transmission regulations, transparent pricing mechanisms, and independent system operation have contributed to improving electricity reliability while facilitating renewable energy integration.

Extending these experiences to Southeast Asia requires addressing several institutional challenges. Cross-border electricity trade depends upon compatible regulatory frameworks, harmonized grid codes, transparent tariff methodologies, and mechanisms for dispute resolution. It also requires trust among participating governments because electricity infrastructure creates long-term strategic interdependence.

From a regional governance perspective, electricity interconnection should be understood not only as infrastructure development but also as an institution-building process that deepens economic integration and strengthens collective resilience.

6.4. Climate Finance and the Mobilization of Private Capital

One of the most significant constraints on low-carbon development is not technological feasibility but financial mobilization. Estimates by the International Energy Agency, Asian Development Bank, and World Bank suggest that achieving net-zero pathways across emerging Asia will require investments measured in trillions of dollars over the coming decades. Public finance alone cannot meet this requirement.

Consequently, the central challenge is to leverage limited public resources to mobilize substantially larger volumes of private investment. This objective requires moving beyond traditional development assistance towards innovative financial architectures capable of reducing investment risks while improving project bankability.

Blended finance has emerged as a particularly promising instrument because it combines concessional public resources with commercial private investment. Public institutions absorb a portion of investment risk, thereby encouraging private investors to finance projects that would otherwise be considered commercially unattractive. Green bonds, sustainability-linked loans, transition finance instruments, and guarantee facilities similarly expand financing opportunities for renewable energy and climate adaptation projects.

ASEAN and India could jointly establish a Regional Green Investment Facility supported by multilateral development banks, sovereign wealth funds, export credit agencies, and private institutional investors. Such a facility would prioritize projects generating regional public goods, including cross-border transmission infrastructure, climate-resilient transport corridors, hydrogen hubs, and digital climate platforms.

Equally important is strengthening project preparation capacity. Many climate projects fail to attract financing not because they lack economic merit but because feasibility studies, environmental assessments, and financial structuring remain inadequate. Regional technical assistance facilities can therefore play a critical role in improving investment readiness.

6.5. Carbon Markets and Regional Climate Governance

The emergence of carbon markets represents another important institutional innovation in global climate governance. Article 6 of the Paris Agreement establishes mechanisms through which countries may cooperate in achieving mitigation objectives through internationally transferred mitigation outcomes (ITMOs). Properly designed carbon markets reduce the overall cost of emissions reduction by allowing mitigation to occur where it is most economically efficient.

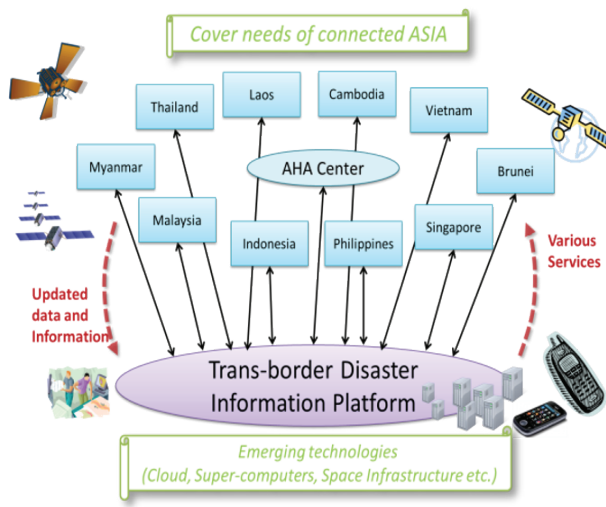
Several ASEAN member states have begun developing domestic carbon pricing mechanisms, voluntary carbon markets, and emissions

trading systems. India has similarly initiated reforms leading towards a national carbon market.

However, fragmented carbon markets generate high transaction costs and limited liquidity. Greater regional coordination could therefore improve market efficiency while strengthening environmental integrity. Harmonization should focus upon measurement, reporting, and verification (MRV) systems, carbon accounting methodologies, digital registries, and mutual recognition of high-quality carbon credits.

Regional carbon markets would also complement broader industrial policy objectives by encouraging investment in renewable energy, energy efficiency, reforestation, and nature-based solutions. Nevertheless, governance remains critical. Weak monitoring systems or inconsistent standards risk undermining environmental credibility and investor confidence. Institutional cooperation should therefore prioritize transparency, accountability, and scientific integrity.

Figure 3. India-ASEAN Information Platform for Resilient Asia



Source: Author's own

6.6. Digital Public Goods and Climate-Resilient Development

Perhaps the most transformative driver of future cooperation is digitalization. Digital technologies increasingly underpin every dimension of environmental governance—from satellite-based forest monitoring and climate modelling to smart electricity grids, precision agriculture, disaster forecasting, and carbon accounting. Rather than viewing digital transformation as a separate policy domain, ASEAN and India should recognize it as an enabling platform for regional climate resilience.

India's experience with digital public infrastructure demonstrates the potential for scalable, interoperable platforms that reduce transaction costs while expanding access to public services. Applying similar principles to environmental governance could significantly enhance regional cooperation.

The proposed India–ASEAN Trans-border Information Platform (TIP), illustrated in Figure 3, offers a strong example of how ASEAN's needs can be matched with India's technological capabilities. Conceptually, TIP would function as a regional digital public good, integrating earth observation satellites, geospatial databases, high-performance computing, artificial intelligence, and real-time communication systems. Such a platform could support climate modelling, disaster early warning, flood forecasting, wildfire monitoring, marine ecosystem management, and agricultural advisory services across national boundaries.

Unlike conventional infrastructure, digital public goods exhibit increasing returns to scale because the value of shared information grows as participation expands. Regional investment in digital climate infrastructure therefore generates benefits that exceed the sum of national initiatives, illustrating once again the importance of institutionalized regional cooperation. Several policy priorities emerge from the foregoing analysis.

First, ASEAN and India should institutionalize annual ministerial dialogues dedicated specifically to environment, climate change, and energy transition. These dialogues should complement existing economic

and strategic cooperation mechanisms and facilitate regular policy coordination.

Second, greater emphasis should be placed on mobilizing private capital through innovative financing instruments. Governments should improve regulatory certainty, strengthen public–private partnerships, and enhance project preparation capacities to attract institutional investors.

Third, renewable energy cooperation should move beyond technology transfer toward integrated regional manufacturing and innovation ecosystems. Collaborative investments in solar photovoltaics, offshore wind, battery technologies, green hydrogen, and critical minerals would strengthen both energy security and industrial competitiveness.

Fourth, digital transformation should become a cornerstone of regional climate resilience. Establishing the proposed Indo-Pacific Trans-border Information Platform would facilitate data sharing, disaster preparedness, climate modelling, and early warning systems.

Fifth, ASEAN and India should accelerate efforts to harmonize technical standards, carbon accounting methodologies, and sustainability reporting frameworks. Regulatory convergence would reduce transaction costs, improve market efficiency, and facilitate cross-border investment.

Finally, environmental cooperation should be mainstreamed into broader ASEAN–India strategic relations. Climate action, biodiversity conservation, circular economy initiatives, and sustainable infrastructure should no longer be treated as peripheral concerns but rather as central components of Indo-Pacific regional architecture.

7. Towards an ASEAN–India Green Partnership Framework

The preceding analysis suggests that future ASEAN–India cooperation should evolve from functional collaboration towards an integrated model of regional governance on sustainability. Such a transformation requires institutional innovation that takes into market push and pull mechanisms

rather than simply expanding the scope of existing policy dialogues and cooperative mechanisms.

This chapter proposes an ASEAN–India Green Partnership Framework built upon five mutually reinforcing pillars as show in Figure 4.

The first pillar is policy coherence and regulatory convergence, encompassing free trade facilitation measures which include harmonized standards for renewable energy, hydrogen certification, carbon accounting, sustainable finance, and environmental goods. Regulatory convergence lowers transaction costs, encourages investment, and facilitates regional market integration.

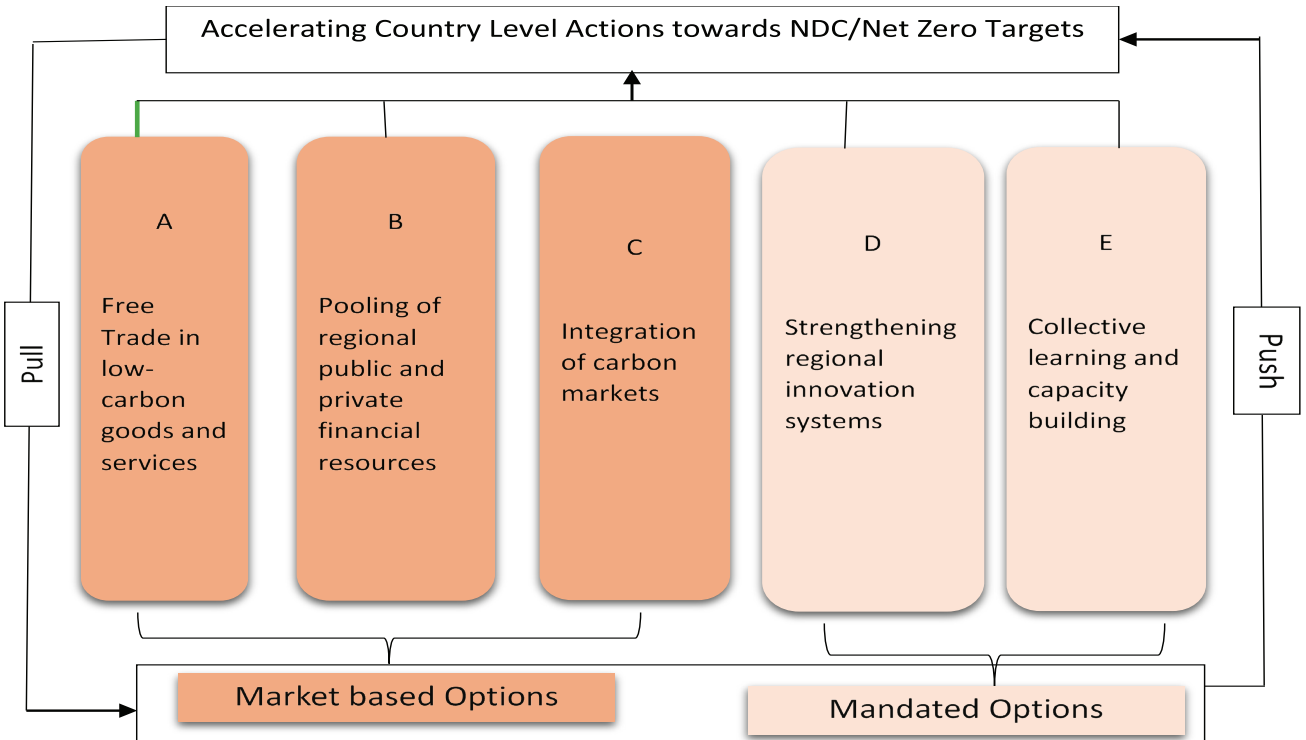
The second pillar is regional green finance, involving blended finance mechanisms, green investment funds, sovereign guarantees, and partnerships with multilateral development institutions. Mobilizing private capital is indispensable for scaling climate investments.

The third pillar is integration of carbon markets, including interconnected carbon credits derived from emerging green hydrogen trade corridors, forest preservation, and liberalized trade in environmental goods and services. Market integration enables economies of scale while improving energy security, climate resilience and industrial competitiveness.

The fourth pillar is innovation and technology ecosystems, linking universities, research institutes, industries, and start-ups through collaborative research in renewable energy, hydrogen, battery technologies, digital agriculture, artificial intelligence, and circular economy solutions.

The fifth pillar is knowledge cooperation and institutional capacity building. Strengthening human capital, technical expertise, policy learning, and digital governance capabilities is essential for ensuring that all 11 ASEAN member states and 29 Indian states and the Union territories participate effectively in regional sustainability initiatives.

Figure 4. An ASEAN- India Cooperation Framework for Low Carbon Development



Source: Author's own

These pillars are mutually reinforcing. Strong institutions facilitate finance; finance accelerates innovation; innovation strengthens markets; integrated markets create incentives for further institutional cooperation. Together they generate a virtuous cycle of sustainable development that extends beyond environmental protection to encompass industrial modernization, economic resilience, and geopolitical stability.

8. Conclusion

The political economy of climate change, resource consumption and meeting sustainability targets is fundamentally reshaping the narratives for sustainable development. In ASEAN and India Environmental sustainability has evolved from a peripheral policy concern into a strategic determinant of economic competitiveness, energy security, technological innovation, and regional resilience. India and ASEAN are therefore presented with a historic opportunity to redefine their partnership around the shared objective of low-carbon, climate-resilient, responsible development.

This paper has argued that despite differences in institutional structures and development trajectories, India and ASEAN exhibit increasing convergence in environmental governance, climate policy, and energy transition strategies. Shared climate vulnerability, common energy security concerns, industrial transformation, and digital innovation provide powerful incentives for deeper cooperation. At the same time, fragmented institutions, financing gaps, regulatory heterogeneity, and uneven implementation capacities continue to constrain progress.

The next phase of ASEAN–India relations should therefore move beyond project-based cooperation toward establishing an institutionalized cooperative regional governance from environmentally sustainable inclusive growth. Such governance is not intended to replicate supranational models of economic integration but rather to strengthen coordination through flexible, consensus-based institutions that generate

regional public goods. Renewable energy value chains, hydrogen partnerships, interconnected electricity markets, blended climate finance, carbon market integration, and digital public goods provide practical pathways through which this transformation can occur.

Ultimately, the significance of ASEAN–India cooperation extends beyond bilateral relations. As two of the world's fastest-growing regions, their collective choices will shape the future of the Indo-Pacific and influence global efforts to achieve the Paris Agreement and the Sustainable Development Goals in time. Speed of actions and coordinating mechanisms are important. By embracing a comprehensive Green Partnership Framework, ASEAN member states and India can position themselves not only as beneficiaries of the global green transition but also as architects of a more resilient, inclusive, and sustainable regional order.

[Author passed away shortly after finalising this Discussion Paper. His intellectual leadership and contributions remain foundational to this work]

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About the Author



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