# Rethinking Asia's Low-Carbon Growth in the Post-Covid World:

## Towards a Net-Zero Economy

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Rethinking Asia's Low-Carbon Growth in the Post-Covid World:
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# FOREWORD BY THE PRESIDENT

Asia's historical development is at crossroad. Eighteen months into the Covid-19 pandemic crisis, the cumulative economic and financial impacts were estimated to be much harder than that of the 2008 global financial meltdown and 1997 Asian economic crunch. Several projections express certain levels of doubt over whether Asian countries, which have been progressively integrated into the global economy, could continue to grow at the pace it had previously enjoyed for more than 3 decades, in the aftermath of pandemic. The deceleration of region's economic growth cannot be simply ignored, given the complex nature of the pandemic containment measures as well as its impacts on industrial production structures and the economics of sustainable development.

Countries in the region differ widely in terms of development stage, health infrastructure provision, and level of economic integration. As the number of countries in the Association of Southeast Asian Nations (ASEAN) and East Asia that have reached middle-income status increases, reaching the next stage needs much more creativity in successfully addressing other challenges such as inequality, resilience, and sustainability

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) stated categorically that the planet is heading irrevocably towards warming and that we should aim to keep climate change below pre-industrial levels by the turn of the century. In line with this, 52 countries have pledged to meet net zero emission targets. Within the region, Japan and the Republic of Korea have joined the pledge for net zero emissions by 2050, while China aims to achieve net zero emissions by 2060. Singapore has also announced ambitious plans to achieve net zero emissions beyond 2050. Although many ASEAN Member States have yet to set specific targets for net zero emissions, several are working hard to redesign their policies towards meeting the Paris Agreement climate targets, as expressed in the nationally determined contributions (NDCs).

This Economic Research Institute for ASEAN and East Asia (ERIA) study, Rethinking Low-Carbon Green Growth in the Post-COVID-19 World: Towards a Net Zero Economy, sheds light on the experiences and lessons of the East Asia Summit countries. This book reviews and assesses the low-carbon green growth policies and practices of the regional economies, and identifies policy gaps and new opportunities. With input from international experts and regional think tanks, this study facilitates forging a regional perspective on net zero transition challenges, options, and issues.

Governments across ASEAN and East Asia have deployed a significant amount of emergency capital in the response to the pandemic, with an initial focus on protecting lives and livelihoods. The pandemic has its own global economic impacts, but has also created a once-in-a-generation opportunity to implement difficult domestic reforms towards a sustainable future that will simultaneously require technology, regulatory policy, and financing innovations. One should never let a good crisis go to waste. In this regard, this book proposes three key points of action.

First, clear and long-term policy frameworks are needed in the post-COVID-19 era as part of the stimulus recovery. This will send the right market signals and help speed up the development and uptake of low-carbon, resource-efficient, and carbon capture and utilisation (CCU) technologies.

Second, investment must be scaled up. Mobilisation of the private sector – including development banks, institutional investors, and bond markets – is crucial to the financing of low-carbon green growth initiatives. Public financing and development aid are also critical for leveraging private capital and meeting the Paris Agreement climate targets.

Third, stronger regional cooperation is needed to share knowledge, technology, and finance effectively and to coordinate action – leading to the effective implementation of strategies such as the ASEAN Comprehensive Recovery Framework.

As an international organisation and a strategic knowledge partner, ERIA provides policy support to the East Asia Summit countries on low-carbon initiatives in a range of sectors, including energy, transport, waste management, and agriculture. It promotes knowledge sharing by holding conferences, policy dialogues, and workshops; and by conducting research studies on the technical, economic, and legal standards of emerging technologies and the taxonomy of financing instruments. Holding capacity building and training workshops to bridge the knowledge gap amongst policymakers and the private sector is one of ERIA's most important contributions.

As countries around the world struggle to repair their battered economies, resetting policy measures during the pandemic recovery towards an inclusive low-carbon green growth path is more than a climate response – it is essential in scaling up actions towards sustainable economic development.

I hope this book will encourage policymakers and practitioners who are considering and evaluating important policy options for building a better future for the citizens of this region. The book will also serve as a valuable knowledge resource for those seeking a comprehensive overview of low-carbon green growth initiatives in ASEAN and East Asia.

Hidetoshi Nishimura
President
Economic Research Institute for ASEAN and East Asia

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| | |
|---|---|
| 3R | reduce, reuse, recycle |
| 4R | reduce, reuse, recycle, remove |
| AAPL | Australia-ASEAN Power Link |
| ACE | ASEAN Centre for Energy |
| ACGF | ASEAN Catalytic Green Finance Facility |
| ACRF | ASEAN Comprehensive Recovery Framework |
| ACT | Australian Capital Territory |
| ADB | Asian Development Bank |
| ADBI | Asian Development Bank Institute |
| AEC | ASEAN Economic Community |
| AI | Artificial Intelligence |
| AIF | ASEAN Infrastructure Fund |
| AJC | ASEAN-Japan Centre |
| AMCHAM | American Chamber of Commerce |
| AMEM | ASEAN Ministers on Energy Meeting |
| AMME | ASEAN Ministerial Meeting on Environment |
| AMS | ASEAN Member States |
| APEC | ASEAN Plan of Action for Energy Cooperation |
| APCAP | Asia Pacific Clean Air Partnership. |
| APEC | Asia-Pacific Economic Cooperation |
| APERC | Asia Pacific Energy Research Centre |
| ARIC | The Asia Regional Integration Center |
| ASCC | ASEAN Socio Cultural Community |
| ASCN | ASEAN Smart Cities Network |
| ASEAN | Association of Southeast Asian Nations |
| ASRIA | Association for Sustainable & Responsible Investment in Asia |
| ASSET | Advanced Technologies Promotion Subsidy Scheme with Emission Reduction Targets |
| ATS | Advanced Technologies Scenario |
| AWGCC | ASEAN Working Group on Climate Change |
| BAU | Business as Usual |
| BEV | Battery Electric Vehicle |
| BIMP-EAGA | Brunei Darussalam–Indonesia–Malaysia– Philippines–East ASEAN Growth Area |
| BPDPKS | Oil Palm Plantation Fund Management Agency |
| BRI | Belt and Road Initiative |

| | |
|---|---|
| Btu | British thermal unit |
| CAC | command-and-control |
| CAREC | Central Asia Regional Economic Cooperation |
| CBDR-RC | common but differentiated responsibilities and respective capabilities |
| CCAP | The Center for Clean Air Policy |
| CCE | circular carbon economy |
| CCS | carbon capture and storage |
| CCU | carbon capture and utilisation |
| CCUS | carbon capture, utilisation, and storage |
| CCR | Cost Containment Reserve |
| CCTV | closed-circuit television |
| CEFIA | Cleaner Energy Future Initiative for ASEAN |
| $CO_2$ | carbon dioxide |
| CO2e | carbon dioxide equivalent |
| CMIM | Chiang Mai Initiative Multilateralization |
| CPTPP | Comprehensive and Progressive Agreement for Trans-Pacific Partnership |
| CRED | Centre for Research on the Epidemiology of Disasters |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| DAC | direct air capture |
| DACCS | direct air capture for carbon storage |
| DBS | Development Bank of Singapore Limited |
| DER Lab | Distributed Energy Resources Laboratory |
| DRI | direct reduced iron |
| EDF | Électricité de France |
| EITE | Emissions-Intensive Trade-Exposed |
| ERIA | Economic Research Institute for ASEAN and East Asia |
| ESG | environment, social, and governance |
| ETS | emissions trading system |
| EU | European Union |
| EV | electric vehicle |
| FAME | Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles |
| FCEV | fuel cell electric vehicle |
| FDI | foreign direct investment |
| FiT | feed-in tariff |
| FOLU | forestry and land use |
| FTAs | free trade agreements |
| FYP | Energy Five-Year Plan |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |

| | |
|---|---|
| GGGI | Global Green Growth Institute |
| GHG | greenhouse gases |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GMS | Greater Mekong Subregion |
| GNI | Gross National Income |
| GRI | Global Reporting Initiative |
| GSCs | global supply chains |
| GST | goods and services tax |
| Gt | gigaton |
| $GtCO_2$ | gigatons of carbon dioxide |
| Gtoe | gigaton of oil equivalent |
| GW | gigawatt |
| G20 | The Group of Twenty |
| HAPUA | Heads of ASEAN Power Utilities and Authorities |
| HKMA | Hong Kong Monetary Authority |
| HSBC | Hongkong and Shanghai Banking Corporation Limited |
| $H_2$ | hydrogen |
| ICAP | International Carbon Action Partnership |
| ICE | internal combustion engine |
| ICMR | Institute for Capital Market Research |
| ICT | Information and Communication Technology |
| IEA | International Energy Agency |
| IEEJ | The Institute of Energy Economics, Japan |
| IETA | International Emissions Trading Association |
| IFC | International Financial Corporation |
| IGES | Institute for Global Environmental Strategies |
| ILO | International Labour Organisation |
| IMF | International Monetary Fund |
| IMT-GT | Indonesia–Malaysia– Thailand Growth Triangle |
| INDC | Intended Nationally Determined Contributions |
| IPCC | Intergovernmental Panel on Climate Change |
| IPNs | international production networks |
| IPOs | initial public offerings |
| IPR | intellectual property rights |
| IRENA | International Renewable Energy Agency |
| ISA | International Solar Alliance |
| JETRO | Japan External Trade Organization |
| KfW | Kreditanstalt für Wiederaufbau |
| kt | kiloton |
| $ktCO_2$ | kilotons of Carbon dioxide equivalent |
| kWh | kilowatt-hour |
| K-ETS | Korea emission trading scheme |

| | |
|---|---|
| LNG | Liquefied Natural Gas |
| LTMS-PIP | Lao PDR-Thailand-Malaysia-Singapore Power Integration Project |
| LT-LEDS | long-term low greenhouse gas emissions development strategies |
| LULUCF | land use, land use change, and forestry |
| MAS | Monetary Authority of Singapore |
| MB | megabyte |
| MBIs | market-based instruments |
| MBtu | million British thermal units |
| MRV | monitoring, reporting, and verification |
| MSMEs | micro, small, and medium-sized enterprises |
| MSW | municipal solid waste |
| Mt | million tons |
| $MtCO_2$ | million tons of carbon dioxide |
| $MtCO_2e$ | million tons of carbon dioxide equivalent |
| Mtoe | million tons of oil equivalent |
| MW | megawatt |
| M&A | mergers and acquisitions |
| NBFI | Non-Banking Financial Institution |
| NDCs | Nationally Determined Contributions |
| NEDO | New Energy and Industrial Technology Development Organization |
| NTB | non-tariff barrier |
| NZT | net zero target |
| ODA | official development assistance |
| OECD | Organisation for Economic Co-operation and Development |
| PACE | property assessed clean energy |
| PAT | Perform, Achieve, and Trade |
| PHEV | plug-in hybrid electric vehicle |
| PPP | purchasing power parity |
| PPP | public–private partnership |
| PV | photovoltaic |
| RBI | Reverse Bank of India |
| RD&D | research, development, and demonstration |
| RCEP | Regional Comprehensive Economic Partnership |
| REC | Renewable Energy Certification |
| REDD+ | Reducing Emissions from Deforestation and Forest Degradation in Developing Countries |
| RPS | renewable portfolio standard |
| R&D | research and development |
| SAARC | South Asian Association for Regional Cooperation |
| SAF | sustainable aviation fuel |
| SDGs | Sustainable Development Goals |
| SIIA | Singapore Institute of International Affairs |

| | |
|---|---|
| SMEs | small and medium-sized enterprises |
| SOC | social overhead capital |
| SPAD | Land Public Transport Master Plan |
| STI | science, technology, and innovation |
| $tCO_2$ | ton of carbon dioxide |
| $tCO_2e$ | ton of carbon dioxide equivalent |
| TRIPS | Trade-Related Aspects of Intellectual Property Rights |
| TWh | terawatt-hour |
| UK | United Kingdom |
| UN | United Nations |
| UNCTAD | United Nations Conference on Trade and Development |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environmental Programme |
| UNESCAP | United Nations Economic and Social Commission for Asia and the Pacific |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNIDO | United Nations Industrial Development Organization |
| USMCA | United States–Mexico–Canada Agreement |
| US | United States |
| USSR | Union of Soviet Socialist Republics |
| VAT | value-added tax |
| WAN | wide area network |
| WHO | World Health Organization |
| WREA | Wyoming Rural Electric Association |

# Chapter 1

## Putting Long -term Sustainable Growth in Perspective

## Chapter 1
## Putting Long-term Sustainable Growth in Perspective



## 1. Introduction

A year and a half since the onset of the coronavirus disease (COVID-19) pandemic, the world has witnessed its devastating impacts, with the tragic loss of lives and livelihoods around the globe. The pandemic has caused a severe contraction of the world economy, with effects broader and deeper than those of the 2008 global financial crisis. The COVID-19 pandemic is a distressing reminder of the deep vulnerability of globally integrated economies. It underscores the urgency of building economies that are resilient not only in the face of pandemics, but also of the systemic risks of climate change and inequality that have been the focus of global attention. The pandemic provides opportunities to build back better, in that new development pathways must focus on the agenda of restoring growth, creating employment, and building resilience.

While the pandemic is far from over, and the global economic outlook after COVID-19 remains uncertain, this book argues that it is urgent for countries to adopt and implement policies for sustainable growth. It sets out ideas for achieving this through coherent policy frameworks, institutional strategies, and approaching a well-managed COVID-19 recovery in a regionally coordinated way. The book presents a strong case for Asia, especially the Association of Southeast Asian Nations (ASEAN) economies, to step up efforts to pursue this combined policy approach. This integrated approach sits at the very centre of development pathways that have underpinned economic growth, productivity, and well-being since the 2008 global financial crisis (ADBI, 2013) – and this book will review Asia's experience of the policies and practices for low-carbon green growth in the last decade. At this juncture, however, the agenda has gained greater urgency given the need for the region to move to a post-COVID-19 recovery.

The remainder of this introductory chapter reviews Asia's economic landscape before the COVID-19 pandemic and elaborates on how the pandemic makes the low-carbon resilient development agenda more urgent. It highlights the experience of low-carbon growth implementation in the past decade and, considering the COVID-19 challenges, points out future strategic priorities for the region. The chapter then gives a thematic overview of the ensuing chapters.

## 2. Shifting Developmental Trends, Evolution of Economic Cooperation, and Sustainability Challenges

### 2.1 Economic Landscape of Asia Before the COVID-19 Pandemic

Asia's economic performance has been strong since the 1990s. Gross domestic product (GDP) has almost tripled, rising by more than 6%–9% per year to reach US$65 trillion in 2019. Asia's share in the global economy grew from 21.5% in 1991 to 37.8% in 2019 (World Bank, 2021). The bulk of the growth has come from the developing markets of China, India, and Southeast Asia. Other indicators of economic growth are equally striking. Exports have increased to one-fifth of the world's total, or more than US$18 trillion per year, making the region one of the most open trading regions in the world (UNTCAD, 2018). The region has been the largest destination for foreign direct investment for the past 2 decades and has US$2.0 trillion worth of foreign exchange reserves (UNCTAD, 2020). For the 10 ASEAN Member States (AMS) (Brunei, Cambodia, Indonesia, the Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam), China, and India – for which comparable data are available – the share of the population living on less than US$2 per day, a common measure of extreme poverty, dropped from 70% in 1998 to 30% in 2019, lifting more than 150 million people out of poverty (ADB, 2017; Anbumozhi and Bauer, 2010). A huge educated middle-class population has also emerged during the period, contributing to the skilled labour force.

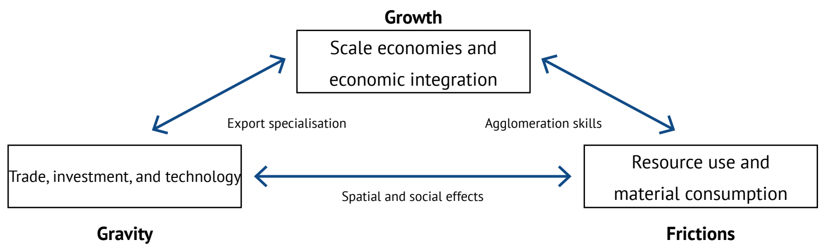
Asian countries have become more integrated with the world economy, which has increased their exposure to international shocks. However, the Asian economic crisis of 1997 and the 2008 global financial crisis have enhanced the resilience capacity of Southeast and East Asian economies. The more open economies – such as Cambodia, Indonesia, Malaysia, and Thailand – were hardest hit in the crises, but were able to bounce back quickly to recover and resume growth.

Structural reforms that were enacted in the aftermath of the crises could be attributed to the enhanced capacity to withstand successive shocks. For instance, the banking sector has become more solid, with capital adequacy ratios strengthened above Basel III levels and non-performing loan ratios and loan-loss provisions comparing favourably with those of many developed countries (Kawai, 2013). Regional cooperation initiatives such as the Chiang Mai Initiative – a multilateral currency swap arrangement amongst the 10 AMS, China, Japan, and the Republic of Korea (henceforth, Korea) – and the ASEAN Free Trade Agreement have their roots in the 1997 Asian financial crisis. That was a determining moment when many policymakers saw for the first time the risks that came with the benefits of globalisation.

The widely quoted ASEAN Rising of the Economic Research Institute for ASEAN and East Asia (ERIA) (Intal et al., 2014) and ASEAN, PRC, and India: The Great Transformation (ADBI, 2014a) explained the superior economic achievements of high-performing economies in the region. They concluded that these economies achieved high growth by getting the basics right. These two books and ASEAN 2030 (ADBI, 2014b) went on to claim that fundamental macroeconomic policies were only part of the success story and that, in one form or another, governments had intervened systematically and through multiple channels. Large infrastructure connectivity programmes have boosted growth in several of the countries (Baviera and Maramis, 2017). They have been effective in facilitating investment in energy, transport, and communication connectivity (Kawai and Lee, 2015). Sizeable fiscal stimulus and massive liquidity injections in Japan, Korea, and China immediately after the 2008 financial crisis also contributed to the fast economic recovery. Thus, a willingness to experiment, together with policies adapted to changing circumstances, were the key elements of the sustained and resilient economic growth of ASEAN and East Asia before COVID-19 struck the region.

Another salient feature of the rapid economic growth of AMS during that period was a market-driven process of regional economic integration that has seen the intra-regional acceleration of trade, finance, innovation, and infrastructure investments while globalisation was taking hold.

**Figure 1.1 Principal Forces of Economic Development in ASEAN and East Asia**




ASEAN = Association of Southeast Asian Nations.
Source: ERIA Study team.

In many respects, the 1997 and 2008 financial crises increased the pace of this regional integration process, as can be seen from the number of international and regional free trade agreements recently concluded (ARIC, 2021).

Figure 1.1 summarises the principal forces that have driven the region's economic development. High growth occurred because of the exploitation of the scale economies that developed through export specialisation. This integration shifted the centre of gravity of global economic growth towards the region. When they are well managed, the resource-use and regional development trends feed back into more scale economies through the agglomeration of production and more rapid skill formation. On the other hand, over-exploitation of resources and unsustainable consumption in some parts of the region led to a reduction in the resources for sustainable growth in the future, resulting in developmental gaps.

This characterisation of the principal forces of economic development in Asia also reflects the fact that this is a region of diversity, with countries encompassing high-income, upper middle-income, lower middle-income, and low-income economies. This diversity creates opportunities for countries at different stages of development to cooperate for economic complementarity and to develop regional production networks, alongside efforts towards regional infrastructure and trade and investment reforms.

### 2.2. Industrialisation: Competitiveness, Resource Use, and the Technology–Trade Nexus

Scale economies played an important role in Asia's rapid industrialisation, as they resulted in efficiency gains from large production volumes, which improved competitiveness (ERIA, 2015). The industrial competitiveness utilised the international division of labour and pioneered the formation of international production networks (IPNs). Taking advantage of open trade policies, technology transfer, and knowledge spillovers that reduced service link costs, local firms in Southeast and East Asia quickly became able to participate in the IPNs. Global supply chains (GSCs) originating in the region have expanded at different rates, with the apparel and automobile sectors growing in the 1980s; the electronics industry in the 1990s; and the service sector, especially business process outsourcing, being the most dynamic in the 2000s. In terms of dispersion and complexity, IPNs should be differentiated from GSCs. While GSCs include all sorts of international industrial links, IPNs (e.g. in the automobile and electronics industries) are based on the task-wise international division of labour connected by tight service links (Kimura, 2020). Because of the interconnectedness of the participating firms and the built-in technical and financial assistance programmes mentored by lead firms, IPNs are known to be more resilient against external shocks.

The extraordinary ramping up of GSCs and IPNs over the past 3 decades has been accompanied by high rates of resource consumption.[1] Natural resources account for an important share of total wealth in the region – on average, more than 20% of total wealth, well above the 2% average in Organisation for Economic Co-operation and Development (OECD) countries (OECD, 2021). Oil, gas, and wood are the most important resources in the region. Resource extraction for economic use increased from 9 billion tons in 1985 to 13 billion tons of resources in 2005 and reached almost 23 billion tons in 2015 (OECD, World Bank, and UN Environment, 2018).

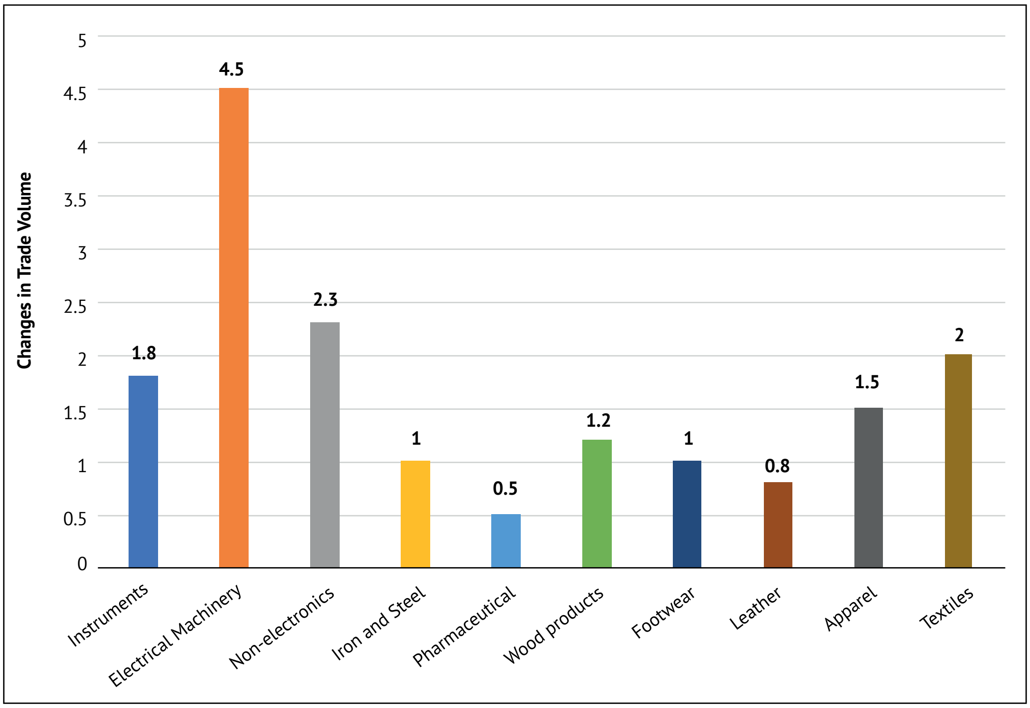
During 1997–2019, the growth of resource extraction in Asia was much faster than the global average. The share of emerging Asian countries, including China, India, and ASEAN, in global resource extraction increased from 22% in 1985 to 31% in 2015 (Anbumozhi et al., 2016). The composition of extracted resources changed considerably over time. While renewable resources such as biomass accounted for almost half of all extraction in 1990, this share diminished to 36% in 2015, as extraction of non-renewable resources increased at a much higher pace (Anbumozhi and Kalirajan, 2017). Large amounts of sand, gravel, and other bulk construction materials have been used to build urban infrastructure and manufacturing plants. This growing share of non-renewable resources is one of the main characteristics of the competitive industrialisation process, which has accelerated significantly in many developing AMS since the beginning of the 1990s (Wolf et al., 2016). As a result of this process, the region consumed 20% of world energy in 2000 but 29% in 2019 (IEA, 2020; Kimura and Han, 2021). This poses a serious challenge to sustainable growth, in view of the finite resource base, climate change, and the fragile ecology on which countries of the region depend for economic expansion, social well-being, and human development.

Asia's industrialisation has taken place along with technological improvements in some salient ways (ADB, 2020). Highlighted here is the technology–trade nexus. Over time, exports of modern technology products requiring more highly skilled labour have overtaken exports of products requiring lower skilled labour. Falling under the broader category of 'machinery' in international trade statistics, these goods account for more than half of ASEAN and East Asia's exports, energy use, and embedded carbon emissions.

This trend may best be explained by two related technological developments that have been profoundly affected by goods produced in the developing countries of Asia and sold worldwide. First, scale economies exist in the manufacture of products such as electrical machinery, scientific instruments, iron and steel, and pharmaceuticals (Figure 1.2), which are also energy intensive. On the other hand, products such as wood, leather, apparel, and textiles show no tendency towards scale economies; these industries have seen their exports fall.

[1] In general, four major types of resources are considered: (i) agriculture, forestry and fishery, and biomass products (including textiles and wood products such as paper); (ii) fossil energy carriers (coal, oil, gas, and peat), used for energetic and non-energetic purposes (including chemicals based on fossil materials); (iii) minerals (industrial and construction minerals) and mineral products (such as glass or natural fertilisers); and (iv) metal ores and metal products (including, for example, machinery).

**Figure 1.2 Changes in the Export Share of ASEAN and East Asian Economies, 1991–2016 (%)**




ASEAN = Association of Southeast Asian Nations.

Source: ERIA Study team.

Second, the evolution of the trade–technology nexus in East Asia also illustrates the shifting location of production and technology transfer, as described by the famous 'flying geese' analogy (Akamatsu, 1962). According to this model, a lead economy, such as Japan, develops new technologies and production capabilities, but, as it develops, it shifts these techniques to economies with cheaper labour. In this way, mature industries migrate from more to less developed economies, while the lead economy specialises in more sophisticated technologies and complex industries (Fujita, Krugman, and Venables, 2001).

This resulted in a trend whereby firms in the developing countries of ASEAN relied extensively on technology from the advanced economies of East Asia, Europe, and the United States, where nearly 80% of relevant global innovations have happened (OECD and ASEAN, 2020). Developing AMS and firms have used different mechanisms to acquire technology, depending on the sector and the stage of industrial development. It is a well-known fact that export-oriented firms along the global value chain tend to be more technologically efficient than their non-exporting domestic counterparts. Indeed, technological innovation, transfer, and absorption have stimulated and caused exports (ERIA, 2012). By undertaking original equipment manufacturing production, firms constantly upgrade their technological capabilities with the assistance of foreign buyers (Ando and Kimura, 2003; Kawai, 2013). Once established, they develop their ability to do create their own products, thereby moving up the technology value chain.

This technology–trade nexus has a profound impact on energy consumption and pollution in the developing countries of ASEAN. The total energy supply in the leading 'goose', Japan, in 1955 was 64 million tons of oil equivalent. The main energy source at that time was carbon-intensive coal, which accounted for 47% of total energy supply (IEEJ, 2017). The primary energy supply continued to expand in line with economic growth, totalling 385 million tons of energy equivalent in 1973 (IEEJ, 2017), although the pace of the increase slowed because of energy sector regulations and changes in industrial structure. Manufacturing industries have curbed their final energy consumption as the emphasis has moved from materials-based production to other light industries. The iron and steel industry has made remarkable progress in promoting energy conservation. As a result, the proportion of final energy consumption accounted for by manufacturing industries, which was 36% in 1974, declined to 26% in 2006 (APERC, 2008). The combined share of four energy-intensive industries – steel, paper and pulp, chemicals, and cement – declined from 44.4% in 1974 to 31.0% in 2006 (APERC, 2008).

In many AMS, China, and India, air and water pollution already threaten the well-being of local communities. A sharp rise in industrial production, growing reliance on coal-fired power plants, and increases in the use of motorised vehicles have all contributed to higher air pollution. Concentrations of particulate matter are very high in megacities. The rapid pace of urbanisation and industrialisation in some countries is also contributing to water pollution, adding to pollution coming from agriculture and residential sectors (Limaye and Limaye, 2011). Waste generated from households and industries already represents a serious environmental challenge in many ASEAN and East Asian countries. While low- and middle-income countries produce considerably less waste than high-income countries in the region, rapid urbanisation, industrialisation, and strong economic growth are likely to see the amount of waste increase rapidly. Open dumps are the most hazardous waste disposal method in several countries, easily polluting air and groundwater.

### 2.3. Poverty, Inequality, and the Middle-Income Trap

The region's fast and robust growth since the 1990s has moved hundreds of millions of people out of poverty. Table 1.1 catalogues the growth trends of the countries, together with the number of years they have had low and high growth rates. The region's economic growth has remained remarkably strong. Table 1.1 shows that the region's fight against poverty is far from over. Several countries still have a large share of their population living below the income poverty line. Using non-monetary measures, a large section of the population does not have access to necessities such as electricity, safe drinking water, and sanitation. For example, a substantial portion of the population – about 200 million people – does not have access to electricity (Anbumozhi et al., 2017).

The region is also confronted with the challenge of persisting inequality. Measured by the Gini coefficient, income inequality rose by more than 22% between 1990 and 2018 (ERIA, 2020b). The between-country inequality fell thanks to regional economic integration, which seems to have

**Table 1.1 Distribution of Economic Development and Income Inequality**

| Country | Population (2019, People) | Economic growth rate (30 years average) | Number of years | | | Percentage of populaiton living below poverty line (Data from 2012-2019) | Gini index (data from 2012-2019) | Percentage of populaiton living without electicity | Energy consumption per capita (2019, in kWh) |
|---|---|---|---|---|---|---|---|---|---|
| (ASEAN+6) | | | Negative growth rate | Growth rate in range 0-2% | Growth rate above 2% | | | | |
| Australia | 25,365,745 | 2.99 | 1 | 0 | 29 | 13.6 | 34.4 | <1 | 70,644 |
| Brunei Darussalam | 433,285 | 1.12 | 9 | 7 | 14 | N/A | - | <1 | 123,822.666* |
| Cambodia | 16,486,542 | 7.21 | 0 | 2 | 28 | 17.7 | 30.8* | 4 | 2,933.223* |
| China | 1,397,715,000 | 9.32 | 0 | 0 | 30 | 0.6 | 38.5 | <1 | 27,452 |
| India | 1,366,417,754 | 6.55 | 0 | 0 | 30 | 21.9 | 35.7 | 4.76 | 6,924 |
| Indonesia | 270,625,568 | 5.17 | 1 | 1 | 28 | 9.4 | 38.2 | 2 | 9,147 |
| Japan | 126,264,931 | 1.07 | 6 | 9 | 15 | 15.7 | 32.9 | <1 | 40,889 |
| Republic of Korea | 51,709,098 | 5.18 | 1 | 1 | 28 | 14.4 | 31.4 | <1 | 67,083 |
| Lao PDR | 7,169,455 | 6.76 | 0 | 0 | 30 | 18.3 | 38.8 | 2.08 | 12,009* |
| Malaysia | 31,949,777 | 5.77 | 2 | 1 | 27 | 5.6 | 41.1 | <1 | 37,054 |
| Myanmar | 54,045,300 | 8.43 | 1 | 0 | 29 | 24.8 | 30.7 | 27 | - |
| New Zealand | 4,979,300 | 2.8 | 3 | 4 | 23 | N/A | 38.5 | <1 | 53,225 |
| Philippines | 108,116,615 | 4.57 | 2 | 2 | 26 | 16.7 | 42.3 | 5.14 | 5,200 |
| Singapore | 5,703,569 | 5.84 | 2 | 3 | 25 | N/A | 37.5%** | <1 | 169,886 |
| Thailand | 69,625,582 | 4.45 | 3 | 3 | 24 | 9.9 | 34.9 | <1 | 22,399 |
| Viet Nam | 96,462,106 | 6,92 | 0 | 0 | 30 | 6.7 | 35.7 | <1 | 11,862 |

kWh = kilowatt-hour, N/A = not available.

* 2016 data.

** Singapore: Household income from work per household member (including employer CPF contributions) after accounting for government transfers and taxes.

Sources: World Bank (2019), World Development Indicators. https://databank.worldbank.org/source/world-development-indicators (accessed 30 September 2021); IEA (2020); and Our World in Data (2019), https://ourworldindata.org/ (accessed 30 September 2021).

helped to bring the average living standards closer across countries. However, the inequality within countries widened. An aspect of inequality that is robust across all countries in the region is rural–urban differentials in income, electricity consumption, poverty, education, and emissions. Urban mean electricity consumption levels are 50%–100% higher than rural levels.

During the past 30 years, a number of Asian countries have moved from levels of income associated with abject poverty to levels that have earned them middle-income status. With China, India, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam having average per capita GDP between US$1,000 and US$10,000, about 90 out of every 100 people in the region now live in a middle-income country (IMF, 2021). This region encompasses more middle-income countries than high-income and low-income countries.

It is logical for policymakers in countries that are attaining middle-income status to ask what should be done to ensure that their countries' income levels do not stagnate. While recognising the domestic efforts of these countries towards achieving middle-income status, an important driver in the process was the development of regional production and distribution networks, technological progress, and greater spending on research and development (Ando and Kimura, 2003; Anbumozhi and Kawai, 2015).

Going forward, regional integration and cooperation remains a key driving factor for Asia's middle-income countries to succeed. The necessary institutional infrastructure exists for this continuing cooperative effort. The ASEAN Economic Community was inaugurated in 2016, providing a framework for the free flow of goods, services, investment, capital, and skilled labour. ASEAN+ cooperative platforms are also in place. It is important for countries to work together with these processes.

## 3. Rethinking Low-Carbon Green Growth and Raising Ambitions for a Net Zero Economy

The rapid growth of the regional economy has provided tremendous growth potential for industry, but as noted earlier, has also brought interlinked environmental and social pressures. ASEAN and East Asian countries are some of the world's most vulnerable to climate-induced natural disasters. From 1990 to 2019, this region accounted for up to 80% of deaths and 38% of global economic losses from natural disasters (Anbumozhi, Breiling, and Reddy, 2019). Disasters such as Cyclone Negris in Myanmar in 2008, the 2011 floods in Thailand, and the 2013 Typhoon Haiyan in the Philippines are amongst the worst ever recorded in these countries. According to Anbumozhi, Kimura, and Thangavelu (2020) estimates, the damage caused by the 2011 floods in Thailand amounted to around 13% of GDP. To mitigate the risks associated with the increasing likelihood of such disasters, countries in the region will need to improve land use planning and formulate appropriate policies.

Model simulations suggest that Southeast and South Asia will be the regions of the world most negatively affected by climate change in the coming decades. According to several studies (ADB, 2016; Anbumozhi, Breiling, and Reddy, 2019; OECD et al., 2015), climate change could result in GDP loss of 5%–9% in 2050, i.e. above a baseline involving no climate change. A large share of these losses is likely to occur in the agriculture, water, and health sectors, which are important for sustaining economic growth.

The global environmental and local social challenges that accompany rapid economic growth were met in part by the Paris Agreement, the United Nations Sustainable Development Goals, the ASEAN Community Blueprint, and of late the ASEAN Comprehensive Recovery Framework which advocates a low-carbon green growth paradigm. Low-carbon green growth can help countries to meet the challenge of sustaining economic and social development in the short term while safeguarding longer-term economic performance and human well-being.

Rather than replacing the concept of sustainable development, low-carbon green growth encourages pathways to achieving it without neglecting the desire for continuing increases in conventionally measured standards of living. The concept and principles require the decoupling of economic growth from carbon emissions and the recoupling of economic growth with intergenerational social equity and social capital creation. It abandons the conventional linear economic model of development, to explore alternative modes of growth that emphasise the co-benefits or the triple dividends – economic growth, environmental

**Table 1.2 Nationally Determined Contributions Set in the Paris Climate Agreement**

| Target | High-income countries | Upper middle-income countries | Lower middle-income countries |
|---|---|---|---|
| Reduction below BAU | Republic of Korea: 37%<br>Brunei Darussalam: 63% | Thailand: 20%–25%* | Viet Nam: 8%, 25%*<br>Indonesia: 29%, 41%*<br>Cambodia: 27%* |
| Absolute reductions | Australia: 26%–28%<br>Japan: 26% below 2013 level | | |
| Emissions intensity | Singapore: 36% below 2005 level | China: 60%–65% below 2005<br>Malaysia: 35%, 45%* below 2005 level | India: 33%–35% below 2005 level |

* 2030 nationally determined contributions conditional target emission reduction.

BAU = business as usual.

Source: Compiled by the ERIA Study Team.

preservation, and social equity – of attaining a net zero economy.

### 3.1. Climate Change, the Paris Agreement, and Net Zero Emissions

Even before the COVID-19 outbreak, the world had already warmed, on average, by just over 1°C since pre-industrial times (IPCC, 2018). When countries struck the landmark Paris Agreement in 2015, they committed to limit global temperature rises to well below 2°C compared with pre-industrial levels. Nations also agreed to strive for an even safer cap on warming of 1.5°C through voluntary emissions-cutting plans, known as Nationally Determined Contributions (NDCs), which would be ratcheted up in scope and ambition every 5 years. Table 1.2 shows the wide variations in the carbon emission reduction targets set by countries in the ASEAN and East Asia region.

To achieve the global goal of net zero emissions established in Article 4 of the Paris Agreement, each country that has signed and ratified the agreement must consider how to contribute to the goal with more ambitious NDCs. Various mitigation pathways are consistent with the 1.5°C target and net zero emissions, all of which would require transformational change in energy and economic systems across the region. The IPCC (2018) noted that for net carbon emissions to peak by 2030, the following are required: an emphasis on rapid and deep decarbonisation of the global energy supply in the near term; demand-side mitigation efforts across all end-use sectors, such as switching from fossil fuels to electricity in the transportation and residential sectors; and substantial shifts in investment patterns, away from carbon-intensive energy production, energy efficiency improvement demand reduction, and the adoption of carbon capturing and recycling at scale.

Table 1.3 presents the current and projected carbon emission trends for the region until 2040. The region's share in global emissions is expected to surge, driven by rapid economic growth and a rising population. According to Kimura and Han (2021), the energy demand and energy-related carbon emissions of the 16 economies are likely to double between 2020 and 2040. The growth rates of developing ASEAN are well above those observed in the developed countries of Japan, Korea, Australia, and New Zealand over the same period, but are broadly comparable with the large emerging economies of China and India.

## Table 1.3 Current and Projected Energy Use and Carbon Emission Trends

| Country | Population | | $CO_2$ Emissions | | $CO_2$ Emissions per capita | | Emission Intensity ($tCO_2$/GDP) | Total Energy Demand* | | Electricity Consumption |
|---|---|---|---|---|---|---|---|---|---|---|
| (ASEAN+6) | 2020 | 2040 | 2020 | 2040 | 2020 | 2040 | 2020 | 2020 | 2040 | 2019 |
| Unit | Million | | Mt | | t/capita | | $tCO_2$/GDP | Mtoe | | TWh |
| Australia | 25.5 | 30.6 | 380.7 | 358.4 | 14.9 | 11.7 | 246 | 83.3 | 89.6 | 235 |
| Brunei Darussalam | 0.4 | 0.6 | 1.4 | 1.8 | 3.1 | 3.0 | 88 | 2.0 | 2.8 | 3 |
| Cambodia | 16.7 | 22.5 | 3.3 | 13.9 | 0.2 | 0.6 | 158 | 4.5 | 13.1 | 10 |
| China | 1,440.0 | 1,449.8 | 9,941.5 | 9,853.4 | 6.9 | 6.8 | 814 | 2,163.1 | 2,338.1 | 6,510 |
| India | 1,380.5 | 1,593.3 | 2,545.7 | 5,355.4 | 1.8 | 3.4 | 778 | 680.5 | 1,343.4 | 1,230 |
| Indonesia | 272.1 | 311.6 | 142.5 | 307.2 | 0.5 | 1.0 | 117 | 180.2 | 360.8 | 245 |
| Japan | 125.8 | 112.7 | 1.058.9 | 861.0 | 8.4 | 7.6 | 168 | 286.2 | 244.6 | 960 |
| Korea, Republic of. | 51.9 | 52.8 | 587.8 | 693.4 | 11.3 | 13.1 | 403 | 192.9 | 222.0 | 553 |
| Lao PDR | 7.3 | 9.8 | 5.4 | 9.4 | 0.7 | 1.0 | 372 | 3.4 | 7.4 | 6 |
| Malaysia | 32.4 | 38.9 | 60.5 | 120.1 | 1.9 | 3.1 | 151 | 68.2 | 137.3 | 155 |
| Myanmar | 55.0 | 62.7 | 9.6 | 21.1 | 0.2 | 0.3 | 99 | 19.2 | 35.2 | 18 |
| New Zealand | 5.0 | 6.0 | 33.2 | 30.2 | 6.6 | 5.0 | 169 | 15.0 | 14.5 | 40 |
| Philippines | 105.2 | 141.7 | 37.4 | 86.4 | 0.4 | 0.6 | 123 | 41.5 | 85.0 | 106 |
| Singapore | 5.8 | 7.2 | 19.0 | 27.2 | 3.3 | 3.8 | 53 | 25.3 | 31.4 | 47 |
| Thailand | 69.9 | 74.4 | 58.9 | 114.3 | 0.8 | 1.5 | 127 | 94.7 | 176.3 | 194 |
| Viet Nam | 96.6 | 107.0 | 64.0 | 178.4 | 0.7 | 1.7 | 298 | 70.5 | 157.8 | 217 |

$CO_2$ = carbon dioxide, GDP = gross domestic product, Mt = million tons, Mtoe = million tons of oil equivalent, t = ton, $tCO_2$ = ton of carbon dioxide, TWh = terawatt-hour.

* Total energy demand includes total demand on industry, transportation, others, and non-energy sectors.

Sources: Kimura and Han (2021); Enerdata (2020), $CO_2$ Emissions from Fuel Combustion. https://yearbook.enerdata.net/co2/emissions-co2-data-from-fuel-combustion.html (accessed day month year); CEIC Data (2021), https://insights.ceicdata.com/Untitled-insight/myseries (accessed 23 April 2021).

The low per capita carbon emissions of most developing countries are largely explained by their lower income, but the carbon intensity of their GDP is close to the average of the advanced countries. On average, AMS perform better in terms of their carbon intensity than China, India, and Korea, which could be explained by the lesser importance of heavy industry. The sooner the region's emission trajectory begins to trend downward towards net zero, the smoother will be the transition to a low-carbon economy at the global level. Improving energy efficiency and achieving net zero emissions will result in a triple dividend: reducing pollution, conserving scarce natural resources, and improving the international competitiveness of the region's export-oriented economies.

The term 'net zero emissions' often refers to achieving an overall balance between greenhouse gas emissions produced and the past emissions taken out of the atmosphere. Getting to net zero means economies can still produce some emissions, if they are offset by processes that reduce greenhouse gases already in the atmosphere. Nineteen countries have already adopted net zero targets, and more than 100 others are considering doing so. Japan and Korea have each announced goals for reaching net zero carbon emissions by 2050, and China by 2060. Indonesia is considering setting a net zero emissions target for 2070 as part of its efforts to update its NDCs, while maintaining the country's previous pledge to reduce emissions by 29% if reliant on its own ability to finance decarbonisation, or by 41%

with international assistance, by 2030 (ACE, 2020). In Thailand, the energy and environmental authorities are together planning to achieve zero net carbon emissions by adjusting the fuel mix in the country's power generation industry.

While countries have made national level pledges of carbon emission reductions in line with the Paris Agreement, detailed plans for how they will get there are largely missing. It is important to have detailed decarbonisation plans carefully developed at the sector, industry, and subnational levels, with financing and implementation arrangements established.

### 3.2. The Impact of COVID-19 on the Low-Carbon Energy Transition

The economic impact of COVID-19 on export-led Asian economies has been felt predominantly through three channels: disrupted supply chains and decreased manufacturing, a complete halt in tourism, and changes in patterns of domestic demand. The extent to which these channels affect the economy, change consumption, and reduce carbon emissions very much depends on how strictly and lengthily pandemic containment measures, including social distancing measures and vaccination programmes, are implemented in each country. Nevertheless, the combination of a sharp drop in exports, tourism, and domestic demand led to deep recessions in most of the emerging economies in 2020. Large contractions in GDP growth in the range of −2% to −9% were observed in most of the economies in the region (ADB, 2021). These outcomes have already widened income inequality, disrupted financial markets, and caused deep cuts in planned public spending on infrastructure development (IMF, 2021). The cumulative economic and financial fallout is estimated to be much worse than that of the 1997 Asian economic crisis and the 2008 global financial meltdown (Table 1.4).

**Table 1.4 Economic Impact of the COVID-19 Pandemic on the Regional Economy**

| Country | Economic growth, 2020 | 'Average economic growth rate (2010-2019)' | Growth forecast | | | | | Fiscal balance | Average fiscal balance [pre-pandemic] | Non-performing assets |
|---|---|---|---|---|---|---|---|---|---|---|
| (ASEAN+6) | | | 2021 | 2022 | 2023 | 2024 | 2025 | Percentage of GDP 2020 | Percentage of GDP 2010-2020 | Percentage of GDP |
| Australia | -2.4 | 2.58 | 4.5 | 2.8 | 2.3 | 2.3 | 2.4 | -0.7 | -2.6 | 0.961 |
| Brunei Darussalam | 1.2 | 0.51 | 1.6 | 2.5 | 2.3 | 2.1 | 2.1 | no data | no data | 3.899 |
| Cambodia | -3.5 | 7.03 | 4.2 | 6.0 | 6.3 | 6.6 | 6.7 | -2.6 | -2.5 | 1.554 |
| China | 2.3 | 7.67 | 8.4 | 5.6 | 5.4 | 5.3 | 5.1 | -5.5 | -2.7 | 1.862 |
| India | -8.0 | 6.98 | 12.5 | 6.9 | 6.8 | 6.7 | 6.6 | -6.6 | -7.3 | 9.234 |
| Indonesia | -2.1 | 5.44 | 4.3 | 5.8 | 5.7 | 5.4 | 5.2 | -1.8 | -1.9 | 2.433 |
| Japan | -4.8 | 1.28 | 3.3 | 2.5 | 1.1 | 0.7 | 0.6 | -2.1 | -5.5 | no data |
| Republic of Korea | -1.0 | 3.31 | 3.6 | 2.8 | 2.6 | 2.4 | 2.3 | 1.5 | 1.5 | 0.254 |
| Lao PDR | -0.4 | 7.16 | 4.6 | 5.6 | 5.8 | 5.8 | 6.1 | -5.0 | -3.7 | no data |
| Malaysia | -5.6 | 5.33 | 6.5 | 6.0 | 5.7 | 5.3 | 5.0 | -2.5 | -3.1 | 1.534 |
| Myanmar | 3.2 | 6.62 | -8.9 | 1.4 | 4.7 | 5.0 | 5.0 | -3.8 | -2.7 | no data |
| New Zealand | -3.0 | 2.89 | 4.0 | 3.2 | 2.6 | 2.5 | 2.4 | 0.7 | -1.0 | no data |
| Philippines | -9.5 | 6.38 | 6.9 | 6.5 | 6.5 | 6.5 | 6.5 | -1.4 | -0.5 | 1.974 |
| Singapore | -5.4 | 4.96 | 5.2 | 3.2 | 2.7 | 2.6 | 2.5 | 3.1 | 5.4 | 1.306 |
| Thailand | -6.1 | 3.64 | 2.6 | 5.6 | 3.8 | 3.5 | 3.6 | -0.7 | -0.3 | 3.130 |
| Viet Nam | 2.9 | 6.50 | 6.5 | 7.2 | 6.9 | 6.8 | 6.6 | -4.3 | -4.8 | 1.501 |

ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, GDP = growth domestic product.

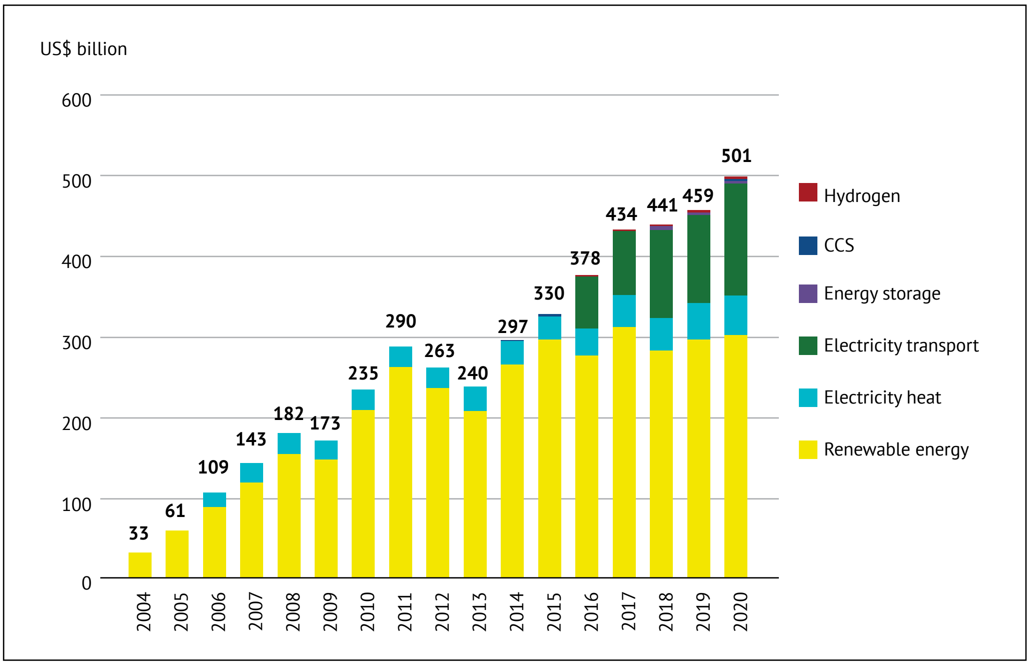
Sources: IMF (2020) https://www.imf.org/ (accessed 30 September 2021); World Bank (2019) https://databank.worldbank.org/ (accessed 30 September 2021).

As countries recover from the pandemic, in the short and medium term individual economies are projected to expand by at least 2%–7% every year (World Bank, 2021). The projected growth rates for the next 5 years, however, are based on the assumption of the successful COVID-19 containment measures and pre-pandemic economic structures of countries.

Figure 1.3 shows global trends in energy investment. The energy sector, particularly electricity, has played a critical role in the immediate response to the pandemic. Uninterrupted energy supplies have enabled hospitals to provide healthcare, food, and other essentials to be transported and delivered; and allowed people to study and work from home. However, the pandemic has also slowed down low-carbon energy investment, creating short-term uncertainties and long-term implications for the financing landscape. The quarantines, industrial lockdowns, and work-from-home arrangements have changed the ways in which energy is consumed and interrupted the supply chains of both fossil fuels and renewable energy, with corresponding lost revenues.

Figure 1.4 shows the changes in energy demand and investment at the global level. Global energy demand is estimated to have fallen by around 5%–9% in the period between the outbreak in March 2020 and December 2020, compared with the same period in 2019 (IEA, 2020). Some countries, including Malaysia and the Philippines, experienced a drop of 30%–45% in electricity demand during the first half of 2020, though this bounced back in the third quarter (ACE, 2020). The oil demand of ASEAN and East Asian

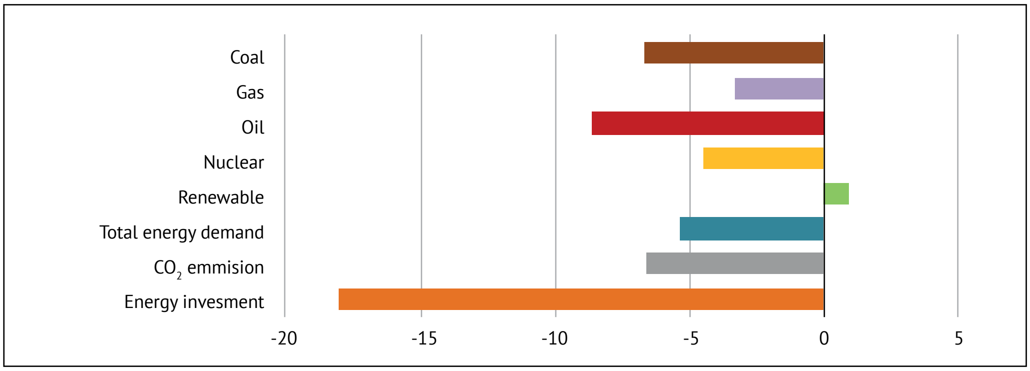
**Figure 1.3 Trends in Global Energy Investment**




CCS = carbon capture and storage.

Source: BloombergNEF (2021).

**Figure 1.4 Changes in Global Energy Demand and Low-Carbon Investment During the COVID-19 Pandemic**




$CO_2$ = carbon dioxide, COVID-19 = coronavirus disease.

Source: IEA (2020).

countries declined by 8% during that period, with transport and aviation fuel demand accounting for the biggest declines. While the renewable energy output was steady at a global level, fossil fuel producers saw a fall in demand, imposing cuts in profitability. Although electricity demand shifted from the industrial and transport sectors to the residential sector, increased household use has been outweighed by a massive reduction in demand from commercial offices and industrial operations (ERIA, 2020a). The experience in 2008 offers potential lessons. The annual carbon dioxide ($CO_2$) emission growth rate decreased by half in 2008 (to 1.7%, from 3.3% in 2007), mainly driven by the 0.6% drop in oil consumption that resulted from the economic slowdown and high oil and food prices at the time (Hamilton, 2009). However, global emissions rebounded in 2010 due to emissions growth in several developing economies of ASEAN, China, and India; economic stabilisation in developed economies; and an increase in fossil fuel intensity, particularly due to the use of coal and gas (Grossman, 2015). The rebound in energy demand depends on the roll-out of vaccines and a recovery of the industry and transport sectors.

Relative to 2019, global energy investment contracted by 17%, with a particularly hard impact on energy jobs – although employment more generally also suffered (IEA, 2020). About 8.3 million jobs are estimated to have been lost due to the COVID-19 outbreak in the Philippines. Indonesia's Planning and Development Agency reported that its unemployment rate rose to about 10.0%, or nearly 14 million people, from April to December 2020, a substantial number of whom worked in the energy and manufacturing sector (ILO, 2020a; ILO, 2020b). Ducanes (2020) estimated that up to 2 million jobs may be lost in ASEAN, both directly and indirectly, nearly one-third of which are in the energy sector. Significant efforts should be made for the region to generate more jobs through future low-carbon energy investments. Nevertheless, it should be noted that the recovery may be rapid in 2021, depending on the pandemic response measures implemented as well as new economic and industrial activities supported by special fiscal stimulus packages.

### 3.3.Stimulus Measures and Financing Decarbonisation

Governments in ASEAN and East Asia are responding to this crisis on a massive scale, producing fiscal stimulus packages to counter the negative economic impacts of COVID-19 totalling 3%–13% of GDP from April to December 2020. The total stimulus of G20 countries up to December 2020 amounts to US$13.0 trillion, and presents an opportunity to support resource-intensive sectors through the COVID-19 crisis while boosting global resilience to mounting climate and biodiversity risks (Vivid Economics, 2021). The Greenness of Stimulus Index of Vivid Economics shows that the developing and emerging economies which are most dependent on environmentally intensive and high-carbon sectors, and lacking in strong regulatory oversight, have the biggest task in turning their stimulus green, and have so far failed to harness this opportunity, though a few are rising to meet the challenge.

The fiscal interventions made by individual governments in ASEAN can be classified into three categories (ASEAN, 2020). The first is household subsidies, including cash allowances and subsidies for social security contributions, which are crucial for the daily needs of low-income households. Governments have provided tax exemptions, rent moratoriums, and restructuring of bank loans for affected businesses. The combination of fiscal measures and economic contractions is likely to lead to a sizeable increase in public debt across major emerging economies in ASEAN and East Asia. The monetary policy response of most central banks in the region has been conventional: increased liquidity for banks and lower interest rates to spur lending. The results of the economic and monetary stimuli are not yet clear but may not be sufficient to support several commercial banks with a high proportion of non-performing assets. The region's leading economies – China, Japan, Korea, Indonesia, Malaysia, Singapore, and Thailand – have pumped about US$2 trillion directly to sectors with relatively high carbon emission intensities: the agriculture, industry, energy, transport, and waste sectors. It is unclear how much of this large amount of investment in high carbon emissions intensity industries was made in accordance with decarbonisation financing standards.

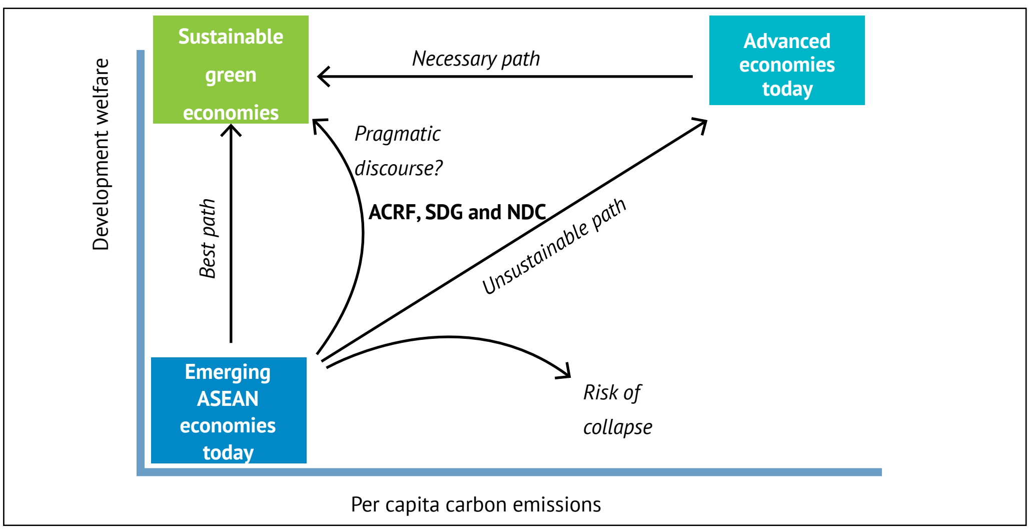
The regional investments needed to implement commitments under NDCs amount to more than US$30 billion per year until 2030 (ADB, 2016; 2017); and achieving net zero emissions by 2050 will require an estimated US$50 trillion annually in investments. Public financing will not be sufficient to achieve all the decarbonisation goals, given the limited funds available as well as competing priorities in the health, education, and social services sectors. International finance for climate change mitigation is similarly limited. Private sector investment will be crucial to close the financing gap, by seizing some of the new business opportunities. An ERIA study identified US$23 trillion of investment opportunities to finance the national climate action commitments of 18 East Asia Summit economies, representing 38% of global greenhouse gas (GHG) emissions (Anbumozhi and Kalirajan, 2017). These investment opportunities include low-carbon buildings, energy efficiency and transport, and clean energy infrastructure. Both governments and the private sector can play a role in unlocking further investment by enhancing the leverage and multiplier effects of their financing – that is, for every dollar of public funding of low-carbon infrastructure development, an additional US$2–US$5 of private investment is mobilised, adding US$40 billion–US$100 billion to development flows every year (Anbumozhi, Kimura, and Kalirajan, 2018). It is essential to develop standards for low-carbon and green investment and to enforce implementation through public financial management and banking systems (Anbumozhi and Yao, 2016; Anbumozhi et al., 2020; Durrani, Volz, and Rosmin, 2020). This is to ensure that the financing made can contribute to achieving genuine decarbonisation goals.

## 4. Seizing the Window of Opportunity for Raising the Rate of Low-Carbon Green Growth

The COVID-19 pandemic has underlined the fragility and the dangers of the old economic paradigm. The dangers of ignoring the links between economic growth, natural resources depletion, and climate risk have come to the fore as the pandemic has taken hold. The COVID-19 health crisis has also underscored the importance of technology, social cohesion, and international cooperation. The pandemic also happened at a time when countries witnessed rapid advances in digital technologies, such as artificial intelligence, robotics, and the internet of things, which brought resilience to several supply chains but also disrupted traditional consumer markets. These risks will only heighten as the COVID-19 crisis continues, economies recover, and populations grow.

Figure 1.5 illustrates that now is a critical juncture to make sweeping advances through the low-carbon green growth agenda that will help governments, businesses, and societies achieve global commitments to the Sustainable Development Goals, the

**Figure 1.5 Sustainable Development Dilemmas of Emerging Economies of Asia**




ACRF = ASEAN Comprehensive Recovery Framework, ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, NDC = Nationally Determined Contribution, SDG = Sustainable Development Goal.

Source: ERIA Study Team.

Paris Agreement, and the ASEAN Comprehensive Recovery Framework.

Today's decisions by policymakers will determine the region's development path for decades. There is evidence that decoupling of carbon emissions from economic growth in many developing countries is not only possible but will also improve social inclusion (ERIA, 2020a). Studies (Fulton and Capilno, 2014; Li and Zhang, 2018; Choi, Liu, and Lee, 2017; Mo, Zhai, and Lu, 2017) have also shown that regional economic cooperation through liberalised trade and investment, integration of carbon markets, and increased investment in innovation on low-carbon products and services can contribute both to lower pollution and emissions and to raising long-term economic growth prospects. Other studies (OECD, 2016; Anbumozhi, Kimura, and Kalirajan, 2018) have also found that public finance support to redirect investments towards low-carbon green technologies is imperative and would have long-term benefits, not least by catalysing private financing channels.

Transition from a COVID-19 shock to a more resilient economy: COVID-19 has exposed and exacerbated inequalities between countries just as it has within countries (IMF, 2021). Countries that have practised short-sighted policymaking and suffered more acute inequalities have tended not to manage the health pandemic well (World Bank, 2021). COVID-19 has highlighted the pressing need for better global risk management and more inclusive growth. Health, economic, digital technology, trade, and other systems interwind through complex networks. Over-arching principles are necessary for risk management and for global systemic risks. Through decentralisation, individuals, businesses, and communities are empowered to make their own quick decisions.

Transition from business as usual to a low-carbon/net zero economy: Whether a clean environment and green infrastructure are to be achieved is being decided now – determining energy consumption, pollution, and natural wealth for decades to come. Developing countries of the region can still leapfrog 20th century technologies and infrastructure investments by adopting low-carbon, viable, and economically viable alternatives. To keep costs and risks low, policymakers need to act now to shape dynamic economies so that they are resource efficient, resilient to climate change, and provide essential services for the socially disadvantaged.

Transition to becoming an innovation hub: The challenge for many of the developing economies that are at middle-income status is to advance to the high-income level. What is needed is innovation and creative industries that increasingly seek green investment opportunities as part of international and domestic trade so that corporate income growth goes hand in hand with low-carbon green growth. The region can lead the global shift, given its production networks and natural resources wealth.

Nevertheless, low-carbon green growth requires a broad range of new strategies involving a mix of policies and instruments, including net zero targets. For example, framework legislation and strategies (e.g. climate laws, renewable energy regulations, and long-term industrial growth strategies); economic instruments (e.g. carbon taxes, subsidy reform, trade policy, and tax incentives for eco-innovation); regulatory instruments (e.g. regarding energy-related emissions, transport technology, and consumer product standards); and other approaches such as information policies, procurement policies, voluntary agreements for small and medium-sized enterprises, and evaluation and accountability mechanisms, can play important roles in the broader low-carbon green growth policy package.

However, reconciling low-carbon climate-resilient growth and social cohesion while financing the investments necessary for sustainable growth requires a holistic approach, although these objectives have mostly been addressed separately so far by the region's governments. A coherent and comprehensive implementation framework is necessary to reduce the short-term costs of moving towards a net zero economy and to avoid adverse social and competitiveness impacts on sectors, firms, and households.

There is evidence that low-carbon green growth can unlock economic opportunities and create jobs. In mid-2020, European governments approved a very ambitious low-carbon green growth programme, agreeing to invest more than €500 billion as an economic response to the pandemic, with 25% of the stimulus to be set aside for climate-friendly measures. The European stimulus proposes investments in renewable energy, energy storage, clean hydrogen, batteries, and carbon capture and storage. It proposes to install 1 million electric vehicle charging points. The European Union recovery package is designed to help to achieve the emission reduction targets adopted in the Paris Agreement, and is projected to add 1% of GDP and create 1 million jobs over the next decade, while investing in the circular economy will add another 700,000 jobs (European Commission, 2020).

The stimulus packages implemented in China, Korea, Japan, and Viet Nam in the aftermath of the 2008 crisis typically included government spending on renewable energy development, industrial energy efficiency, climate-resilient infrastructure, and large-scale support for eco-innovations (Table 1.5). A wide range of policy initiatives, incentive

**Table 1.5 Share of Low-Carbon Economy Components in the 2008 Green Stimulus**

| Economies | Low carbon/Green stimulus (US$ billion) | | | | Share of green stimulus (%) | | |
|---|---|---|---|---|---|---|---|
| | Renewable energy | Energy efficiency | Waste and water | Total | Global total | Fiscal stimulus | GDP |
| China | 1.6 | 182.4 | 34.0 | 218.0 | 41.8 | 33.6 | 3.1 |
| US | 39.3 | 58.3 | 20.0 | 117.7 | 22.5 | 12.0 | 0.9 |
| Republic of Korea | 30.9 | 15.2 | 13.8 | 59.9 | 11.5 | 78.7 | 5.0 |
| Japan | 14.0 | 29.1 | 0.2 | 43.3 | 8.3 | 6.1 | 1.0 |
| EU | 13.1 | 9.6 | - | 22.8 | 4.4 | 58.7 | 0.2 |
| Germany | - | 13.8 | - | 13.8 | 2.6 | 13.2 | 0.5 |
| France | 0.9 | 5.1 | 0.2 | 6.2 | 1.2 | 18.2 | 0.3 |
| UK | 0.9 | 4.9 | 0.1 | 5.8 | 1.1 | 16.3 | 0.3 |
| Canada | 1.1 | 1.4 | 0.3 | 2.8 | 0.5 | 8.7 | 0.2 |
| Italy | - | 1.3 | - | 1.3 | 0.3 | 1.3 | 0.1 |
| **G20 total** | **105.3** | **330.1** | **78.1** | **513.5** | **98.3** | **17.1** | **0.8** |
| **World total** | **107.6** | **335.4** | **79.1** | **522.1** | **100.0** | **15.7** | **0.7** |

EU = European Union, GDP = gross domestic product, UK = United Kingdom, US = United States.

Source: Barbier (2010).

mechanisms, and new regulatory frameworks helped to deliver the intended objectives of green stimulus, but to differing extents.

Green stimuli appeared to be most effective in communities which had workers who already possessed the skills required for green jobs (Popp et al., 2020; Chen et al., 2020). The transformation of several strategic sectors within the emerging economies of ASEAN and East Asia is central to stimulating low-carbon green growth. The key challenge is to carefully select the types of technological and infrastructure investments than can bring both jobs in the short run and sustainability benefits in the medium term. Advancing the low-carbon green growth agenda also requires harnessing innovation potential within and across international borders.

## 5. Overview of the Book

The latest IEA, World Bank, and World Economic Forum joint report (2021) underscored the urgency of speeding up energy transitions and clean energy investments in emerging and developing countries. For developing countries in Asia, the transformation and transition to low-carbon resilient green growth are imperative, feasible, and attractive.

Being heavily dependent on imported resources and energy, the emerging economies of ASEAN and East Asia had already embarked on the application of the new development paradigm before the COVID-19 outbreak. The speed of the transition must rise. Why are perceptions about low-carbon green growth changing and what is the scale of the challenge? What are the successful transformation strategies, policies, and practices and how has the pandemic changed emission trajectories? How can policymakers align pandemic recovery and stimulus packages with long-term sustainability goals? What are the opportunities for cooperation, collaboration, and coordination? This book aims to answer these questions, reviewing the low-carbon green growth policy initiatives taken by countries at the national, sectoral, and local levels, and assessing the achievements made, while identifying the gaps and examining the new opportunities in the transition to a net zero economy.

Aiming to inform national leaders about low-carbon green growth in the context of COVID-19, the book covers:

- the experience of low-carbon energy transitions during the last decade to identify major trends, performance drivers, and gaps;
- an updated outlook for emission reduction scenarios to achieve sustainability, inclusion, and resilience;
- the economy-wide impact of COVID-19 and the dynamics of structural changes;
- the evolving course of the pandemic recovery and the content of stimulus packages;
- developing new means of financing low-carbon green growth;
- promoting regional cooperation to accelerate the transition; and
- key conclusions and recommendations to help policymakers advance the low-

carbon green growth agenda in the region.

The book takes a practical approach to low-carbon green growth, as applicable to ASEAN and East Asia. It includes contributions about the practical implications of emission reduction policies from a regional perspective and the various ways to incorporate the concept of green growth in day-to-day policymaking. The chapter-by-chapter outlines are narrated below.

Chapter two of the book assesses the evolving global mega trends and converging regional perspectives on low-carbon green growth as an integral part of an inclusive and sustainable development agenda. The megatrend assessment is important to inform countries that design and update their post-recovery package with more ambitious NDC targets. The chapter also highlights a few major takeaways from the megatrend assessment, which will help regional policymakers to track the results of their policies and public investments. Thus, the chapter sets a broad context for country and thematic discussions in the ensuring chapters.

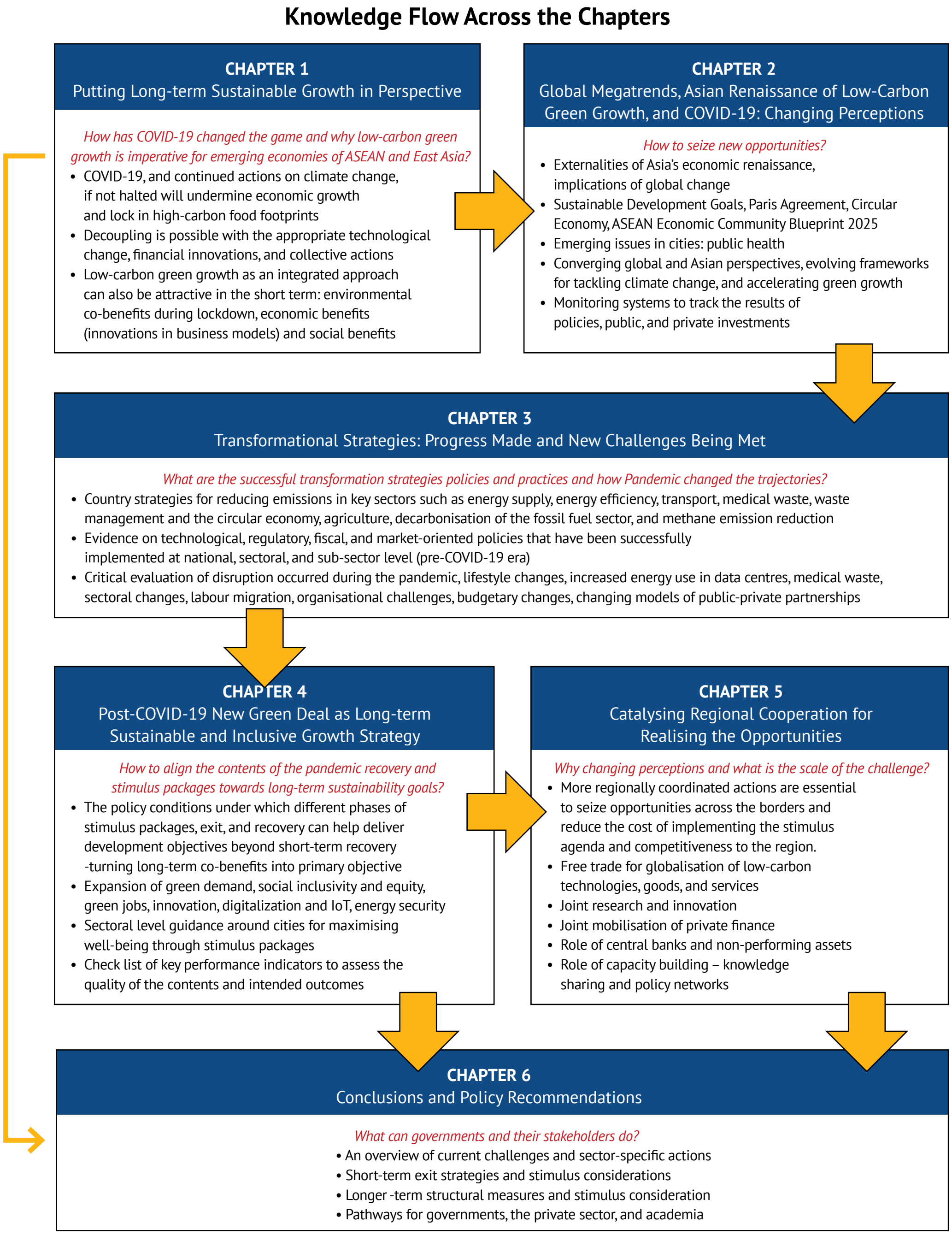
Chapter three reviews the experience of the low-carbon green economy transition in the recent decade. It presents evidence about various country-wide actions to reduce GHG emissions and to promote low-carbon 'circular' economies, with a focus on economic sectors such as the energy supply, energy efficiency, transport, waste management, agriculture, and tourism sectors. These sectors determine the overall trend in emission reductions and whether reducing climate risks can be achieved while increasing people's well-being. This chapter discusses policy reforms and sectoral case studies to highlight the potential of their replication and scale-up, with the institutional and financing implications for effective implementation. It also reviews policy lessons of public–private partnership models that will be relevant to AMS, China, and India mobilising the efforts of all stakeholders to implement the new net zero economy agenda.

Chapter four presents the most challenging aspects of incorporating a low-carbon development process in Asia, by looking at the impact of COVID-19 on the emission trajectories and the contents of stimulus and economy recovery packages. It compares the lessons learned from examining the business-as-usual and green stimulus development scenarios; and debunks several myths and misconceptions related to the actual costs and benefits of green industries, smart cities, and environment, social, and governance (ESG) investments, providing practical guidance to policymakers on what policy interventions will further unlock the potential of co-benefit approaches and productive employment. It integrates low-carbon choices into broad development strategies, and focuses on the implications of low-carbon green growth choices for employment and social inclusion. In doing so, it gives some guidance about the likelihood of recent fiscal stimuli by ASEAN governments reducing GHG emissions, while continuing to maintain high levels of economic growth and employment. This chapter also analyses how innovation systems are to be developed and strengthened for technology and institutional development, to promote synergies of low-carbon, green, and inclusive measures.

The fifth chapter focuses on how to seize opportunities that lie across national boundaries – both market-based opportunities, such as trade and investment flows in low-carbon green products and services, and non-market opportunities for regional collective action (joint research, finance mobilisation, policy networking, and knowledge sharing). It emphasises the need for a monitoring, reporting, and verification system as a policy management tool for understanding the impact of these strategies. These strategies must be embodied comprehensively in the economic policies, regulations, and new investment programmes of any country. They cannot be an after-thought or a half-baked effort, and must go hand in hand with national development strategies.

The sixth chapter summarises key policy messages, distilling lessons and insights from what has been done to date and what could be done in the future, including picking the 'low-hanging fruits' – the easiest options for decarbonisation – over the next 10 years, highlighting those recommended in chapters three, four, and five in matrix form. It is hoped that the policy recommendation matrix serves as a guide for regional policymakers and analysts to monitor and track the progress of low-carbon green growth. Figure 1.6 is the reader's guide to navigating the chapters.

## Figure 1.6 A Reader's Guide to Navigating the Chapters




ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, IoT = internet of things.

Source: ERIA Study Team.

# Chapter 2

## Global Megatrends, Asian Renaissance of Low-Carbon Green Growth, and Covid -19: Changing Perceptions

## Chapter 2
## Global Megatrends, Asian Renaissance of Low-Carbon Green Growth and Covid -19: Changing Perceptions



## 1. Introduction

The coronavirus disease (COVID-19) pandemic has caused unprecedented global disruption, but has proved that societies can act decisively in times of need. Addressing the public health crisis and recovering from the first Asia-wide recession in nearly 6 decades presents considerable challenges (ADB, 2020d). Tackling these issues, together with decisive action to combat the climate crisis, is not only a political imperative but is also efficient in the long term. A post-pandemic recovery strategy must aim for solutions that support economic recovery and accelerate the transition towards decarbonisation in future growth for resilience and inclusiveness.

This chapter explores key regional and global megatrends that inform and shape the course of the transition to a low-carbon economy in the Association of Southeast Asian Nations (ASEAN) and East Asia. In doing so, it attempts to distinguish between long-standing, multi-year megatrends that were present before the 2020–2021 COVID-19 pandemic and trends that emerged during the crisis and the associated responses (things which have otherwise broken with expectations for business as usual). The chapter also notes several potential megatrends in how countries are looking to exit the crisis period that, though nascent, could represent game changers for the region's energy strategies and overall outlook. Within each of these sections, key economic, social, environmental, market, technological, and governance trends are considered.

The key trends, issues, and drivers that are particularly relevant from the perspective of the decarbonisation of Asia's economies, are:

- the state of economic development in Asia, including persistent challenges in addressing inequality within and across countries;
- changing societal features, such as shifts in employment patterns and rapid urbanisation;
- the region's accelerating adoption of green and digital technologies, as notably driven by their increased technical viability, declining costs, and ongoing challenges and opportunities for implementation; and
- evolving regional perspectives on environment and climate concerns; opportunities from low-carbon technologies; and green growth synergies with other key issues such as air quality, resilience, and energy security.

In examining the collective impacts of these megatrends, the chapter argues that prospects for accelerating low-carbon green development in Asia – and in China, India, and numerous sites across Southeast Asia  in particular—continue to be bolstered by a number of factors. These include a growing recognition that well-designed green policies can not only address urgent climate concerns, but also support new economic growth and 'future-oriented' jobs. The chapter also notes several factors that may challenge this more positive outlook, including growing concerns about the long-term impacts of the pandemic on the region's most vulnerable communities. The chapter concludes by highlighting a number of key takeaways and recommendations for how regional decision-makers might tackle these challenges, all while dramatically improving the region's long-term energy and environmental outlook.

## 2 Long-Standing, Multi-Year Megatrends

### 2.1. Economic: Asia's Economic Rise, Competitiveness, and Sustainable Development

Over the past 60 years, Asia's economic transformation has been remarkable in both speed and scale. Between 1960 and 2018, per capita gross domestic product (GDP) grew roughly threefold in Australia, fivefold in Japan, and a whopping 15-fold in Asia overall (ADB, 2020a). While 68% of the region lived in extreme poverty in the 1960s, that number stood at less than 8% as of 2015 (ADB, 2020a). More than 1.3 billion people have been lifted out of extreme poverty since 1980.[1] In tandem with this rising economic power, the region has undergone a dramatic shift in the drivers of its GDP activity. ASEAN, for example, has undergone a relatively recent and dramatic shift from a predominantly agriculture-based economy to an industry-dominated one, with signs of gradually moving towards a service-driven economy (Tay and Puspadewi Tijaja, 2017). This shift in key drivers matches trends observed earlier in China, the Republic of Korea (henceforth, Korea), and Japan.

Such dramatic shifts during a relatively brief period have been enabled by a range of factors. These include a robust expansion of energy, transport, and other physical infrastructure; greater openness to foreign trade and investment; and large-scale market and policy reforms – all of which contributed to better positioning Asia to benefit from generally positive global development trends during this period (ADB, 2020a). Meanwhile, these advances have contributed to the countries' progress in reducing income poverty (Table 2.1). They have also helped to support how countries have resourced social welfare systems and other public goods. This includes the notable expansion of national healthcare systems, universal public education, and various social safety nets, which, in turn, has helped to fuel even greater economic growth and overall productivity gains.

Placing these trends in a global context, it is worth noting that Asia's development gains have significantly outstripped global averages during the same period, resulting in the region capturing a growing share of global GDP (Figure 2.1).

Consequentially, the region's rise has had implications for shifting patterns of production and consumption globally. Moreover, the region has emerged as the home of some of the world's most successful companies; and developers in both the region's advanced and emerging economies are aggressively pursuing global leadership in industries ranging from advanced manufacturing to new energy technologies. Asia's economies have thus emerged as not only important destination markets, but as globally competitive market leaders in their own right – ones that shape how numerous regional and global economic and investment megatrends are unfolding.

[1] As defined in the underlying source material, 'extreme poverty' refers to living under 'the US$1.90 per day international poverty line at 2011 purchasing power parity' (ADB, 2020a: 5)

## Table 2.1 Progress of Poverty Reduction in the ASEAN+6 in the Last Three Decades

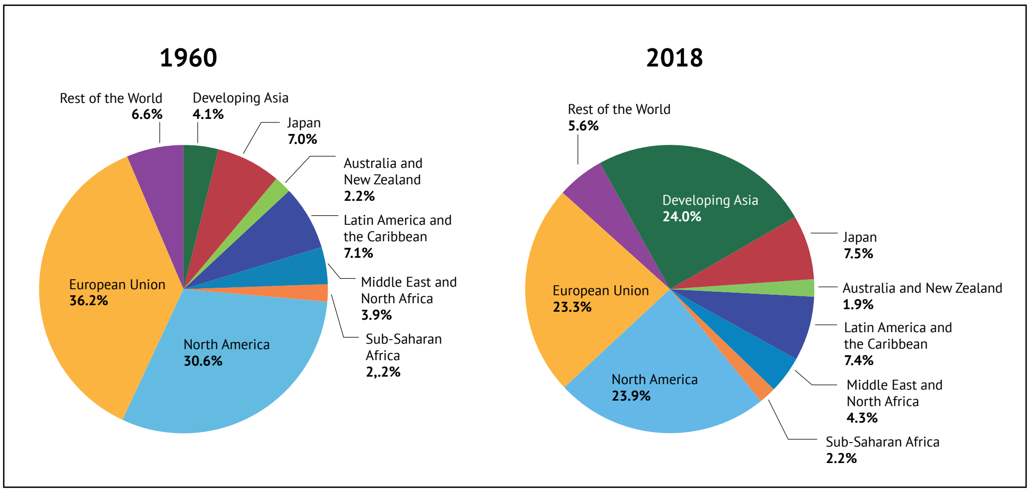
| Economy and years | Population in poverty (as % of total population) | | | Poverty Gap (%) | | | Poverty Headcount Ratio (as % of population) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2002 | 2010 | 2018 | 2000 | 2010 | 2018 | 2000 | 2010 | 2018 |
| Australia | 11.5 (2003) | 12.6 (2009) | 13.2 (2016) | 0.6 | 0.3 | 0.4 (2014) | 0.7 (2001) | 0.3 | 0.5 (2014) |
| China | 4.6 | 3.8 | 1.7 | 10.1 (2002) | 2.7 | 0.1 | 31.7 (2002) | 11.2 | 0.5 (2016) |
| India | 26.1 | 29.8 | 14.9 | 8.6 | 32.7 | 0.3 | 39.90 (2004) | 32.80 (2009) | 22.5 (2011) |
| Indonesia | 23.4 | 12.5 | - | 12.8 | 2.3 | 0.5 | 19.0 (2008) | 13.3 | 3.6 |
| Japan | - | - | - | 0.2 | 0 | 0.2 (2013) | 0.5 (2008) | 0 | 0.7 (2013) |
| Republic of Korea | 7.4 | 5.0 | 16.7 | 0.2 (2006) | 0.2 | 0 (2016) | 0.2 (2006) | 0.5 | 0.2 (2016) |
| Lao PDR | 38.6 | 27.6 | 23.2 | 15 (1997) | 5.9 (2007) | 1.8 | 50.7 (1997) | 25.7 (2007) | 10 |
| Malaysia | 8.1 | 3.8 | 0.4 | 0.2 (2003) | 0 (2011) | 0 (2015) | 1.2 (2003) | 0.6 (2008) | 0 (2015) |
| Myanmar | - | - | 24.8 (2017) | - | - | 0.1 (2017) | - | - | 1.4 (2017) |
| Philippines | 40 | 26.5 | 16.6 | 3.1 (2003) | 2.3 (2009) | 0.5 | 13.7 | 10.7 (2009) | 2.7 |
| Thailand | 12.9 | 7.8 | 9.9 | 0.4 | 0.4 | 0 | - | 2.5 | 0 |
| Viet Nam | 5.5 | 14.5 | 5.8 | 7.6 | 10.1 | 0.4 | 37 (2002) | 4 | 1.9 |

- = data not available, ASEAN = Association of Southeast Asian Nations, PPP = purchasing power parity.

Note: Poverty gap (%) and poverty headcount (% of population) at US$1.90 a day (2011 PPP).

Sources: ERIA Study Team.

## Figure 2.1 Asia's Growing Share of Global GDP, 1960 and 2018




GDP = gross domestic product.

Notes: For 1960, data for the Middle East and North Africa refer to 1968 and data for New Zealand refer to 1970. Shares calculated using GDP in constant 2010 United States dollars.

Source: ADB (2020a).

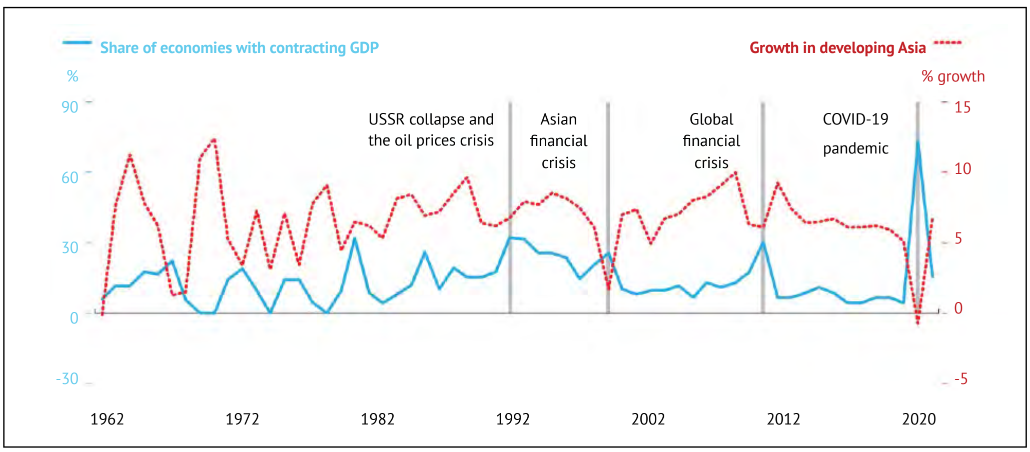
Still, Asia has also experienced several economic setbacks in the past several decades. Since 1990, it has faced four major crises that produced regional recessions: the 1990 collapse of the Soviet Union and the disrupted oil supplies, the 1997 Asian financial crisis, the 2008–2009 global financial crisis, and the 2020–2021 COVID-19 pandemic (Figure 2.2). Encouragingly, many of the region's national governments responded to the first two crises by ultimately coupling significant financial stimulus to struggling industries with targeted market and policy reforms designed to improve their country's overall economic resilience (IMF, 2020). Such national efforts were reinforced through regional cooperation, including ASEAN efforts to promote regional economic integration as a means for collective responses to various market shocks. In turn, the GDP of Asia and the Pacific ultimately grew a further 75% between 1992 and 2010 (ADB, 2020a), while the International Monetary Fund (IMF) has noted that the region also weathered the global financial crisis better than other regions (IMF, 2020).

As of this writing, efforts to respond to the fourth crisis – the 2020/21 COVID-19 pandemic – are actively under way; more on this will be discussed in subsequent subsections of this chapter as well as later chapters of this book.

### Asia as a proactive player in the global economy

As of 2021, more than 60 bilateral free trade agreements (FTAs) worldwide feature at least one East Asian economy, while a number of ASEAN+1 FTAs – including the ASEAN–China FTA, ASEAN–Japan FTA, ASEAN–Australia–New Zealand FTA, ASEAN–Korea FTA, and ASEAN–India FTA – have been established (ERIA, 2015). Progress on expanding multilateral trade agreements has largely stalled in other parts of the world over the past 5 years, but Asia has continued to press forward, including through the recent ratification of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive

**Figure 2.2 Economic Growth in Asia Across Four Periods of Economic Crisis**

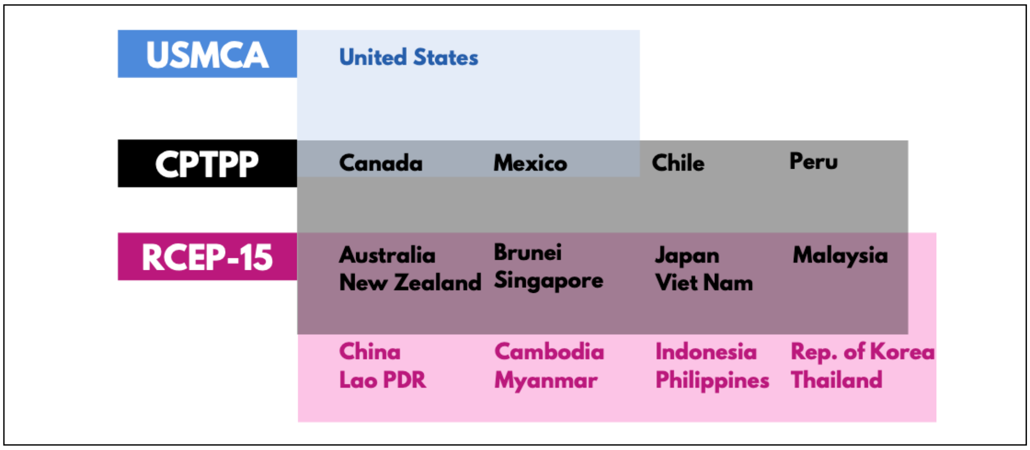



COVID-19 = coronavirus disease, GDP = gross domestic product, USSR = Union of Soviet Socialist Republics.

Notes: The period 1962–1969 includes 17 economies: Bangladesh, China, Fiji, Hong Kong, Georgia, India, Indonesia, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, the Philippines, the Republic of Korea, Singapore, Sri Lanka, and Thailand. Three economies are added in 1970 to 1979: Kiribati, Taiwan, and Solomon Islands. Thirteen economies are added in 1980–1989: Bhutan, Cambodia, Kyrgyzstan, the Lao People's Democratic Republic, Marshall Islands, Federated States of Micronesia, Samoa, Tajikistan, Tonga, Turkmenistan, Uzbekistan, Vanuatu, and Viet Nam. Nine were added in 1990–2000: Armenia, Azerbaijan, Brunei Darussalam, Kazakhstan, Maldives, Mongolia, Palau, and Tuvalu. Timor-Leste was added in 2001, Afghanistan in 2003; Niue in 2004, and Nauru in 2005, bringing the total to 46.

Source: ADB (2020b).

**Figure 2.3 Recent Multilateral Free Trade Agreements in the Asia-Pacific and Their Membership**




CPTPP = Comprehensive and Progressive Agreement for Trans-Pacific Partnership, RCEP = Regional Comprehensive Economic Partnership, USMCA = United States–Mexico–Canada Agreement.

Source: Petri and Plummer, 2020b.

Economic Partnership (RCEP). In addition, although not an intra-regional agreement, the European Union (EU) and Japan recently finalised the EU–Japan Economic Partnership Agreement, one of several examples of how countries within Asia are continuing to pursue opportunities for deepening ties beyond the region's borders. Figure 2.3 shows the membership of several Asian countries in recent multilateral FTAs.

The implementation of these agreements, as well as progress towards realising the ASEAN Economic Community (AEC) over the past 2 decades, have helped to lower formal barriers to intra-regional trade, investment, and mobility – promoting more efficient supply chains and (to an extent) greater free flow of people. Such lowered barriers have also supported a notable uptick in foreign direct investment in the region (ERIA, 2015). In addition, although it is too early to assess the full effects of the EU–Japan Economic Partnership Agreement, year-on-year findings suggest that EU exports to Japan increased by 6.6% since the agreement came into force in February 2019, while Japanese exports to Europe increased by a similar percentage (European Commission, 2020). Modelling by the Peterson Institute for International Economics suggested that the CPTPP and the RCEP may add about US$147 billion and US$186 billion, respectively, to global annual incomes in 2030 (Petri and Plummer, 2020a). In unpacking these benefits at the national level, the same study found that the lowered barriers to trade from these two agreements will 'yield especially large benefits for China, Japan, and South Korea [sic]' – yet may trigger longer-term losses for the United States and India, both of which are currently parties to neither agreement (Petri and Plummer, 2020a: 1).

### Asia's imperative to address energy security

Greater integration in the global economy and various cooperative agreements present countries across Asia with new opportunities for reducing their distinct energy insecurities. Yet such new opportunities have also triggered anxieties over how to deal with greater direct exposure to global market shocks. This anxiety can be especially pronounced in the context of declining self-sufficiency levels across the region – with Korea and Japan already 100% reliant on imports to meet their fossil fuel needs, and China, India, and many others in Southeast Asia either already at or approaching net importer status (IEA, 2019). To that end, over the past 40 years, a range of multilateral efforts led by the International Energy Agency (IEA), the East Asia Summit, ASEAN, and others have sought to address regional (and global) concerns about energy supply chain disruptions, extreme price shocks, and other market volatility risks. As suggested earlier, these efforts have already paid positive dividends in Asia, including bolstering collective action in areas as diverse as energy efficiency and fuel stockpiling.

Nonetheless, volatility remains a prominent feature of global energy markets – and an area where governments across Asia continue to argue that additional efforts may be required to reduce their exposure to its most negative effects. Here, a key debate has centred around how to manage dramatic swings in world oil and gas markets such as the 2014–2016 crash in global prices. For producer countries where oil or gas revenues represent a sizeable share of national GDP (e.g. Indonesia, Myanmar, Brunei Darussalam, and Malaysia), variable revenues have served as an added strain on national budgets and a complication in mid- and long-term strategic planning. The volatility of oil and gas prices creates the risk that depressed prices might incentivise overconsumption or undercut the sense of urgency surrounding energy efficiency campaigns – threatening to set back the region's clean energy transition while leaving these economies highly exposed to subsequent price spikes (National Bureau of Asian Research, 2021).

Recent regional efforts to respond to volatility concerns focus on the phase-out of fossil fuel subsidies and a greater focus on low-carbon technologies. Growing attention to fossil fuel subsidy reform can be observed in several countries (e.g. Indonesia and India) which often aim to seize upon periods of lower global prices as an opportunity to reduce subsidies. Such policy efforts have multiple lasting benefits. They contribute to improving the rationalisation of energy prices, reducing fiscal burdens and, with alternative means of support, improving the effectiveness of assistance to the poor and vulnerable. Meanwhile, many countries (e.g. Japan, China, India, and Singapore) have also articulated national energy strategies designed to better manage their overall dependency on energy supply imports, often with an eye towards reducing their relative reliance on oil, gas, and coal in various sectors. To that end, a larger take-up of renewable energies that is good for addressing climate change is also good for reducing their dependence on power sector imports and thus the exposure to energy market volatility.

### Steady yet uneven progress on sustainable development for all

Asia's economic rise – in particular, steep rises in average incomes and overall living standards – has generated significant knock-on benefits over the past 6 decades, as alluded to in prior sections. To that end, between 1960 and 2018 the region saw 'life expectancy increase from 45 to 72 years and the under-five mortality rate decline sixfold' (ADB, 2020a: 5–6). Looking at the metrics provided by the 17 Sustainable Development Goals (SDGs) of the United Nations (UN), several studies (UNESCAP 2020a, 2021a; ILO, 2021) have found that the region has made significant gains since 2000 across a number of development areas, including working towards eliminating hunger and promoting decent work opportunities for all.

Yet in many ways, ensuring inclusive development remains an elusive and challenging task. In its seminal 2011 Asia 2050 study, the Asian Development Bank (ADB) noted that 'the world's fastest growing region remains home to the majority of the world's extreme poor. "Factory Asia" may be a global hub for manufacturing and information technology services, but vast numbers of its people are illiterate and unemployed' (ADB, 2011: xxiii). A decade later, many of its concerns still ring true. To that end, a 2021 UN assessment noted with concern that the region's development progress appears to have stalled in many areas, with more effort needed in areas such as increasing investment in basic services to the poor and vulnerable, and enhancing social protection more broadly (UNESCAP, 2021a).

Equally worrying, divides between the region's 'haves' and 'have nots' appear to be becoming more – rather than less – pronounced. In the Asia and the Pacific region, economic inequality has been found to be growing (UNESCAP, 2020b). Some dimensions, including rural–urban inequality, are high and persistent (Imai and Malaeb, 2016). Table 2.2 presents a region-wide view of how income inequality, measured by the Gini coefficient, has changed in the past 3 decades, while ADB and others have noted that inequality can be measured not only in terms of outcomes but also in terms of unequal access to proper nutrition, health, education, and other basic services (Hlasny, 2019). In these various terms, while some countries (e.g. the Philippines and Malaysia) have made important strides since the 1990s, others (e.g. Indonesia) have seen growing societal inequality. Other countries (e.g. China) have seen a more mixed picture, with income inequality worsening in the first decade of the 2000s and improving in the subsequent decade thanks to government efforts towards shared prosperity. For the remaining countries, income inequality has either persisted at high (New Zealand and Singapore) or low (Korea and Japan) levels. Meanwhile, the 2020–2021 COVID-19 pandemic has raised the concern of an acceleration in this trend.

A 2019 literature review conducted by Huang and Wen (2019) noted that how countries respond to income inequality can have larger macroeconomic implications. For example, 'High and persistent income inequality can significantly impede growth, cause crises, and weaken demand' (Huang and Wen, 2019: 11; IMF, 2015). In contrast, 'a 10-percentile decrease in inequality increases the expected length of a growth spell by 50%' (Berg and Ostry, 2011: 11), suggesting significant knock-on benefits from tackling these issues head-on. Addressing inequality is thus closely linked to sustaining improvements in regional quality of life, yet may ultimately require greater policy attention on a number of fronts.

**Table 2.2 Inequality growth (Gini index), 1990–2019**

| Countries (ASEAN+6) | 1990–2000 | | 2000–2010 | | 2010–2020 | |
|---|---|---|---|---|---|---|
| New Zealand | 0.468 | 2002 | 0.462 | 2010 | 0.459 | 2016 |
| Singapore | 0.442 | 2000 | 0.482 | 2007 | 0.452 | 2011 |
| Philippines | 0.477 | 2000 | 0.463 | 2009 | 0.423 | 2019 |
| Malaysia | 0.491 | 1997 | 0.463 | 2009 | 0.411 | 2013 |
| Lao PDR | 0.349 | 1997 | 0.354 | 2007 | 0.388 | 2016 |
| China | 0.387 | 1999 | 0.437 | 2010 | 0.385 | 2018 |
| Indonesia | 0.286 | 2000 | 0.364 | 2010 | 0.382 | 2015 |
| India | 0.317 | 1993 | 0.354 | 2009 | 0.357 | 2011 |
| Thailand | 0.428 | 2000 | 0.394 | 2010 | 0.349 | 2018 |
| Viet Nam | 0.354 | 1997 | 0.393 | 2010 | 0.349 | 2019 |
| Australia | 0.326 | 1995 | 0.347 | 2010 | 0.344 | 2014 |
| Japan | 0.317 | 1989 | 0.321 | 2010 | 0.329 | 2019 |
| Korea, Rep. of | 0.298 | 1999 | 0.320 | 2010 | 0.314 | 2018 |

ASEAN = Association of Southeast Asian Nations.

Sources: ERIA Study Team; World Bank (n.d.), DataBank, Gini index. https://data.worldbank.org/indicator/SI.POV.GINI (accessed 12 July 2021); Republic of Korea: Kang, S. (2001), 'FDI, Human Capital and Education in Developing Countries', Technical Meeting, Paris, 13–14 December. https://www.oecd.org/dev/2698445.pdf (accessed 12 July 2021); and New Zealand: NZIER (2013), 'Understanding Inequality: Dissecting the Dimensions, Data and Debate'. Wellington: New Zealand Institute of Economic Research. https://www.businessnz.org.nz/__data/assets/pdf_file/0004/85927/NZIER-Understanding-Inequality.pdf (accessed 12 July 2021 )

So-called green jobs can play an important role in linking decarbonisation efforts with aims for expanding access to high-quality, well-paying employment opportunities. Green jobs are employment opportunities in economic sectors and activities that contribute to the preservation and restoration of the environment – not only in traditional sectors such as agriculture and manufacturing, but also in emerging green sectors such as renewable energy and energy efficiency (Figure 2.4). Green buildings, recycling services, or clean transportation are some activities identified as green jobs at the enterprise level. In Indonesia, the transition to sustainable and low-carbon development may cause shifts in the labour markets and create demand for new skills, retraining programmes, social protection, and financial schemes – particularly for the most exposed workers and businesses. Samples of green jobs in Indonesia are geothermal exploration specialist and waste recycler positions, which have decent working conditions in organised cooperatives.

The European Centre for the Development of Vocational Training defines green skills as 'the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable resource efficient society' (Cedefop, 2013: 8). The demand for green skills is defined by three main trends: (i) skills need to be upgraded and qualification requirements adjusted across occupations and industries; (ii) new or emerging economic activities create new or renewed occupations; and (iii) structural changes create the need to realign sectors that will decline as a result of the greening of the economy and retrain workers accordingly (Cedefop, 2013).

## 2.2 Society: Rapid Urbanisation – Challenges and Opportunities of Growing Densities

Urbanisation is increasing rapidly, particularly in developing and emerging economies, which creates great opportunities but also poses

**Figure 2.4 Green Job Activities**


Source: ERIA Study Team based on ILO (2021).

significant challenges. Cities currently account for about 70% of energy consumption and about 80% of energy-related greenhouse gas (GHG) emissions, while covering only 2% of the earth's land (UN, 2016). Before the pandemic, Asia was already undergoing some of the world's most rapid rates of urbanisation (Table 2.3). China, Indonesia, and Thailand, for example, saw their urban population rise from about one-third of the total population in the early 1990s to more than half of the population by 2020. The UN estimates that over 2 billion people live in the region's cities as of 2019, with another 1.5 billion expected to join them by 2050 (UN, 2019). While this has spurred both new and greater economic and social opportunities, it has also introduced new challenges. These include increased demand for and strains on existing physical and social infrastructure in much of Asia, but especially in the region's developing economies, with strains on healthcare systems particularly apparent during the early pandemic response.

Yet, while Asia's rapid urbanisation may aggravate current challenges, it also provides great opportunities for unlocking new gains in how green technologies are deployed. Urban basic services, such as electricity, mobility, education, and health, can be delivered at greater economies of scale in densely populated areas, increasing their affordability and accessibility. However, this is only possible if urbanisation is accompanied by integrated urban planning. To that end, the New Urban Agenda, the SDGs, and the Paris Agreement provide a conceptual framework for urban access and opportunities for all and have become mainstays of Asian policymaking. Urban basic services such as urban energy, mobility, and resource management can make a vital contribution to achieving sustainable development objectives and reducing urban GHG emissions (UN, 2017).

Investments in urban systems not only contribute to global climate change targets but also are vital enablers for economic growth and social cohesion, which will be crucial

**Table 2.3 Rapid Pace of Urbanisation in Asia, 1991–2020**

| Country | 1991–1992 | 2000–2001 | 2010–2011 | 2019–2020 |
|---|---|---|---|---|
| Australia | 85.42 | 84.17 | 85.24 | 86.18 |
| Brunei Darussalam | 66.51 | 71.41 | 75.14 | 78.10 |
| China | 26.88 | 36.49 | 49.87 | 60.87 |
| Indonesia | 31.10 | 42.39 | 50.25 | 56.31 |
| India | 25.66 | 27.79 | 31.10 | 34.70 |
| Japan | 77.41 | 79.32 | 90.94 | 91.74 |
| Lao PDR | 15.61 | 22.49 | 30.36 | 35.97 |
| Myanmar | 25.33 | 27.12 | 28.98 | 31.00 |
| Malaysia | 50.19 | 62.45 | 71.26 | 76.88 |
| New Zealand | 84.85 | 86.06 | 86.13 | 86.66 |
| Philippines | 46.94 | 46.09 | 45.43 | 47.28 |
| Singapore | 100.00 | 100.00 | 100.00 | 100.00 |
| Thailand | 29.51 | 31.97 | 44.28 | 51.06 |
| Viet Nam | 20.44 | 24.66 | 30.75 | 36.98 |

Source: ERIA Study Team, based on World Bank (2018), World Development Indicators, Urban Population (% of population). https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS (accessed 19 July 2021).

to build back better after the COVID-19 pandemic. For many individuals from rural communities, the move to urban areas was driven by better access to opportunities, e.g. through better connectivity via transport and communication technology. Improving connectivity further, especially at the regional level, however, requires intensive planning since enhanced connectivity could trigger more urbanisation and reduce the benefits if not well managed (Tay and Puspadewi Tijaja, 2017). Similarly, the direct link between urban air quality and public health could be drastically improved with low-carbon urban development approaches, which could have a direct impact on the severity of COVID-19 infections.

Poorly managed urban growth boosts inequality and emissions alike. Countries and cities can build on vast positive and negative urban development experiences from around the world to avoid lock-ins to high-carbon infrastructure and technologies, which will have significant economic, social, and environmental costs for decades to come. Adopting an urban development perspective that combines resilience, social inclusion, economic opportunities, and decarbonisation can turn cities into equitable and future-proof centres (Lah, 2017). The New Climate Economy has introduced the '3C model' of urban development – compact, connected, and coordinated – which aims to lock in economic and climate benefits in cities (Floater and Rode et al., 2019). Three pillars underpin the model:

- Compact urban growth: through managed expansion and/or urban retrofitting that encourages higher densities, contiguous development, functionally and socially mixed neighbourhoods, walkable and human-scale local urban environments, the redevelopment of existing brownfield sites, and the provision of green spaces.

- Connected infrastructure: through investment in innovative urban infrastructure and technology such as bus rapid transit; cycle superhighways; electric vehicles; smart grids; energy-efficient buildings; and essential water, sanitation, and waste services.

- Coordinated governance: through effective and accountable institutions to support the coordinated planning and implementation of programmes of activity and investment across public and private sectors and civil society, particularly for land-use change and transport (Floater and Rode et al., 2019).

This model reflects on the complexity of urban systems, their development dynamics, interventions areas, and decision-making processes. Rarely will a single measure achieve comprehensive climate change impacts and generate economic, social, and environmental benefits. Many policy and planning decisions have synergistic effects, meaning that their impacts are larger if implemented together. It is therefore generally best to implement and evaluate integrated programmes rather than individual strategies. In particular at the city level, the combination of measures can help in integrating packages of interventions to deliver synergies and minimise rebound effects.

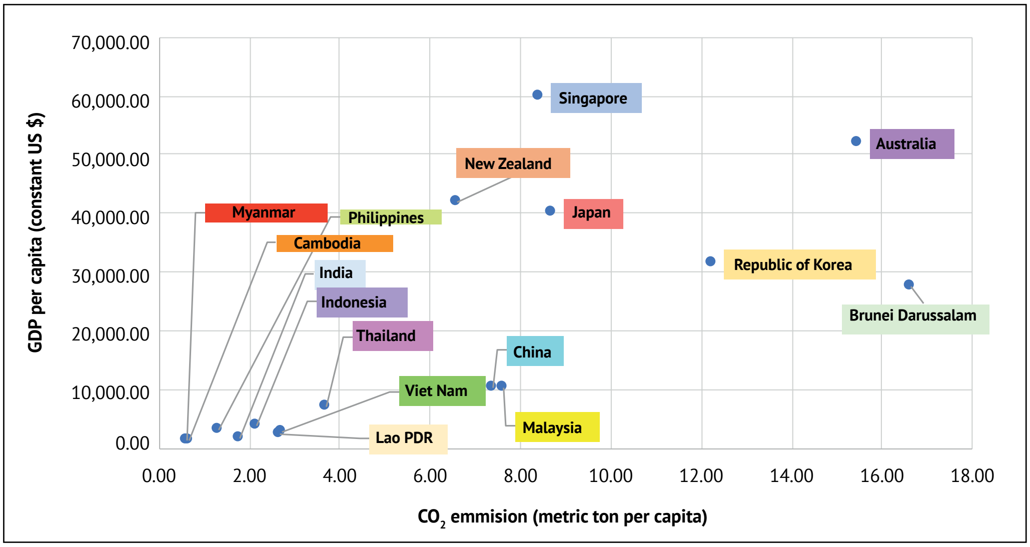
### 2.3 Environment: Growing Awareness of Climate and Environmental Issues

Alongside the above challenges, countries across Asia also face the daunting question of how to address increasingly dire environmental degradation and climate change. Since the 1960s, dramatic upticks in GHG emissions and fine particulate matter – driven by both agricultural practices and greater consumption of fossil fuels by firms and households – has led to worsening air quality across much of the region. In addition, while earlier so-called 'airpocalypse' events in Fukuoka, Beijing, and other sites have sparked national conversations that led to stronger power plant, vehicle, and industrial emission standards, about 92% of Asia and the Pacific – or about 4 billion people – live with air pollution levels considered a 'significant risk' to human health (UNEP, APCAP, CCAP, 2019).

Meanwhile, carbon emissions are closely related to increases in income levels (Figure 2.5). The cascading effects of rising global GHG emissions have led to increasing average temperatures and major, often erratic, shifts in weather patterns. Such effects have included more frequent and pronounced droughts in India, Cambodia, and the Lao People's Democratic Republic (Lao PDR), while Bangladesh, Myanmar, Thailand, the Philippines, and Japan have also grappled with severe flooding and typhoons.

Collectively, these trends pose not only serious and direct threats to public health, safety, and well-being, but also threaten to undermine the region's economic development ambitions. Earlier regional studies projected severe economic impacts if mitigation and adaptation actions were not taken urgently. For example, a 2015 model by ADB found that climate change could reduce Southeast Asia's otherwise projected GDP growth by 11% by the end of the 21st century (ADB, 2015: 69). The ADB Institute projected in 2013 that disruptions to agriculture could push 64 million Asians into poverty for every 10% change in food prices; and major population centres and coastal cities such as Bangkok, Ho Chi Minh City, Manila, and Yangon could see mass economic and social disruption with even moderate sea-level rises (ADB and ADBI, 2012).

**Figure 2.5 $CO_2$ Emissions per Capita vs GDP per Capita, 2020**




$CO_2$ = carbon dioxide, GDP = gross domestic product.

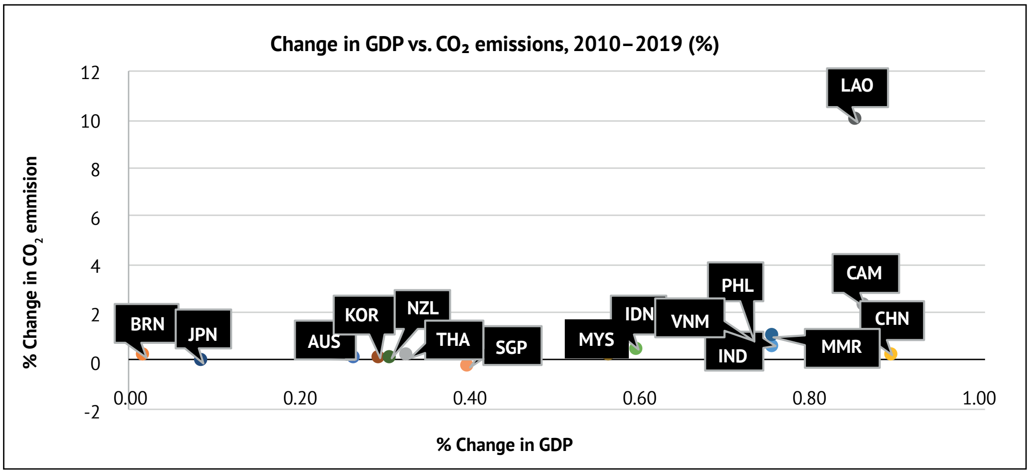
Source: ERIA Study Team based on World Development Indicators

A growing range of stakeholders across Asia is aware of the urgency of acting on these and other risks associated with climate change. Recent surveys in Southeast Asia, for example, suggest that public opinion has tilted towards viewing climate change as both a major policy priority and an area where the benefits of near-term action outweigh the associated costs (UNESCAP, 2020a). Meanwhile, perceptions amongst both public and private sector groups appear to be shifting from viewing low-carbon technologies and services as primarily an added cost to seeing them as a source of high potential return on investment. Governments in Korea, Japan, Malaysia, and several others have prominently touted the idea of 'low-carbon green growth' as central to their visions for the post-COVID-19 economic recovery. Dozens of regional companies have also signed on to the UN's 'Business Ambition for 1.5°C' as a statement of their intent to help delink economic growth from greater carbon emissions.

The approach of key financial actors in the region is also evolving. For example, multilateral institutions like ADB and bilateral institutions such as the Japan International Cooperation Agency are making continuous efforts to understand and address the potential impact of disaster and climate change in infrastructure development. This has broadened the scope of disaster risk reduction investments to include structural engineering solutions and nature- (or eco-) based solutions, national as well as community-based resilience infrastructure, and non-structural interventions such as early warning systems.

Some signs of decoupling between economic growth and carbon dioxide ($CO_2$) emissions – particularly in Asia's upper middle- and high-income countries – appear to be under way (Figures 2.6 and 2.7). Amongst the major contributing factors are various national efforts to implement new energy efficiency standards and air quality and carbon emission regulations. The larger macroeconomic effect of high energy prices during much of the period also discouraged new consumption (ADB and ADBI, 2012).

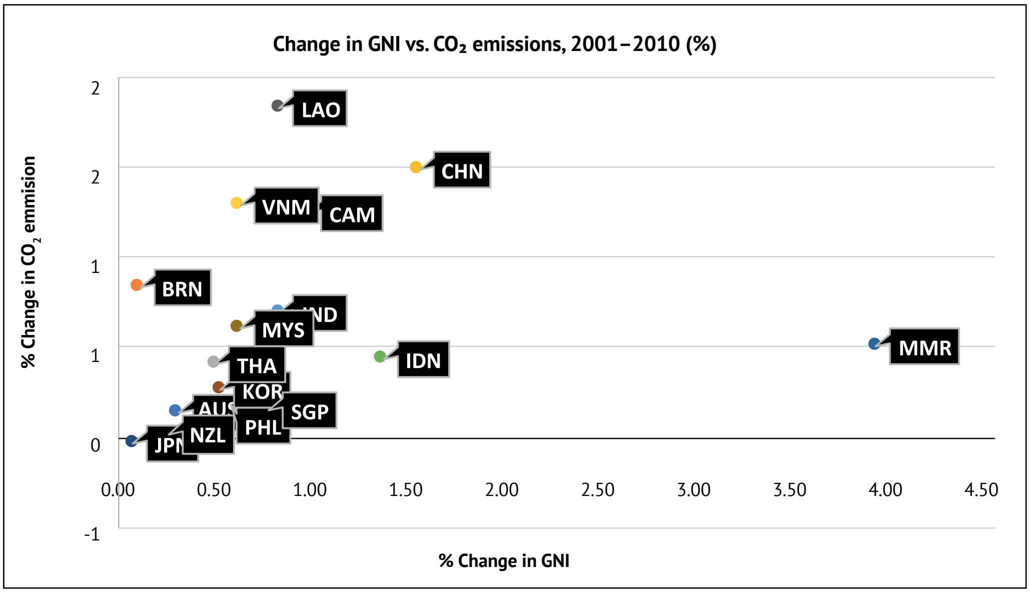
## Figure 2.6 Demand-Based Relative Decoupling in ASEAN and East Asia




ASEAN = Association of Southeast Asian Nations, AUS = Australia, BRN = Brunei, CAM = Cambodia, CHN = China, $CO_2$ = carbon dioxide, GDP = gross domestic product, IND = India, IDN = Indonesia, JPN = Japan, KOR = Republic of Korea, LAO = Lao PDR, MYS = Malaysia, MMR = Myanmar, NZL = New Zealand, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Source: ERIA Study Team.

## Figure 2.7 Consumption-Based Relative Decoupling in ASEAN and East Asia




ASEAN = Association of Southeast Asian Nations, AUS = Australia, BRN = Brunei, CAM = Cambodia, CHN = China, $CO_2$ = carbon dioxide, GNI = gross national income, IND = India, IDN = Indonesia, JPN = Japan, KOR = Republic of Korea, LAO = Lao PDR, MYS = Malaysia, MMR = Myanmar, NZL = New Zealand, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Source: ERIA Study Team.

Still, a large gap remains between ambition and action to reduce pollution and environmental degradation in most countries in Asia (Kimura and Han, 2021). As part of the adoption of the Paris Agreement in 2015, countries across the region set often ambitious targets for tackling their GHG emissions. Yet, while notable progress has occurred to date, several studies by the Economic Research Institute for ASEAN and East Asia (ERIA) have suggested that the pace of progress falls far short of what is required to prevent a catastrophic rise in global temperatures (Anbumozhi, Kalirajan, and Kimura, 2016; Anbumozhi and Kalirajan, 2017; Anbumozhi, Kalirajan, and Kimura, 2019; Kimura and Han, 2021). Amongst the region's developed economies, neither Korea nor Australia are on track to achieve their 2030 targets. Meanwhile, Southeast Asia's $CO_2$ emissions are expected to increase seven times as fast as the global average during 2018–2040 (IEA, 2019). Although this could be partly because the subregion is home to a number of developing economies whose overall energy demand is rising more rapidly than others globally, this highlights the extent to which more aggressive action may be necessary to avoid increasingly dire regional environmental and climate projections.

A joint study by the IEA, the World Bank, and the World Economic Forum (2021) emphasised the urgency of supporting energy transitions and clean energy investment in emerging and developing economies. The report pointed out that unless the speed of the transition is accelerated and the scale of investment is substantially expanded in emerging and developing economies, the world will face a major fault line in efforts to address climate change and achieve other SDGs. A key factor underlying this urgency is that most of the growth in global emissions in the coming decades is set to come from emerging and developing economies as they grow, industrialise, and urbanise. The imperative to decouple development from emissions is crucial so that future development meets citizens' aspirations while avoiding the high-carbon pathways adopted by industrialised economies.

### 2.4 Governance: Progress on Regional Cooperation and Integration

Regional cooperation is a valuable collaborative governance mechanism to address pressing development challenges of common concern. Cooperative mechanisms take on different forms and processes for different topics. In Asia, some of the prominent platforms include the East Asia Summit, Asia-Pacific Economic Cooperation (APEC), and ASEAN-led initiatives (e.g. ASEAN+3,[2] ASEAN+6,[3] and the AEC), which serve as overlapping yet distinct processes that support broader regional economic, financial, social, and security cooperation.

The 1997–1998 Asian financial crisis was a turning point for East Asian and Southeast Asian regionalism. It led to further regional cooperation on monetary and financial issues, spurring innovative mechanisms built on previous initiatives such as the ASEAN Swap Arrangements. ASEAN+3 developed several initiatives to strengthen resilience against

[2] ASEAN+3 comprises the 10 ASEAN Member States (AMS) plus China, Japan, and Korea.
[3] ASEAN+6 comprises the 10 AMS plus Australia, China, India, Japan, Korea, and New Zealand.

financial stability, such as the Chiang Mai Initiative (2000) as a network of currency swap arrangements and the Asian Bond Markets Initiative (2002) to promote long-term financing within the region. This was advanced under the 2003 Bali Concord II, and through the adoption of the AEC Blueprint in 2007 and its subsequent implementation under the ASEAN+6 framework for regional cooperation. Meanwhile, to strengthen their collective preparedness for future crises, the ASEAN+3 launched the Chiang Mai Initiative Multilateralization (CMIM) in 2010 and the ASEAN+3 Macroeconomic Research Office in 2011 to monitor CMIM economies, support the implementation of the CMIM, and provide technical assistance to CMIM members. No further developments have since taken place, and no country has applied for the use of the CMIM.

In the past 2 decades, Asia has seen the expansion of regional and subregional forums to address emerging challenges. This includes notable work at the nexus of pursuing energy security, sustainable development, and climate action. At the 2nd East Asia Summit in 2007, for example, 16 countries jointly affirmed what would become the Cebu Declaration on East Asian Energy Security, agreeing to strengthen collective action on promoting regional energy security, including through greater attention to developing more efficient and cleaner energy supplies and technologies, with the establishment of an Energy Cooperation Taskforce (ASEAN, 2007). Meanwhile, at the subregional level, ASEAN has made considerable progress in developing collaborative mechanisms for addressing the issue of cross-boundary air pollution. This includes the ratification of the ASEAN Agreement on Transboundary Haze Pollution and subsequent adoption of the Roadmap on ASEAN Cooperation Towards Transboundary Haze Control Pollution with Means of Implementation (Tay and Puspadewi Tijaja, 2017).

Asian countries promote global cooperative processes to address the global concerns of inclusive development, sustainable infrastructure, energy systems, and climate change. The G20 is a prime example of Asia's proactive engagement at the global level, with six Asian developed and major economies participating. Through successive summits hosted by Asian countries, the G20 champions renewed emphasis on development through infrastructure. This infrastructure agenda has been deepened to promote the financing of low-carbon investments; enhance the environmental, social, and governance performance of infrastructure investments and services; and safeguard the sound management of infrastructure assets (G20, 2019).

Global and regional cooperation contributes to advancing Asia's energy transitions. ERIA studies (Anbumozhi and Tuan, 2015; Yoshikawa and Anbumozhi, 2018; Kimura and Han, 2021) have pointed out that greater access to energy supplies and technologies available in global markets has played a positive role in making a wide range of cleaner fuels and technologies more viable and affordable to deploy, e.g. contributing to dramatic declines in the cost of solar panels. Nonetheless, ongoing barriers to trade risk undercutting the pace and overall potential for accelerating Asia's clean energy transition. Challenging questions include debates on the pace and desirability of removing tariffs or restrictive export/import quotas on both products (e.g. wind turbines or solar photovoltaic (PV) technologies) as well as the raw materials critical to their production (e.g. critical minerals). More broadly, though, several regional forums including APEC have expressed concern that economies across the region will need to complement action on trade liberalisation with additional domestic market reforms to take full advantage of trends in global markets. As discussed earlier, countries in the region need to make greater progress on fossil fuel subsidy reform and overall market liberalisation so that cleaner fuels and technologies can compete against well-entrenched, yet often less sustainable, alternatives. In this regard, global and regional forums serve as important platforms for countries to share their experience and learn lessons when adopting and sustaining such reform initiatives.

### 2.5 Technology: New Transition Pathways

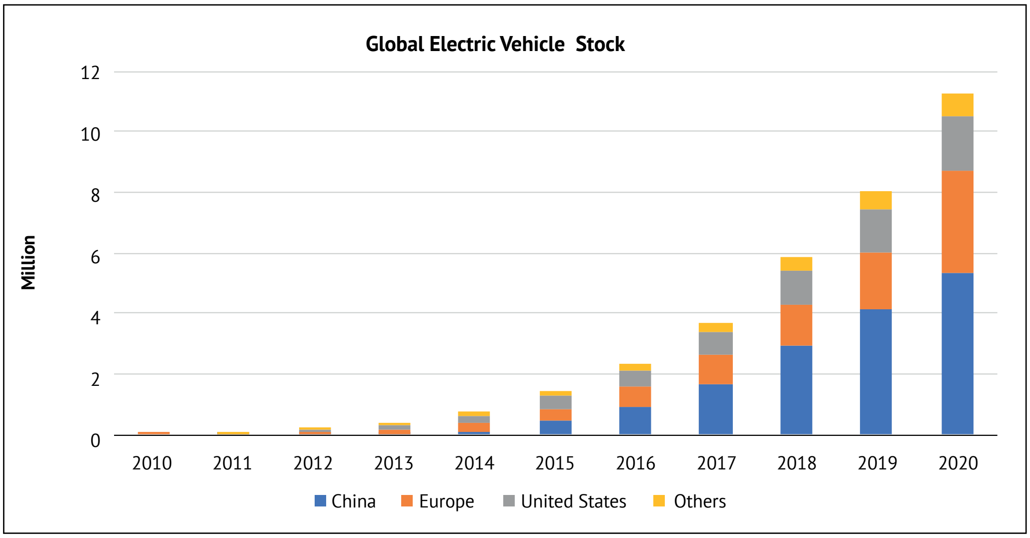
Some of the key factors that have affected the transition to low-carbon technologies in key sectors are the availability of the technologies and their economic viability, acceptability, and application. This has changed drastically over the last decade.

Going into 2020, ASEAN, China, and India were in the midst of a revolution regarding the affordability and viability of a range of clean energy technologies, with implications for how countries might navigate the megatrends individually and collectively. In India, for example, the rapid expansion of solar power, combined with smart policymaking, is transforming the country's electricity sector, enabling it to provide clean, affordable, and reliable power to a growing number of households and businesses (IEA, 2021b). While some cost trends have been late to reach Southeast Asia, evidence from Thailand, Viet Nam, and Cambodia over the past several years shows that the renewable energy transition is gaining pace (Weatherby, 2020). As one example of this, Viet Nam's clean power sector grew as solar energy rose from 0.5% to more than 8.0% of the country's energy mix in 2019 (Apanada, 2020). Similarly, low-carbon mobility solutions appear to be experiencing a major transformation. Over the last decade, the global electric vehicle fleet has grown rapidly – from about 17,000 electric cars in 2010 to about 7.2 million in 2019 – with about 2.3 million electric car sales in 2020 alone (IEA, 2020b). Figure 2.8 shows the rapid global growth in demand for electric vehicles, led by demand in China.

Looking ahead, the International Renewable Energy Agency has suggested that replacing the costliest 500 gigawatts of coal with solar PV and onshore wind would reduce costs by up to US$23 billion annually and save around 1.8 gigatons of $CO_2$ emissions, equivalent to 5% of total global $CO_2$ emissions in 2019 (IRENA, 2020). Figure 2.9 shows the stock of renewable energy that Asian countries have added annually in the past decade. China accounts for the largest share of the annual stock increase.

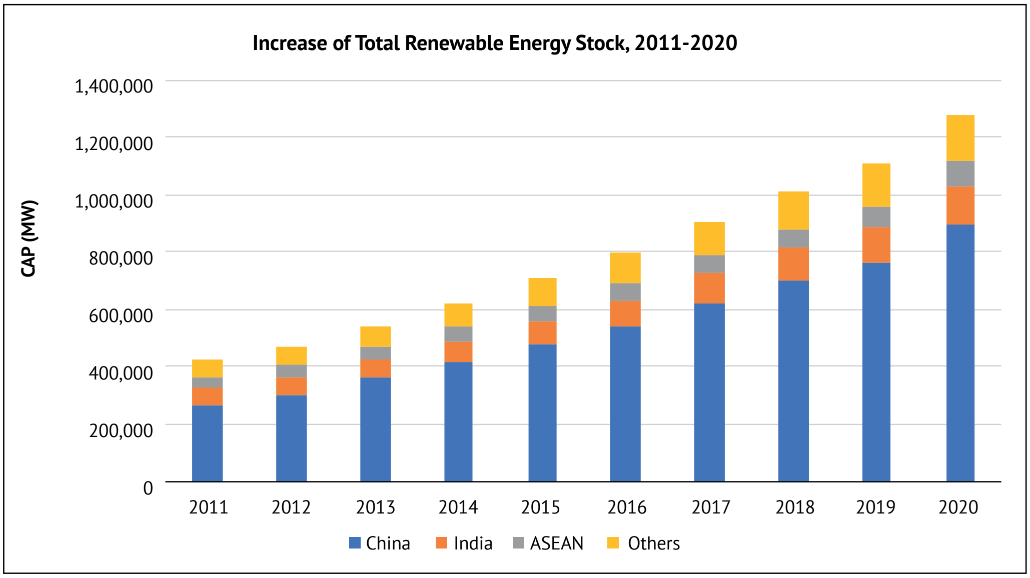
The pursuit of new or more cutting-edge technologies is not without risk. While the adoption of several advanced technologies has had beneficial effects on the domestic and foreign service content of exports in many Organisation for Economic Co-operation and Development (OECD) countries, the evidence remains mixed for the ASEAN region.

**Figure 2.8 Global Growth in Electric Vehicles**




Source: ERIA Study Team.

**Figure 2.9 Changes in Renewable Energy Uptake in ASEAN, India, and China, 2011–2020**




ASEAN = Association of Southeast Asian Nations, MW = megawatt.

Source: ERIA Study Team.

Singapore, for example, is said to have increased its service value-added content of exports while other ASEAN Member States (AMS) have recorded reductions.

Moreover, large-scale investments in emerging or advanced technologies may not be enough to ensure community acceptance. A key example here is the sharp decline in support for nuclear energy witnessed both globally and across the region in the aftermath of the 2011 Fukushima Daiichi disaster, despite earlier views of its centrality to clean energy transitions in Japan, Korea, and elsewhere.

Addressing these concerns is likely to require both national and international commitments. Nationally, ADB, the UN, and others have encouraged embedding sustainability targets into larger national planning agendas. However, for Bangladesh and the Maldives (which are considered amongst the most vulnerable to rising sea levels yet have only modest domestic $CO_2$ emission profiles), even aggressive domestic decarbonisation strategies are likely to be highly insufficient on their own. Thus, collective action is critical to both how individual countries might succeed – as well as how the region might be able to progress more rapidly.

### 2.6 Collective Impact of Long-Standing Trends

Together, these trends have shaped the character and nature of Asia's emergence as the centre of world energy markets. While only 67% of developing Asia had access to electricity in 2000, that number was 96% in 2019 – a level of progress that has extended access to about 1.2 billion people (IEA, 2020b). As a result of such development gains, strong economic growth, and still growing populations as of 2020, the region accounted for nearly half of global energy consumption, with China, India, Indonesia, Japan, and Korea ranking amongst the world's top 10 consumers. In addition, while parts of the region show promising signs of decoupling energy demand growth and emissions, both developed and developing economies in the region continue to struggle with making greater strides in this area. Still, key growth in low-carbon energy technologies in both deployment and innovation are on the rise – particularly in China and India – suggesting at least one potentially promising pathway forward.

Development status amongst Asian country groups differs. A distinct feature across the region, therefore, is that countries have pursued a multi-track, multi-speed approach in dealing with the complex issue of climate change, and in developing their targets for renewable energy and energy efficiency. Cooperation amongst countries at different stages of development, based on the open regionalism approach, aims to make markets work better to result in specific sectoral initiatives such as the development of voluntary guidelines for emission reduction and resource efficiency improvement, with the overall objective of reducing the carbon intensity of development. This should not distract from the fact that Asia's rapid and strong energy demand growth continues to fuel specific and severe environmental challenges, which will need to be addressed through more aggressive action.

Despite positive public statements at both the national and multinational levels, ASEAN's progress in adopting renewable energy has been outpaced by the region's increasing energy demand. During 2000–2018, fossil fuels accounted for 85% of the growth in primary energy demand and the share of renewables in the primary energy mix stagnated. Although ASEAN aims for renewable sources to account for 23% of the region's total primary energy supply by 2025, this target is not expected to be met as the AMS national energy policy frameworks are still largely focused on fossil fuels.

Over the next 2 decades, Asia is projected to comprise about two-thirds of new global demand growth. While China and India continue to see pronounced increases in their overall consumption, Southeast Asia will represent a rising share of added growth. According to IEA estimates, Southeast Asia's consumption is projected to increase by about 6% per year between 2020 and 2040 (IEA, 2020c). Finding ways to meet the energy demand of developing AMS is essential to improving overall standards of living and sustaining economic growth, even though many countries will need to radically transform their energy mix to avoid worsening air quality or other conditions that may make cities unliveable. In this context, the sudden crash in regional energy demand caused by the COVID-19 pandemic has offered a vision of what a potential break from business as usual might look like – even as it raises questions regarding how best to move forward.

## 3. Megatrends that Emerged During the Crisis

The Asia-Pacific energy and environmental outlook continues to be shaped by the long-standing factors mentioned in the preceding section. However, the COVID-19 pandemic represents an unprecedented level of disruption in both global energy markets and daily life. As of July 2021, the pandemic has claimed more than 4 million lives, with the United States and India alone representing one-quarter of this total.

During 2020–2021, policy responses to the global crisis have involved making tough choices, the most prominent being actions to contain the spread of COVID-19 and its mutations. This includes community-level and nationwide lockdowns that have caused economic curtailment and immobility within and, most prominently, across borders. For some countries, early and aggressive interventions have played a vital role in not only slowing the spread of the virus but also allowing for a quicker return to regular activity levels – at least on a domestic level. Yet, for developing economies in ASEAN in particular, the pandemic has triggered a deep and pronounced recession – the first such region-wide recession in nearly six decades (ADB, 2020d). Such strains, if not well managed, could undermine the region's development ambitions on several fronts, including undercutting the resources available for accelerating clean energy transitions. More on each of these issues is explored in the subsequent subsections.

### 3.1 Economic Concerns: Global Markets and Trade – Supply Chain Disruptions

As noted by the Brookings Institution, 'much of the economic activity that continues in a pandemic – health services, housing services, utilities – is not traded internationally, while the widely traded goods such as cars, electronics, and tourism are cut back as people face an uncertain future' (Dollar, 2020: 47).

Thus, perhaps not surprisingly, at the height of the COVID-19 pandemic, global trade declined dramatically – and still fell 14.5% year on year even after a moderate recovery in the third and fourth quarters of 2020 (UNESCAP, 2020b). Similarly, foreign direct investment in virtually all corners of the globe declined dramatically. For Asia and the Pacific, the economic effects have been staggering. The UN estimates that the region experienced a loss of US$2.2 trillion in trade (UNESCAP, 2021b), reducing the resources available to countries as they plan how to build back better.

Slowing global trade has produced ripple effects on domestic development projects within the Asia-Pacific, due to pandemic-caused disruptions to the highly interconnected global supply networks. For example, a 2020 study by the International Finance Cooperation found that for the energy sector in particular, local and international travel restrictions, quarantine requirements, and lockdowns have resulted in project delays and have added to project construction costs (Bakovic et al., 2020: 3). Moreover, such impacts have been felt across the range of power sector projects under construction – including renewable energy projects. ADB (2020e) reported, for example, that in early 2020, many solar PV developers in Asia and elsewhere experienced protracted delays with imports of solar PV modules and other supplies, while concerns over supply chain disruptions continue with the uncertainty of how long lockdowns will last (ADB, 2021).

International trade and investment have long played a vital role in bolstering Asia's development efforts and access to resources, and sustaining a positive role for these factors (including through bolstering supply chain resilience) may ultimately prove critical to the region's full societal recovery from the COVID-19 pandemic (Kimura, 2020: Anbumozhi, Kimura, and Thangavelu, 2020; UNESCAP, 2021b). In this light, it is disconcerting to see the populist moves on deglobalisation and the rising protectionism, such as the increasing tariffs on most traded commodities which make major economies collide (Dollar, 2020). It is important to note that international trade and investment, as well as resilient supply chains, are indispensable for recovery from the COVID-19 pandemic (Kimura, 2020; Anbumozhi, Kimura, and Thangavelu, 2020; UNESCAP, 2021b).

### 3.2 Social Concerns: Shifts in Employment Patterns and Outlooks

The COVID-19 pandemic has had an uneven impact on different employment sectors in individual countries and the region. Employment in travel and tourism, for example, has been negatively impacted by immobility and other disruptions in virtually every country; industrial employment has also been heavily hit, although less uniformly given that production levels have remained high in some sectors. Unemployment increased by 15 million in the region in 2020. Compared with 2019, workers in the region lost 7.1% of their labour income in 2020 – more than US$1.0 trillion. In April 2020, lockdown measures impacted some 829 million informal workers in the Asia-Pacific region (UNESCAP, 2021a). In the energy sector, depressed demand linked to transportation and industry has led to layoffs and other forms of cuts in employment. Further, while this trend has been especially pronounced in the oil and gas sector, employment in both renewable energy and energy efficiency has also been affected as companies observed some new developments being delayed or paused, at least in the near term (ADB, 2021; DeConcini and Neuberger, 2020).

Alongside these disruptions has been a pronounced shift in how business activities have been conducted, with the pandemic spurring on accelerated digitalisation across much of the region. During 2020, lockdowns and other emergency measures taken in response to COVID-19 led to an unprecedented shift in 'work-from-home' employment as well as notable shifts in how typical consumer activities are handled. This included a large surge in the use of digital services for food delivery, shopping, payment processing, and other online services across the Asia-Pacific. Meanwhile, a study by Google, Temasek, and Bain & Company estimated that as many as 40 million people from six countries in Southeast Asia – Singapore, Malaysia, Indonesia, Viet Nam, Thailand, and the Philippines – came online for the first time in 2020 (Google, Temasek, and Bain, 2020: 9), pushing the region's total online population to 400 million and suggesting greater potential acceleration in the region's digital transformation (Anbumozhi, Gross, and Wesiak, 2019).

Most countries are cautiously eyeing timelines for relaxing pandemic-related restrictions by 2022. Demand levels for goods and services from the most impacted sectors are expected to recover gradually by 2025, potentially with some shifts in demand patterns triggered by the pandemic. On the whole, though, countries continue to explore targeted interventions to help strengthen the recovery. This will depend on the effectiveness of the policy instruments used and the availability of stimulus funds. All this will have implications for employment and social well-being, especially of the poor and vulnerable.

### 3.3 Environment I: A Break from Surging Energy Demand Aligns with the Increasing Competitiveness of Renewables

IEA (2020a) observed that the COVID-19 pandemic has caused more disruption to the energy sector than any other event in recent history. Globally, energy demand is estimated to have dropped by about 5% in 2020 while energy investment declined by 18% compared with the pre-pandemic projection of strong year-on-year growth in both areas (IEA, 2020b). Mobility declined at 'an unprecedented scale' in early 2020, with 'global average road transport activity almost falling to 50% of the 2019 level by the end of March' (IEA, 2020c: 138).

The IEA (2020c) observed a notable trend in Asia that the pandemic has accelerated the ongoing decline of coal as a share of power generation within Asia. Further, while total energy demand plummeted in absolute terms, demand for wind and solar power remained relatively resilient compared with other power sector generation sources.

For ASEAN and East Asia, reduced consumption of oil, natural gas, and coal in 2020 led to year-on-year reductions in $CO_2$ emissions in most countries, with India seeing a pronounced uptick in both so-called 'blue sky' days and overall local air quality. However, this near-term dividend may be offset by risks to longer-term sustainability efforts. For example, regional subway, bus, and other public transit use have been negatively impacted by decreased mobility during the pandemic, while ongoing anxiety about local spread could discourage their use in favour of single-passenger or other low-capacity vehicles. Thus, public transit might not fully recover for months if not years, depending on local conditions – challenging the extent to which they may be able to fulfil their envisioned role in mitigating overall emissions levels.

Nevertheless, the COVID-19 pandemic provides further impetus for countries across Asia to integrate economic resilience and public health concerns into their development strategies. This entails numerous near-term needs and opportunities. Providing other low-carbon mobility alternatives such as walking and cycling and (shared) electric mobility, for example, is a vital step towards providing sustainable mobility options; and will enable a more systemic change once mobility demand returns to pre-COVID-19 paths. Before the pandemic, many countries across Asia were moving forward with low-carbon, green growth strategies. An open question now is if countries will not only stay the course but also be able to lead in building back better from the crisis, including by demonstrating a strategic and financial commitment to prioritising more sustainable and climate-resilient infrastructure.

### 3.4 Environment II: The Rise of Net Zero Ambitions

While the temporary drop in demand caused by the pandemic has created numerous environmental dividends, these gains could be short-lived if the recovery is not well managed. In addition, as discussed earlier, there is an ongoing effort to scale up renewable energy in Asia. Even if ambitious targets for scaling up renewable energy in China, India, and ASEAN are fully realised, this may not be enough to minimise the risk of catastrophic climate impacts.

A number of countries in the region and globally appear to have responded to this short-term windfall not by de-prioritising climate action but by entrenching it more firmly in their larger development planning and post-crisis exit strategies. As of March 2021, more than 127 countries globally (representing 63% of worldwide GHG emissions) have formally adopted, announced, or begun crafting plans to reach net zero (i.e. carbon neutrality) around 2050 (UNEP, 2020). In Asia, this list includes Bhutan, Japan, Korea, the Lao PDR, Myanmar, New Zealand, Fiji, China, Nepal, and Cambodia as of June 2021 (Energy & Climate Intelligence Unit, 2021); and several of these countries (including Korea) have formally ensconced these commitments in their post-COVID-19 recovery strategies. Table 2.4 lists the Asian countries that have indicated a goal for net zero emissions as of August 2021 and their target year for realizing that goal.

Several other countries aim to enhance their leadership on decarbonisation technologies. The European Union has formally adopted a binding target of a reduction in net GHG emissions of at least 55% by 2030 compared with 1990, and agreed on a path to achieve climate neutrality by 2050. Similar ambitions have been announced by the US, Japan, and Korea, although legislative action is not yet fully consistent with these ambitions. Australia has detailed a national strategy for bringing hydrogen energy

**Table 2.4 Net Zero Emission Targets and Timelines in Asia**

| Achieved | In law | Proposed legislation | In policy document | Target under discussion |
|---|---|---|---|---|
| **Bhutan** | **Japan** (Target year: **2050**) | **Republic of Korea** (Target year: **2050**) | **Lao PDR** (Target year: **2050**) | **Myanmar** (Target year: **2050**) |
| | **New Zealand** (Target year: **2050**) | **Fiji** (Target year: **2050**) | **China** (Target year: **2060**) | **Nepal** (Target year: **2050**) |
| | | | | **Cambodia** (Target year: **2050**) |

Source: Adapted from Energy & Climate Intelligence Unit (2021).

to scale as a means of using existing energy resources more efficiently and sustainably, while pursuing large-scale investments in carbon capture, utilisation, and storage and other technologies that could lower emissions from fossil fuels, but these have yet to be proven viable and affordable.

While the growing recognition of the urgency for climate action and substantial progress in the formulation of mid- and long-term goals to reduce emissions are very positive, the current nationally determined contributions (NDCs) – at least so far – lack substantial detail regarding the contributions of key sectors of the economy.

### 3.5 Governance: Realising Climate Priorities in an Era of New Budgetary Constraints

Countries in the ASEAN and East Asia region are continuing to examine closely how to operationalise their high-level commitments to tackling greenhouse gas emissions, including recently announced 'net zero' pledges. Prior studies have argued that decarbonisation strategies must be comprehensive in their coverage, explicit in their targets, and include concrete measures to be successful (IPCC, 2014). Yet, as the UN noted in its December 2020 Emissions Gap Report (UNEP, 2020), one reason that countries have fallen behind in their NDC progress is that many submissions do not have specific government actions backing the stated government policy goals. Equally troubling is that an early analysis of post-pandemic recovery packages suggests that while green stimulus was notably prioritised during 2008 recovery packages, the same level of commitment could not be said of COVID-19-related recovery packages as of March 2021 (IMF, 2020).

It should be noted that despite the interest in doing more, the COVID-19 pandemic has resulted in a significant impact on government budgets, even amongst the region's developed economies. Table 2.5 shows that the fiscal deficits were higher in 2020 than in 2015 for a number of Asian countries due to public spending by Asian governments to address the adverse impacts of COVID-19.

Countries have had to deal with not only better resourcing their public health infrastructure, but doing so when economic disruption has reduced expectations for taxation-linked budget revenues. A dramatic decline in global demand for oil and natural gas has had immediate economic implications for major energy exporters such as Indonesia – including in lost potential

**Table 2.5 Changes in Governments' Fiscal Balances, 2015 and 2020**

| Country | (% of GDP) | |
|---|---|---|
| | 2015 | 2020 |
| Australia | −2.8 | −9.9 |
| Cambodia | −0.6 | −1.7 |
| China | −2.8 | −11.4 |
| India | −7.2 | −12.3 |
| Indonesia | −2.6 | −5.9 |
| Japan | −3.9 | −12.6 |
| Korea, Rep. of | 0.5 | -2.8 |
| Lao PDR | −5.6 | −6.5 |
| Malaysia | −2.5 | −5.1 |
| Myanmar | −2.8 | −5.6 |
| New Zealand | 0.3 | -5.7 |
| Philippines | 0.6 | −5.5 |
| Singapore | 2.9 | -8.9 |
| Thailand | 0.1 | −4.7 |
| Viet Nam | −5.0 | −5.4 |

Source: IMF (2021), Fiscal Monitor: A Fair Shot. April. Washington, DC: International Monetary Fund. https://www.imf.org/en/Publications/FM/Issues/2021/03/29/fiscal-monitor-april-2021 (accessed 12 July 2021).

revenue and taxable income – while government budgets are straining to absorb increased healthcare costs. For many others, depressed demand has provided a temporary reprieve from high import bills. However, the persistence of the economic slowdown further constrains the growth of budget revenues. Together, the rising budget deficits for both sets of countries will pose challenges for macroeconomic management, even though the low interest rate situation globally has temporarily eased the burden of managing debt repayment. More structural and sustained solutions need to be developed as part of the countries' post-pandemic recovery packages.

In planning how countries can build back better, another pertinent question is how to spur on greater regional integration and coordination on major recovery efforts. Here, infrastructure projects represent an opportunity – and one that often plays a key role in inclusive and sustainable development. The OECD (2017) projected global demand for new infrastructure to total US$57 trillion–US$95 trillion from 2017 to 2030. For developing Asian countries, ADB (2017) estimated the region's infrastructure needs at US$23 trillion over 2016–2030, equivalent to US$1.5 trillion per year. This is concentrated in sectors such as power, transport, telecommunications, and water and sanitation. These needs are driven partly by the replacement of ageing infrastructure, and mostly by large new incremental demand from unfolding higher growth and structural change in developing countries – especially from rapid urbanisation, the application of new technologies, and an increasing focus in all countries on the transition to low-carbon development.

### 3.6 Collective Impact of Trends that Emerged During the Crisis

At least in the short run, the COVID-19 pandemic has had a more pronounced impact on the global economy than any other downturn since the Great Depression, while its impact on global energy demand is without historical parallel. Even once the immediate crisis has passed, the ripple effects of the pandemic appear likely to continue to affect the conduct of fiscal policy within the Asia-Pacific, given the projected rising debt levels, ongoing high levels of unemployment in certain sectors and communities, and the potential political ramifications of these and other economic shifts which may in turn constrain or alternatively empower decision-makers (Auerbach et al., 2020).

Alongside this, the pandemic has underscored the importance of – and challenges surrounding – access to a wide range of advanced technologies and services. Since the outbreak of the pandemic, patterns of work and trade have centred heavily on digitalisation as one of the essential enablers for participation in the economy and society. Improving equitable access to digital services thus remains a high priority for fostering more resilience in participation in the economy irrespective of physical access, and economic and job opportunities. To do this will require substantial investment in digital and physical infrastructure to reap the benefits of embracing new technologies. Stimulus packages and other measures designed to respond to the varied economic, health, and social impacts of the COVID-19 crisis remain an ongoing opportunity to bridge the gap between stated ambitions and tangible measures to decarbonise regional economies, an issue that chapters 3 and 4 will explore in greater detail.

Some of the changing patterns of work, economic, and social interaction were under way before the COVID-19 pandemic. However, the drastic, sudden, and global shifts that have followed from the response to the pandemic have dramatically accelerated trends in various areas, including boosting the role of digitalisation as both a driver of energy demand and a tool for demand management. As will be discussed in section 2.4, there is evidence of these trends continuing to accelerate.

## 4. Moving Forward – Key Priorities and Opportunities

The dual challenge of addressing the public health crisis and the climate crisis at the same time creates substantial pressure on policymakers at all levels in ASEAN and East Asia. The ability to respond to these challenges differs greatly across the continent, and there is a high risk that the financial resources and capacities of authorities are not sufficient to meet this dual challenge.

In the short term, Asia needs to get the public health crisis under control as a prerequisite for a return to regular trade and economic activity levels. However, it will be vital to keep up the pace and overall potential of low-carbon solutions in this region. This includes investment opportunities in future-proof sectors, closing development gaps, and maintaining a positive role for even greater regional trade and economic integration – issues which ERIA and others have argued are likely to require ongoing attention for accelerating national market and policy reforms in many parts of the region (including the region's advanced economies) (Anbumozhi, Gross, and Wesiak, 2019). High levels of continued diversity across countries – particularly in terms of overall development levels, available domestic resources (both natural and human), and access to capital – also suggest that different countries will confront varied challenges, where greater regional and international collaboration could be a vital tool in helping to realise new gains.

### 4.1 Addressing Uneven Economic Recovery

Regional progress towards recovering from the 2020–2021 COVID-19 pandemic remains uneven on a country-by-country basis, due to differences in the health and economic impacts and in the policy response capacity (IMF, 2020). Countries experiencing prolonged adverse impacts and delayed recovery may see millions slipping into poverty, representing a drastic erosion of the development gains made in recent decades. Such trends suggest the need for close, sustained attention by regional decision-makers. This includes through the potential application of additional stimulus measures as well as greater policy reforms designed to strengthen the underlying economic health and resilience of several countries.

The rapid growth of several Southeast Asian economies, along with China and India, has created substantial regional economic potential that could be beneficial for less developed economies in the region (ADB and ADBI, 2014). While all the dynamic developing economies in the region share common boundaries, opportunities, and challenges, regional cooperation is lacking across the continent on trade, investment, coordinated value chains, and infrastructure development (ADBI, 2014). The AEC, for example, could benefit greatly from improved interconnectedness, coordination on innovation, the digital economy, sustainable development, and stakeholder engagement (ASEAN, 2016). However, there are promising signs of a convergence of economic and environmental priorities in developing Asia, in policymaking and implementation. Many Asian countries are aiming to utilise the potential of green industries such as solar and wind power manufacturing and electric mobility. Efforts are visible in the development of innovative and cost-competitive products in renewable energy and low-carbon transport, and in the testing of low-carbon technologies in the context of urban living labs. It is noteworthy that countries have been exploring the synergy of low-carbon and smart digital technologies in the continuing process of economic transformation.

Asia's renaissance journey has never been smooth or without challenge (ADB, 2020a). The region's experience teaches the important lesson that crisis management does not only involve coping with the immediate economic and social impacts, but also developing and strengthening institutional capability at all levels (community, national, and regional) to prevent and mitigate crisis impacts in the future. To that end, roadmaps such as the ASEAN Vision 2040 have sought to detail regional and subregional priorities for collective action (ERIA, 2019).

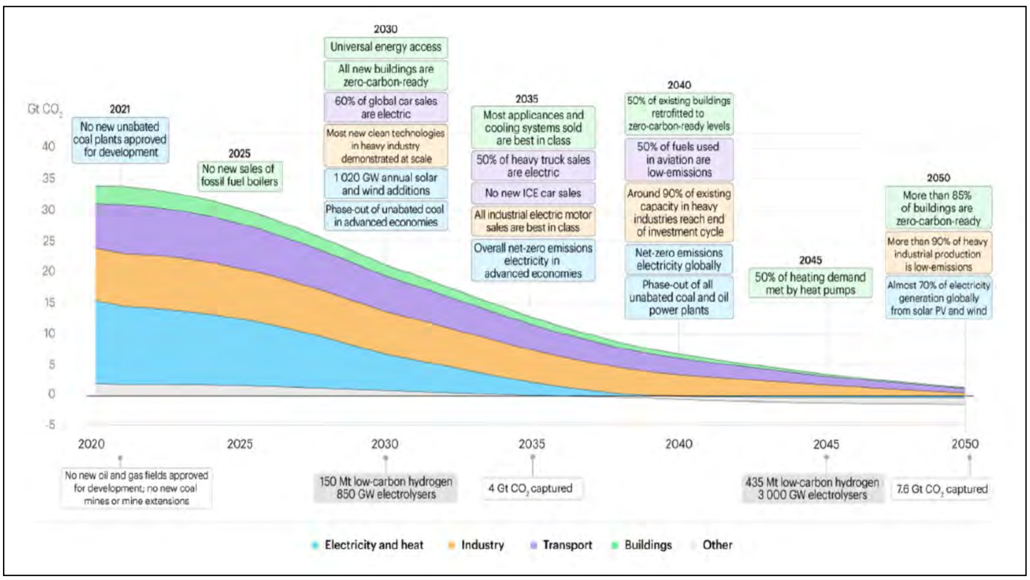
The slowdown in global economies in 2008 shifted demand to Asian economies, which have worked to expand regional supply chains while retaining a spirit of open regionalism and multilateralism. Countries in the region have been focusing on the decoupling of economic growth from GHG emissions, costs to the environment, and ecological systems. Indeed, pursuing low-carbon, green, and circular economic growth is becoming a new strategic imperative in Asia. The post-COVID-19 recovery will require even bolder efforts for regional cooperation and coordination to foster resilience and to realise the opportunities of sustainable development.

### 4.2 Creating Positive Momentum for Moving Beyond Paris to Net Zero

Translating the global path towards decarbonisation into the Asian context will require aggressive policy action across sectors that goes beyond the current plans and policies in the region. Net zero scenarios of the IEA (2021b) outlined ambitious but feasible routes towards decarbonisation in all sectors by 2050, with interim benchmarks for specific actions and steps (Figure 2.10). It suggests, for example, that the world could achieve carbon neutrality if countries act to ensure that no new oil and gas fields and no new (unabated) coal-fired power plants are approved from now on, no new sales of fossil fuel boilers occur after 2025, and 60% of all new cars are electric by 2030. It also notes that under these conditions, the world would still be able to ensure universal energy access by 2030, in no small part due to the ongoing trends in the greater deployment of decentralised renewables (IEA, 2021c).

The transition to low-carbon technologies will be massive and will require considerable policy and investment support. However, there is also considerable potential for efficiency gains and cost savings from the shift towards a decarbonised economy. Various studies indicate that GHG reduction measures have favourable abatement costs, but need higher capital intensity for the initial investment, which will be

**Figure 2.10 Net Zero Scenario by Sector**




$CO_2$ = carbon dioxide, Gt = gigaton, GW = gigawatt, ICE = internal combustion engine, Mt = , PV = photovoltaic.

Source: IEA (2021).

offset by the reduced cost for fuels and resources (Shalizi and Lecocq, 2009; IPCC, 2014; IEA, 2020b). Even though these investments lead to considerable economy-wide benefits, they may not create sufficient returns for the individual companies or consumers responsible for investment decisions. To reduce the cost barrier of new technologies, several Asian governments and industries have cooperated successfully in generating a mutually reinforcing cycle of market expansion and cost reduction. This has led to large-scale deployment of low-carbon technologies in Asia (Anbumozhi and Kimura, 2018)). While investments are needed in large infrastructure projects, especially sustainable energy and transport systems, the risk of overemphasis on these types of projects at the expense of smaller but highly efficient interventions needs to be considered when designing implementation projects and funding programmes.

A key factor holding back more ambitious transitions to low-carbon technologies remains the split incentive between individual cost and economy-wide benefits, which is particularly strong in the energy and transport sectors. Decisions are made by companies and/or individuals who apply discount rates that are considerably higher than the societal perspective. As such, only a small percentage of the economy-wide benefits is taken into consideration when deciding on a purchase, with negative consequences on the economy-wide benefits/costs over the approximate lifespan of an electrified installation or a vehicle. This suggests a potentially powerful and necessary role for comprehensive strategic planning, including in sending market signals through fiscal and other monetary incentives. It also emphasises the role of local and national governments in fostering the adoption of low-carbon technologies such as renewables, energy-efficient appliances, and electric vehicles through regulation, incentive schemes, and procurement.

Recognising the challenges in the adoption of low-carbon technologies, countries in Asia can take – and are taking – steps to strengthen domestic conditions for bolstering and sustaining clean energy transitions. For example, as the pandemic hit, Viet Nam received a credit of US$84.4 million from the International Development Association to support its multisectoral policy reforms to promote climate-resilient landscapes, green transport, and energy systems (World Bank, 2020a). In the Philippines, the country's Climate Change Commission has advocated for an economic recovery centred on ecological investment and programmes that build climate resilience. This includes supporting low-carbon technologies, eco-construction and design policies, research and development for ecological purposes, and natural capital investment for ecosystem resilience and regeneration (Apanada, 2020).

### 4.3 New Momentum Behind Carbon Pricing?

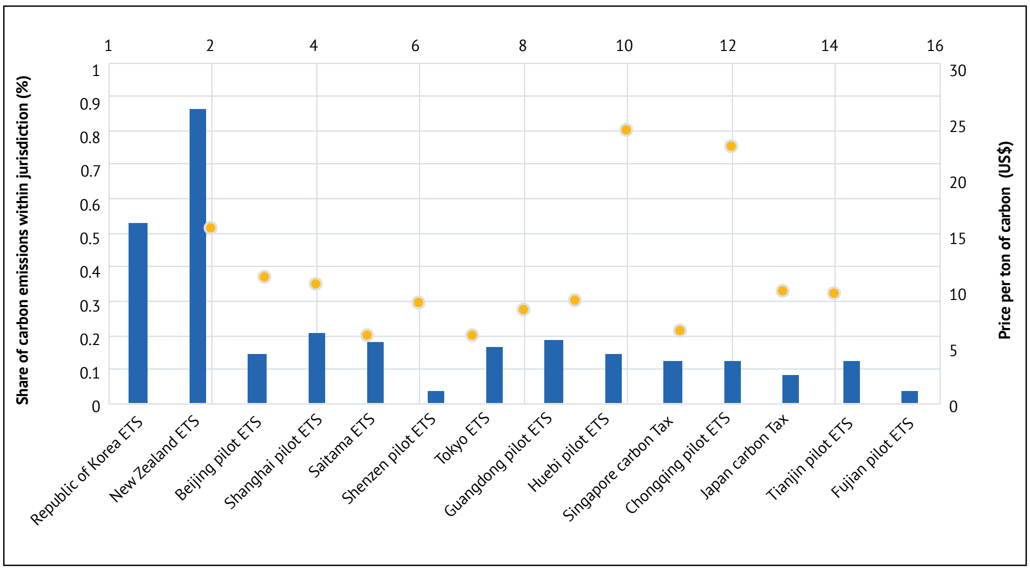
With more countries moving towards net zero emissions goals, the value of effective carbon pricing to incentivise research and development as well as investment decisions (what, where, and how much) cannot be overemphasised. Effective carbon pricing aims to direct investment decisions away from high-carbon activities and towards low-carbon activities. Such carbon pricing mechanisms can include carbon taxes, emissions trading schemes, results-based climate financing, and carbon offsets credits (some companies have also adopted an internal price on carbon).

As of April 2021, 64 carbon pricing initiatives have been implemented or are scheduled for implementation worldwide, covering 46 national jurisdictions and 35 subnational jurisdictions (World Bank, 2021a). In ASEAN, only Singapore has a direct carbon tax, set at US$3.5 or SUS$5.0 per ton of $CO_2$ equivalent, which is paid by major industrial energy users. This could rise to US$10 by 2022. Indonesia and Viet Nam are considering introducing an emissions trading system (ETS), while Thailand is considering adopting either an ETS allowance or a carbon tax. Almost all AMS have renewable energy project development experience with a carbon credit mechanism, either through the UN-supported Clean Development Mechanism or the Japan-initiated Joint Crediting Mechanism.

Figure 2.11 presents the ETS status of East Asia. While trends in China, Japan, and Korea are encouraging, faster and more ambitious carbon pricing would drive private capital allocations. Globally, average carbon pricing remains at only US$2 per ton and existing schemes cover only about 20% of total emissions. In East Asia, the price ranges from about US$1 per ton in subnational ETSs in China and Japan to US$29 per ton in Korea.

The design and sectoral coverage of East Asian ETSs varies considerably (see Box 2.1). In China, carbon markets cover over 1,000 energy entities from more than 20 industry sectors, with the total emission trade volume reaching 200 million tons of carbon or an estimated monetary value of about US$7 billion. The price ranged from $0.15 to US$18.93 per ton of $CO_2$ (Li, Zhang, and Hart,

**Figure 2.11 Evolving Carbon Market Mechanisms in East Asia**




ETS = emissions trading scheme, tCO2e = ton of carbon dioxide equivalent.

Carbon price: April 2021, US$/$tCO_2e$.

Source: ERIA Study Team.

2018). Japanese voluntary ETSs have 389 members and achieved a reduction of 59,419 tons of carbon from 2012 to 2019, with a mean trading price of US$2 per ton of $CO_2$ (Arimura and Abe, 2021). Korea's ETS has an estimated emissions cap of 538.7 million tons of $CO_2$, covering mostly the power and manufacturing industries (Choi, Liu, and Lee, 2017).

The International Carbon Action Partnership (ICAP, 2021) surveyed the latest plans and schedules of countries across the globe to introduce carbon pricing mechanisms. Many steps are being taken to strengthen existing ETSs or introduce carbon pricing mechanisms, but much remains to be done regarding carbon pricing. Several areas of concern are of particular relevance: the level and scope of pricing, a fuller understanding of pricing impacts for more informed policymaking, and greater efforts in regional cooperation. Beyond these are some operational matters to improve the effectiveness of carbon markets. There is also the important issue of how to use carbon taxes to support industrial and residential decarbonisation efforts. In this regard, the policy adopted by Singapore of using carbon tax revenues to subsidise energy efficiency is worth replicating and adapting in other countries. This redistribution of carbon taxes and similar measures could be vital for the acceptance and social balance of corresponding interventions. It could also help lower the cost of low-carbon technologies or provide suitable alternatives that are accessible for all.

The UN Economic and Social Commission for Asia and the Pacific (UNESCAP, 2020a) called for raising the level of ambition on carbon pricing in Asia and the Pacific. Moves to expand the coverage and raise the level of pricing will also need to consider how these moves lead to differential impacts across sectors. A related policy concern is the employment impact of carbon pricing. However, this needs to be placed in a much broader context of structural transformation towards the New Climate Economy, featuring low-carbon or net zero emissions.

Another policy concern relates to regional cooperation in carbon pricing. This priority becomes especially important as Asian economies are increasingly integrated, e.g. through regional supply chains. An ERIA regional cooperation study (Anbumozhi et al., 2016) outlined some concrete actions for pursuing regional cooperation in this area. Finally, amongst the major operational concerns on carbon markets, greater transparency in governance and standards enforcement must be developed and implemented to ensure that carbon markets function effectively to incentivise emissions reductions and to channel the revenues for supporting activities in the low-carbon transition. Broadly speaking, the low-carbon transition must have public support and be socially just. It is critical not only to plan policies carefully, including carbon pricing, but also to communicate proactively with the public about the benefits they can bring to our communities, workers, and environment.

A low-carbon green growth strategy requires sector policy interventions that promote a wide spectrum of technologies, and thereby reduce carbon emissions despite rapidly growing demand. Developing and implementing such a programme is affected by sector-specific economic policies (notably subsidies, tariff barriers, and industrial policies); institutions; consumer preferences; political economic considerations; and technological choices.

**Box 2.1** **ETS Developments in Asia and the Pacific**

**China:** In late 2020, President Xi pledged to peak China's emissions before 2030 and achieve net zero by 2060. In this context, the Chinese national ETS became operational in 2021 as the world's largest system, covering more than 4 billion $tCO_2$ (about 40% of national carbon emissions). The system operates as an intensity-based ETS and covers the power sector, with other sectors expected to be introduced later. The national registry and trading platform are currently being developed, and details of key design elements (e.g. monitoring, reporting, and verification) are being finalised.

**Chinese pilot projects:** Throughout 2020, the eight Chinese regional ETS pilots continued operating and further developed allocation, offsetting, and trading rules. While the Chinese pilots will initially operate in parallel to the national ETS, it is anticipated that overlapping entities will be gradually integrated into the national market.

**Taiwan:** An act creating a mandate for an ETS is currently under revision.

**Central Asia**

**Kazakhstan:** Completed the final year of the system's third phase, during which participating operators could choose between grandparenting and product-based benchmarking as the allocation method. Operators participating in the fourth phase must use benchmarking as the method of allocation. A new National Allocation Plan was also issued, setting the cap for 2021.

**Oceania**

**New Zealand:** Completed comprehensive legislative reforms in 2020, laying the foundations for new regulatory settings for 2021–2025 in line with newly legislated net zero targets to 2050. A cap on emissions was established for the first time under the New Zealand ETS, and auctioning was introduced in March 2021, incorporating new market stability measures. Other reforms include the phase down of free allocation for EITE activities, forestry sector accounting changes, and plans to put a price on agricultural emissions by 2025.

EITE = Emissions-Intensive Trade-Exposed, ETS = emissions trading scheme, $tCO_2$ = ton of carbon dioxide.
Source: ICAP (2021)

Many commercially proven technological innovations have accelerated decoupling in upper and high-income countries, as illustrated in Figure 2.12.

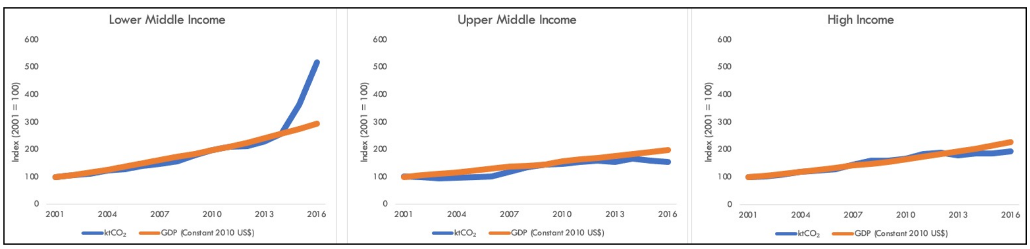
Recent announcements of the net zero ambition will reinforce decoupling trends. Yet within the region, a number of countries – in particular low-income countries such as the Lao PDR and Cambodia – still have some way to go to decouple economic growth from energy intensity. Countries also realise that acting early and comprehensively will serve to address other development concerns such as employment and social inclusion.

This reflects an important lesson from 2008 that the recovery from the global financial crisis led to a sharp rise in carbon emissions. Thus, countries that made the net zero pledge also emphasised acting immediately to avoid repeating the same mistakes. Countries also realise that acting early and comprehensively will serve to address other development concerns such as employment and social inclusion.

### 4.4 Low-Carbon Technologies as Opportunities for Growth

Ultimately, a low-carbon economy requires structural change and the growth of industry sectors producing

**Figure 2.12 $CO_2$ and GDP Developments in Selected Economies in Asia (Country Groups)**




CO2 = carbon dioxide, GDP = gross domestic product, kt = kiloton.

Sources: World Bank (2020), DataBank, GDP (current US$). https://data.worldbank.org/indicator/EN.ATM.CO2E.KT, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD (accessed 19 July 2021); and ERIA Study Team.

environmentally friendly products. Adopting green growth requires more labour resources to be dedicated to low-carbon activities, particularly in the near to medium term when the capital stock for low-carbon production has to be put in place and the capital stock embodying environmentally destructive technologies replaced. That offers the opportunity to create new jobs and provides new skills to workers, both of which are central to the promotion of a socially inclusive economy (ADB and ADBI, 2012).

The key technologies needed for the decarbonisation of the global economy hold vast economic potential. Whereas many traditional industries have been dominated by companies from advanced economies, new low-carbon technologies and products may hold great potential for economic development in all Asian countries. Some emerging economies in Asia, notably China, are gaining substantial ground in low-carbon technology sectors. The need to leapfrog to low-carbon technologies that are affordable and locally accessible may also hold substantial potential for less advanced economies in the region – focusing on energy, industry, and mobility solutions that are fit for purpose but also that are affordable and generate local value. Electric mobility is one area where locally produced two- and three-wheelers or minibuses could become a viable option for industrial development, even for least-developed economies (Lah, 2018).

Global demand for electric vehicles will surge over the coming decades, with estimated demand for more than 200 million battery electric and plug-in vehicles globally in just the next 10 years, in a sustainable development scenario that is in line with the Paris Agreement (IEA, 2021b). Similarly, the demand for renewable energies will continue to be very high to enable the decarbonisation of the electricity and industry sectors. The share of renewables in global electricity will need to grow from 27% in 2019 to almost half of generation by 2030 to be in line with the Paris Agreement (IEA, 2021b). This creates substantial challenges for countries in Asia to shift their electricity generation towards renewables, but also creates opportunities for the development of renewable energy solutions for the domestic, regional, and global markets.

### 4.5 Moving Towards Zero – Together

In moving towards net zero economies, advanced industrialised economies of the region – such as Japan, Korea, Singapore, Australia, and New Zealand – have advanced infrastructure, regulations, and skilled human resources and are in a better position to exploit the technological potential of new innovations in niche areas of alternative energy sources such as hydrogen fuel, financing energy efficiency, and the application of digital services. Energy and resource efficiency are a welcome side effect of the digital economy, but rarely a key objective of deploying them. A more conscious and targeted approach for linking emerging technologies could create more opportunities for the region's advanced economies to reduce their carbon footprints at the global level.

Emerging economies in the region – such as China, India, Viet Nam, the Philippines, Indonesia, and Thailand – have developed or are developing new zero emission strategies for their societies and key industrial sectors. They are also important suppliers for global value chains. Their low-carbon actions are often driven by market demands as well as the need for finding the co-benefits of improved pollution prevention and reducing inequalities. Market orientation and social inclusion could therefore play an important role in pushing low-carbon policies and practices in these emerging economies.

Developing economies in Asia – such as the Lao PDR, Cambodia, and Myanmar – have made significant progress in developing policies, infrastructure, and institutions that drive low-carbon resilient growth. They have realised the potential benefits of low-carbon green growth through collaborative and often community-led innovations, as well as government-led demonstrative pilot initiatives. However, they face severe technological and financial challenges with respect to net zero emissions growth. In 'leapfrogging' to make their countries' development low-carbon and resilient, these countries need proactive international development assistance and regional cooperation in finance and technology. International cooperation frameworks for a net zero economy should therefore consider the economic and social implications associated with setting high ambitions for those countries and help them to turn the risks into opportunities.

## 5. Key Takeaways

This chapter has given a broad overview of major developments globally and across Asia. It outlines distinct forms of megatrends that continue to influence development policymaking in developing Asia. Asia's continuing economic renaissance and low-carbon development create potentially mutually converging paths. A salient point from this overview is that COVID-19 does not appear to have derailed Asia's development trajectory. The pandemic has only served to create urgency for countries to broaden the scope and step up the speed of future growth that is inclusive, sustainable, and resilient.

Reflecting on the Asia-wide experience with the pandemic crisis management and looking ahead to possible recovery pathways, we can identify the following takeaways.

**a. As countries continue to deal with the fall-out from COVID-19, Asia as a regional whole is already seeing a clear reset of the development agenda focusing on both short-term responses (rescue and recovery) and long-term commitments (net zero).**

In the heat of the crisis response, much discussion emerged on how response operations could avoid or minimise irreversible negative impacts in the long term. Such concerns were wide-ranging – from social and economic matters to the public and private sector, such as medical waste disposal, infrastructure construction, budget management efficiency and effectiveness, the stability of the financial system, and entrepreneurship.

In connecting the short-term responses to long-term commitments, terms such as inclusive, sustainable, and resilient are no longer rhetorical, but carry real and substantive meaning. COVID-19 brings forth particular emphasis on the importance of resilience on top of efficiency considerations. Serious efforts have been made to review and scrutinise the response budget programmes to ensure consistency with the long-term commitment to inclusive, sustainable, and resilient development. The green recovery strategy features prominently at the national and regional levels.

An added feature of the green recovery strategy is the emphasis on technological and institutional innovations to move to a new era of development. For example, in November 2020, ASEAN promulgated a coordinated plan of action by AMS to pursue a five-pillar recovery strategy, including pillar 4 (digital transformation) and pillar 5 (low-carbon and resilient development). In announcing their commitment to the net zero emissions goal by 2050, China, Japan, and Korea are actively at work to integrate digital platform and smart technologies into the new green growth strategy for a low-carbon growth agenda.

**b. Differences between national roadmaps and economic opportunities for low-carbon development**

Countries face different pressures from energy security concerns, reflecting their domestic resources and stages of development. While subscribing to the same set of overarching goals, different countries may pursue country-focused pathways to inclusive, sustainable, and resilient development. NDCs are such processes to develop and implement the country-relevant strategic plans. Recent experience suggests that integrating NDCs into national development strategies has become the norm. Growing recognition that environmental concerns and economic development are two sides of the same coin will be a vital enabler to participate in global competition for innovative low-carbon products and technologies.

While countries in Asia are at different stages of development, there are opportunities for all of them. Low-income countries will benefit from avoiding locking into technologies and infrastructures that are inefficient and carbon-intensive, and may find niches for innovative low-carbon products in regional and global markets. There are also opportunities for firms in low-income countries to explore innovations which are the first in their own domestic market (ADB, 2020b). Middle-income countries have the capacity and potential to pursue low-carbon research and development and to deploy new technologies abroad, including to low-income countries. The post-COVID-19 era presents an opportunity for advanced high-income economies such as Japan and Korea to reset their growth priorities. Indeed, they can and are pursuing low-carbon technological frontiers, in combination with digital and smart platforms.

Low-income countries face critical concerns regarding national capacity and institutional capability that must be addressed for them to pursue effective planning and implementation of national roadmaps. Past experiences with externally supported capacity building have generated mixed results. A workable practice is to integrate the adoption of new technology from abroad in the context of active local learning and experimentation (Andrews et al., 2007).

### c. Governance, the role of local and national governments, and regional cooperation

A coherent and coordinated low-carbon, sustainable development strategy for Asia will require effective governance underpinned by active engagement of all policy actors at the local and national levels, along with private sector players. The implementation gap is often a result of capacity constraints, which can be overcome through concerted capacity building programmes, combined with policy, investment, and business development support. There is also a need to ensure effective accountability regarding how strategic implementation progress and performance undergo monitoring, reporting, and verification. SDG performance tracking is one example of performance monitoring and reporting. Such an approach could be extended to monitoring and reporting on the implementation of low-carbon or net zero emission strategies.

While countries assume the principal role of designing and implementing low-carbon green growth strategies, important concerns must be tackled at the regional level through greater cooperation amongst countries. These involve joint technology development and deployment. Regional supply chains and production networks are being recalibrated in the context of the RCEP and other regional and bilateral agreements that will broaden and deepen economic interdependence and regional integration in the era after COVID-19.

# Chapter 3

## Transformational Strategies:

## Progress Made and New Challenges being Met

## Chapter 3
## Transformational Strategies: Progress Made and New Challenges being Met



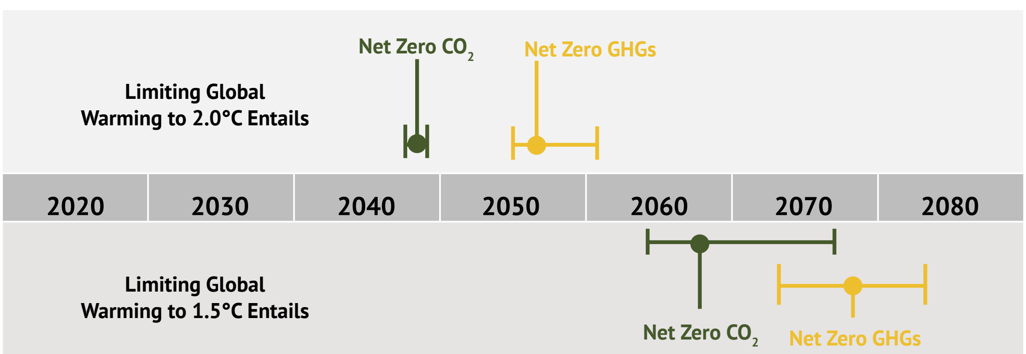
This chapter conducts an empirical examination of similarities and differences in policies and actions across developed and developing Asian countries to promote low-carbon green growth. It seeks to assess whether policies and plans are aligned with low-carbon pathways leading to net zero emissions targets. It reviews the strategies and actions undertaken by the major economies of the Association of Southeast Asian Nations (ASEAN) and East Asia, comparing and contrasting these with initiatives in advanced economies such as Japan, the Republic of Korea (henceforth, Korea), and Singapore. Success stories and initiatives based on experiences across countries, sectors, or specific user groups that can provide lessons to the entire region are also highlighted.

While much has been achieved, and significant efforts are being made across the region, the analyses indicate that current and planned efforts are not sufficient in terms of the scale of action that will be required globally to achieve a net zero future. Figure 3.1 shows that, in order to limit global warming to 1.5oC, countries need to achieve net zero carbon dioxide (CO2) emissions by 2050 and net zero emissions of all greenhouse gases (GHGs) by 2070 (given that some non-CO2 gases, such as methane emanating from agriculture, are more difficult to phase out). How quickly the highest emitters reach net zero emissions plays a crucial role in limiting warming to 1.5°C (Levin et al., 2021). Recent commitments by China, Japan, Korea, the United States (US), and the European Union (EU) towards net zero targets are likely to impart greater momentum to the low-carbon energy transition across economies.

While technology is one of the key drivers of transformative low-carbon pathways, the availability of finance and enabling policies are equally important for the rapid diffusion and upscaling of alternative options.

Economies in ASEAN and East Asia have had a number of successes in implementing low-carbon growth strategies. Examples include innovative applications of know-how in industrial units, frameworks or models for examining and changing behaviour and consumption patterns, and the application of targeted policies and initiatives that have enabled efficiency improvements or influenced market dynamics toward alternative technologies. Such successes need to be sustained, replicated, and scaled up.

**Figure 3.1 Scenarios Limiting Warming to 1.5°C and 2.0°C**




$CO_2$ = carbon dioxide, GHG = greenhouse gas.

Source: ERIA Study Team.

This chapter has five sections. The first section gives a comparative assessment of the region's performance in low-carbon green growth in recent decades. The second section examines how different policy instruments have been developed and deployed to support the implementation. Potential and opportunities to bring efforts into line with the net zero targets are identified. The third section assesses how the pandemic shock has disrupted the early envisioned low-carbon pathways by developing and emerging economies of ASEAN and East Asia. This assessment focuses on a number of key sectors which are vital to economic livelihoods and significant in terms of emission reduction potential. The fourth section extends the low-carbon green growth discussion to cover the circular economy perspective, to point out how the pandemic response actions so far heighten policy attention to new priorities of the circular economy, including the disposal of toxic medical waste and other conservation efforts. The fifth section presents a preliminary review of countries' response actions to the coronavirus disease (COVID-19) pandemic. The assessments of this chapter provide the basis for closer examination of post-COVID-19 recovery priorities and pathways in the next chapter. The last section highlights key takeaways from this chapter.

## 1. Comparison of Trends Across Key Low-Carbon Green Growth Indicators

### 1.1. Energy Consumption and Energy Intensity

Nearly 87% of all human-produced CO2 emissions emanate from the combustion of fossil fuels such as coal, oil, and gas. The remainder results from clearing of forests and other land use changes (9%), as well as industrial processes such as cement manufacturing (4%). Clearly, energy is not only the primary driver of economic growth but also of carbon emissions in most countries.[1] At present, China is the highest energy-consuming country, followed by the US and India. However, the growth (compound annual growth rate) of energy consumption during 2010–2019 was 4% for China, 6% for India, and less than 1% for the US, largely reflective of the stage of development and structure of the economies. Total energy consumption declined only in Japan during this period. Although the energy consumption of all ASEAN Member States (AMS) is low due to the small size of their economies, the growth of energy consumption was high for the Lao People's Democratic Republic (Lao PDR) (20%), Cambodia (13%), Myanmar (12%), and Viet Nam (9%), while the growth rate for other AMS was 3%–6% during this time.

Driven by considerations of energy security, and with continuous improvements in technologies and processes, the efficiency of energy use has been improving across most countries, as indicated by declines in the energy intensity of gross domestic product (GDP). China and Japan exhibited the largest declines in energy intensity during 2010–2018, with a reduction of 4% for China and 3% for Japan. The energy intensity of the US dropped by 2% while that of Korea and India declined by 1% each. Amongst the AMS, the energy intensity increased by 12% in the Lao PDR, 2% in Viet Nam, 3% in Brunei, and 5% in Myanmar and Cambodia. The energy intensity of GDP declined for other AMS, including Singapore, Malaysia, Thailand, and the Philippines.

[1] Non-$CO_2$ emissions from agriculture, forestry, and other land use are significantly high in a few ASEAN Member States (AMS) such as Indonesia, the Lao People's Democratic Republic (Lao PDR), and Cambodia (Zeleke et al., 2016).

### 1.2 Per Capita Emissions and Economic Growth

Per capita emissions are an important indicator to measure the performance of low-carbon green development strategies. According to the statistics provided by the US Energy Information Administration (2021), total per capita CO2 emissions declined for major developed countries such as Japan, Australia, and the US during 2010–2018, but continued to increase in other major economies like China, India, and Korea, largely because of energy use.

While the growth of per capita emissions was 5% for India, it was 2% for China and Korea. Average per capita emissions for ASEAN also increased during 2010–2018. Amongst AMS, the per capita energy use and emissions of Brunei and Singapore are significantly higher than in the US and grew by 1.4% during 2010–2018. While the per capita emissions of the Lao PDR increased by more than 20 times, they rose by 12% for Myanmar and Cambodia and 8% for Viet Nam during the same period.

### 1.3 Energy Poverty and Access to Clean Energy

Table 3.1 presents the key development and environmental indicators for ASEAN and selected major economies across the world. Most of the major economies had achieved 100% village electrification by 2018 and 99.99% household electrification by 2019, although the availability and reliability of power supply remains a major challenge in many rural areas. According to Sachs et al. (2020), about 2.3% of India's population is living below the poverty line (USUS$1.9 per day), while the poverty situation is much better in China (0.2%).

**Table 3.1 Key Development and Environmental Indicators of Major Economies**

| Indicator | Australia | China | India | Japan | Rep. of Korea | US | ASEAN |
|---|---|---|---|---|---|---|---|
| Population with access to electricity (%) | 100.0 | 100.0 | 92.6 | 100.0 | 100.0 | 100.0 | 94.36 |
| Population with access to clean fuels and technology for cooking (%) | 100.0 | 59.3 | 41.0 | 100.0 | 96.7 | 100.0 | 58.1 |
| Per capita $CO_2$ emissions ($MtCO_2$ per capita) | 16.3 | 7.4 | 1.8 | 9.6 | 16.3 | 16.2 | 8.9 |
| Per capita energy consumption (MBtu/person) | 243.2 | 102.4 | 23.4 | 151.3 | 243.3 | 309.7 | 145.8 |
| Share of renewable energy in total primary energy supply (%) | 6.5 | 11.2 | 8.5 | 10.2 | 1.9 | 9.8 | 12.0 |
| Share of renewable power generation | 17.9 | 27.0 | 18.3 | 22.0 | 4.6 | 17.8 | 30.2 |
| Energy intensity of GDP (1,000 Btu per US$1 at 2015 constant PPP) | 5.1 | 6.7 | 3.6 | 3.6 | 5.9 | 5.2 | 4.4 |
| Poverty headcount ratio at US$1.90/day (%) | 0.5 | 0.2 | 2.3 | 0.5 | 0.5 | 0.5 | 2.2 |

ASEAN = Association of Southeast Asian Nations, Btu = British thermal unit, $CO_2$ = carbon dioxide, GDP = gross domestic product, Mt = metric ton, MBtu = million British thermal units, PPP = purchasing power parity, US = United States.

Source: Compiled by the ERIA Study Team based on data from US Energy Information Administration (n.d.) and Country Profile: Sustainable Development Report (2020).

Amongst the AMS (Table 3.2), poverty is highest in the Lao PDR (8.9%), followed by Indonesia (3.7%), the Philippines (3.1%), and Myanmar (2.1%). Myanmar is also far behind in access to clean energy, with only 70% of its population having access to electricity, and only 18% with access to clean cooking fuel. Many other AMS also lack access to clean fuel and technology for cooking – the Lao PDR (6%), Cambodia (18%), and the Philippines (43%).

National development considerations such as providing access to clean energy and infrastructure – or enhancing education, health, and employment opportunities to improve people's well-being – are overriding priorities that influence the energy and emission levels of countries. Alternative development pathways can have a strong influence on countries' emission trajectories.

Despite the relatively high energy and emission intensity of China compared with other major economies under study, its rates of decline of energy intensity and emission intensity were the largest during this period, indicating the success of energy efficiency and decarbonisation efforts, including the closure of many polluting factories in recent years (Nace, 2017). After China, Japan has the second largest rate of decline in energy intensity. The US has the second largest decline in emission intensity during this period, with a rise in the rate of technological progress (Chetwynd and Sargent, 2019).

In the ASEAN and East Asia region, there are two distinct sets of countries in terms of decarbonisation. Figure 3.2 illustrates carbon emissions and economic growth. While countries such as Indonesia, Malaysia, Thailand, and Singapore have improved energy efficiency and carbon intensity, the situation is the opposite in countries like Brunei, Myanmar, Cambodia, the Lao PDR, and Viet Nam, where both energy intensity and emission intensity grew during this period. The Philippines is a special case, where the economy improved in terms of carbon intensity but continued to reflect positive growth. The Lao PDR is a very small country in terms of GDP but exhibited high growth in both energy and emission intensity during this period, indicating that low-carbon green growth featured less in their development plans. Extensive use of fossil fuels and less attention to energy efficiency are primary factors behind such trends (Ayertey Odonkor, 2020).

## 2. Targets, Policies, and Measures with Implications for Low-Carbon Development

To avoid furthering the climate change crisis, it is critical to contain cumulative emissions within limits. While some nations still lack a clear strategic plan towards any climate commitment, others have proposed targets of net zero emissions by mid-century. Recognising the urgency, some nations such as New Zealand have even declared a climate emergency (Taylor, 2020).

### 2.1. Targets for Emissions Reduction

All ASEAN and East Asian countries have ratified the Paris Agreement and have submitted their nationally determined contribution (NDC) plans to reduce GHG emissions. The parties have also committed to submitting an update of the NDCs every 5 years to demonstrate progress and enhance their ambitions over the previous target.

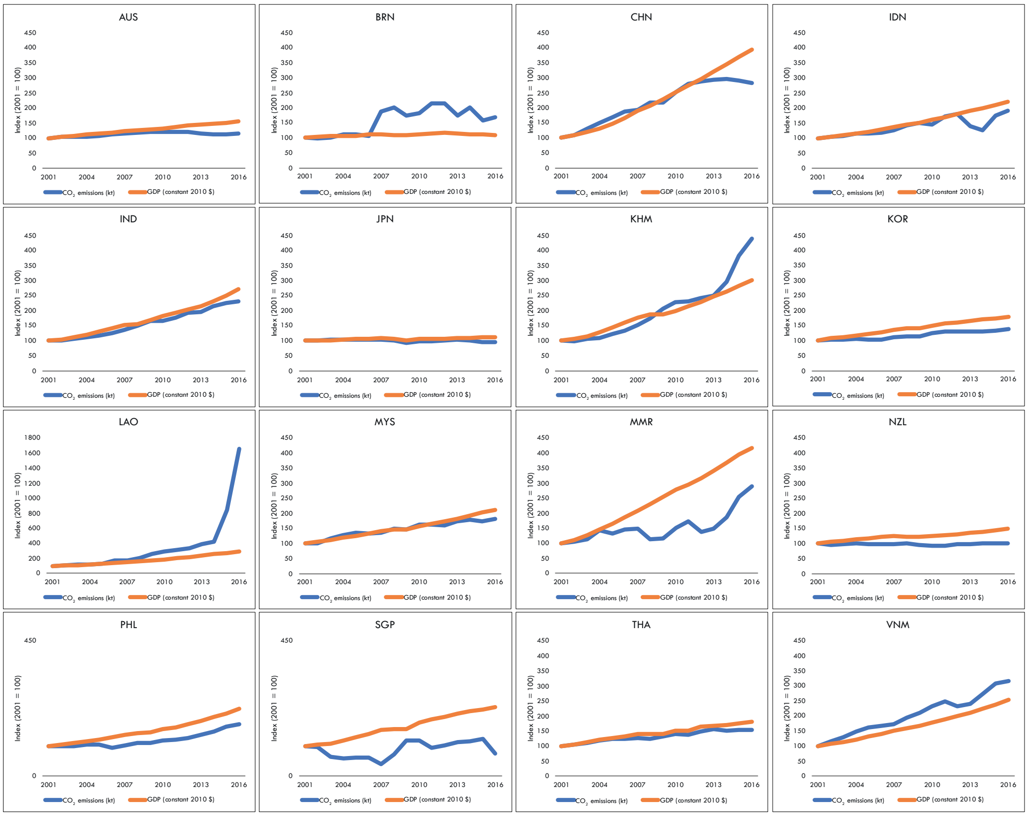
**Table 3.2 Economic and Environmental Status Comparison Amongst ASEAN Member States**

| Indicator | Brunei Darussalam | Myanmar | Cambodia | Indonesia | Lao PDR | Malaysia | Philippines | Singapore | Thailand | Viet Nam | ASEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Population with access to electricity | 100.0 | 69.8 | 89.1 | 98.1 | 93.6 | 100.0 | 93.0 | 100.0 | 100.0 | 100.0 | 94.36 |
| Population with access to clean fuels and technology for cooking (%) | 100.0 | 18.4 | 17.7 | 58.4 | 5.6 | 96.3 | 43.2 | 100.0 | 74.4 | 66.9 | 58.1 |
| Per capita $CO_2$ emissions ($MtCO_2$ per capita) | 23.9 | 0.6 | 0.8 | 2.0 | 4.2 | 7.7 | 1.2 | 42.0 | 4.4 | 2.6 | 8.9 |
| Per capita energy consumption (MBtu/person) | 425.0 | 11.4 | 12.6 | 29.8 | 61.0 | 120.1 | 18.0 | 662.3 | 79.3 | 38.9 | 145.8 |
| Share of renewable energy in total primary energy supply (%) | 0.0 | 19.6 | 23.9 | 5.8 | 25.5 | 6.6 | 10.7 | 0.41 | 6.6 | 20.8 | 12.0 |
| Share of renewable power generation | 0.1 | 58.9 | 60.2 | 18.2 | 66.2 | 17.5 | 24.0 | 3.3 | 17.3 | 36.4 | 30.2 |
| Energy intensity of GDP (1,000 Btu per US$1 at 2015 constant PPP) | 5.5 | 1.9 | 3.2 | 2.6 | 8.5 | 4.4 | 2.1 | 7.0 | 4.5 | 4.3 | 4.4 |
| Poverty headcount ratio at US$1.90/day (%) | NA | 2.1 | 0.2 | 3.7 | 8.9 | 0.0 | 3.1 | 0.9 | 0.0 | 0.6 | 2.2 |

ASEAN = Association of Southeast Asian Nations, Btu = British thermal unit, $CO_2$ = carbon dioxide, GDP = gross domestic product, Mt = metric ton, MBtu = million British thermal units, NA = not applicable, PPP = purchasing power parity, US = United States.

Source: Compiled by the study team based on data provided by US Energy Information Administration (n.d.) and Country Profile: Sustainable Development Report 2020.

**Figure 3.2 Patterns of Decoupling of Carbon Emissions from Economic Growth**




AUS = Australia, BRN = Brunei, CHN = China, $CO_2$ = carbon dioxide, GDP = gross domestic product, IDN = Indonesia, IND = India, JPN = Japan, KHM = Cambodia, KOR = Republic of Korea, kt = kiloton, LAO = Lao PDR, MMR = Myanmar, MYS = Malaysia, NZL = New Zealand, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

Source: Compiled by ERIA Study Team.

Further, the parties are invited to submit their long-term strategy or long-term low GHG emissions development strategies by 2021 as part of the 2021 United Nations Climate Change Conference (COP26). The long-term strategy/long-term low GHG emissions development strategies are particularly beneficial in driving and shaping short-term action, and can play a fundamental role in informing the future NDCs (Falduto and Rocha, 2020).

Table 3.3 presents the mitigation targets and updates of ASEAN and East Asia countries. The data indicate that most countries in the ASEAN and East Asia region, except Myanmar and the Lao PDR, have spelt out clear emission reduction targets. In the 2020 NDC update process, while most ASEAN and East Asian countries did not make any changes to their NDC commitments, a few countries proposed a stronger NDC target. Singapore, for instance, targeted an emission intensity reduction of 36% by 2030 in its NDC commitment against the reference year 2005 (UNFCCC (n.d.)).  In its first NDC update, the country specified an absolute target of peaking emissions at around 65 million tons of carbon dioxide equivalent (MtCO2e) in 2030 (UNFCCC (n.d.)).

## Table 3.3 Mitigation Targets and Updates of ASEAN and East Asian Countries

| Country | Summary of pledges and targets | 2020 NDC update | LT-LEDS/ Informal long-term climate commitment |
|---|---|---|---|
| **Brunei Darussalam** | NDC target: Reduce energy consumption 63% by 2030 (reference: BAU) | First NDC: Reduction in GHG emissions by 20% relative to BAU by 2030 | |
| **Cambodia** | Reduce emissions, conditional 27% by 2030 (reference: BAU)<br><br>Reduce emissions, conditional 41.7% emission reduction (reference: BAU) of which 59.1% is from FOLU; 25% of renewable energy in the energy mix (solar, wind, hydro, biomass) by 2030 | Reduce emissions, conditional 41.7% emission reduction (reference: BAU) of which 59.1% is from FOLU; 25% of renewable energy in the energy mix (solar, wind, hydro, biomass) by 2030 | |
| **Indonesia** | 29% below BAU by 2030, including LULUCF | Mitigation target remained unchanged | With a low-carbon scenario compatible with the Paris Agreement target, Indonesia foresees peaking of national GHGs emissions in 2030 with a net sink in FOLU, further exploring opportunity to rapidly progress towards net zero emissions in 2060 or sooner. |
| | Conditional – up to 41% below BAU by 2030, including LULUCF | Mitigation target remained unchanged | |
| **Lao PDR** | INDC targets: 70% of forest cover by 2020; 30% renewable energy, excluding large hydro, of total energy consumption by 2030; share of biofuels to meet 10% of transport fuels; expansion of large hydro to 5,500 MW by 2020 and 20,000 MW by 2030 | NDC target – 2030 unconditional target – 60% GHG emission reductions compared to baseline scenario, or around 62,000 $ktCO_2$ in absolute terms<br><br>Conditional sectoral targets across the land use change and forestry, agriculture, energy, and waste sectors | |

| Country | Summary of pledges and targets | 2020 NDC update | LT-LEDS/ Informal long-term climate commitment |
|---|---|---|---|
| **Myanmar** | By 2030, boost hydropower capacity by 9.4 GW to achieve electrification, using at least 30% renewable energy sources; expand forest area 30% by 2030 | Reducing its reliance on coal from 33% under a BAU scenario to 20% (3,620 MW) as an unconditional target by 2030, but a conditional target of 11% (2,120 MW); unconditional target for new renewable energy of 11% (2,000 MW) of total energy mix by 2030. Conditionally, increase the renewable energy contribution to 3,070 MW (17% of the total energy mix). | |
| **Malaysia** | Reduce emissions intensity of GDP by 35% (reference: 2005) | Unconditional reduction in emissions intensity of GDP by 45% (reference: 2005) | |
| | 45% conditional reduction in | | |
| **Thailand** | Reduce emissions by 20% (reference: projected BAU) | Mitigation target remains unchanged | |
| | 25% conditional reduction (reference: projected BAU) | | |
| **Philippines** | Reduce emissions conditional 70% below BAU by 2030 | | |
| **Singapore** | INDC – reduce emission intensity by 36% by 2030 (reference: 2005) | First NDC – peak emission level at 65 MtCO2e around 2030 to achieve a 36% reduction in emission intensity from 2005 levels by 2030 | Achieve net zero emissions as early as possible after mid-century |
| **Viet Nam** | 8% below BAU by 2030, including LULUCF | The base year is revised to 2014 compared with 2010 in the previous NDC; 9% below BAU by 2030, including LULUCF | |
| | Conditional – 25% below BAU by 2030, including LULUCF | Conditional 27% below BAU by 2030, including LULUCF | |
| **China** | Peak CO2 emissions by 2030 at the latest | | Achieve net zero emissions by 2060 |
| | Non-fossil share: 20% in 2030 | | |
| | Forest stock: +4.5 billion cubic metres by 2030 compared to 2005 | | |
| | Carbon intensity: −60% to −65% below 2005 by 2030 | | |

| Country | Summary of pledges and targets | 2020 NDC update | LT-LEDS/ Informal long-term climate commitment |
|---|---|---|---|
| **India** | 33%–35% below 2005 emissions intensity of GDP by 2030 | | |
| | Create additional carbon sink of 2.5–3.0 GtCO2e through additional forest and tree cover by 2030 | | |
| | 2030 conditional target(s) – non-fossil share of cumulative power generation capacity 40% by 2030 | | |
| **Republic of Korea** | 37% below BAU by 2030 | Reduce total national GHG emissions by 24.4% in 2017 (709.1 MtCO2e) by 2030 | Achieve net zero emissions by 2050 |
| **New Zealand** | 30% below 2005 by 2030 | Reduce emissions of biogenic methane to 24%–47% below 2017 levels by 2050, including to 10% below 2017 levels by 2030 | Reduce net emissions of GHGs (other than biogenic methane) to zero by 2050 |
| **Japan** | 26% below 2013 by 2030 | Mitigation target remained unchanged | Achieve net zero emissions by 2050 |
| **Australia** | 26%–28% below 2005 by 2030 | Mitigation target remained unchanged | |

ASEAN = Association of Southeast Asian Nations; BAU = business as usual; FOLU = forestry and land use; GDP = gross domestic product; GHG = greenhouse gas; $GtCO_2$ = gigatons of $CO_2$ equivalent; GW = gigawatt; INDC = Intended Nationally Determined Contribution; $ktCO_2$ = kilotons of $CO_2$ equivalent; LT-LEDS = long-term low greenhouse gas emissions development strategies; LULUCF = land use, land use change, and forestry; $MtCO_2$ = million tons of $CO_2$ equivalent; MW = megawatt; NDC = nationally determined contribution.

Note: Targets are unconditional unless specified otherwise.

Source: UNFCCC (n.d.), NDC Registry. https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx (accessed 20 August 2021).

Singapore's long-term low-emission development strategy builds on the enhanced NDC target by aspiring to halve its emissions from its peak to 33 MtCO2e by 2050, with a view to achieving net zero emissions as soon as viable in the second half of the century. Similarly, China proposes to peak its emissions by 2030 and achieve net zero emissions by 2060.

A review of emission reduction targets suggests that, on the one hand, there are very limited signs of enhancement of 2030 NDC targets, although many of these countries have progressed in formulating their long-term strategies and announcing informal long-term national climate commitments, mostly in the form of net zero carbon targets for a climate-resilient and low-carbon future. AMS such as Viet Nam, Singapore, and Cambodia have proposed stronger unconditional and conditional emissions reduction targets as part of the Paris Agreement.

While several developing countries have also proposed ambitious non-binding targets, such as the net zero vision, in accordance with the 1.5°C target of the Paris Agreement, none of these targets are backed by formal binding emission reduction targets incorporated in their NDCs. In addition, there are no clear roadmaps laid out that envisage how countries expect to transition towards their proposed targets. Notwithstanding this, if pursued, these visions by China, Korea, Japan, and New Zealand imply the deployment of transformational low-carbon strategies. Regional cooperation in technology transfer, trade and investment, finance, and capacity building will be instrumental in attaining such targets.

### 2.2. Policies and Measures Driving Low-Carbon Development

An analysis of policies and measures adopted across countries indicates that countries include diverse strategies and measures across sectors and at different levels directed towards achieving the NDC targets. Low-carbon strategies in the energy sector largely include enhancing low-carbon/decarbonised fuels on the supply side (via strategies such as the development of renewable energy portfolio standards) and demand-side strategies that focus on energy efficiency across sectors as well as fuel switching across end-uses. The use of taxes and subsidies to incentivise low-carbon options and the inclusion of carbon pricing are also used widely across countries. Increasingly, countries have focused on integrating local considerations in rolling out measures related to waste and water management, sustainable mobility, and smart cities. Table 3.4 provides an assessment of low-carbon green growth policies and measures practised or proposed in ASEAN and East Asia countries.

## Table 3.4 Summary of Low-Carbon Policies and Initiatives Practised or Proposed in ASEAN and East Asia Countries

| Policy/Measure | | BRN | SGP | IDN | THA | VNM | LAO | MYS | PHL | MMR | KHM | CHN | IND | JPN | AUS | NZL | KOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Energy supply** | Efficient fossil generation technologies | | X | | | | | | | | | X | X | X | X | X | X |
| | Investment excise and other tax credits | | X | X | | | | | | | | X | X | X | | | X |
| | Renewable portfolio standards | | | | | | X | | | X | | X | X | X | X | X | |
| **Power** | Power management | X | | | | | | | | | | | | | | | |
| | Increase in share of renewables in electricity generation | X | | X | X | | X | X | X | | X | | | X | | X | |
| | Advanced fossil generation technologies | | | | | | | | | | | | | | | | |
| | Retiring old, inefficient plants | | | | | | | | | | | X | | | | | |
| **Energy demand** | Efficiency labels | | X | X | X | X | X | X | | | | X | X | X | X | X | X |
| **Industry** | Efficiency improvement/shift to low-carbon technologies | X | X | | | | | | | | X | | | | | | |
| **Buildings** | Efficient/green buildings | | X | | | | | X | | | X | | | X | | | |
| | Control of individual vehicle ownership | | X | | | | | | | | | | | | | | |
| | Vehicle emission standards/improvement | | X | X | X | X | | | X | | | X | X | X | X | | X |
| | Cleaner fuels | X | | | | | | | X | | | | | X | | | X |
| | Phasing out of conventional ICE vehicles | | | | | | | | | | | | | X | | | |
| | Reducing emissions through walk-cycle-ride | X | X | | | | | | | | X | | | | | | |
| | Crop carbon sequestration | | | X | | | | | | | | X | X | X | X | | X |
| | Reduction of open field burning | | | X | X | | | | | | X | X | X | X | | | |
| | Promote climate resilience in agriculture | | | | | | X | X | | | | | | | | | |
| **Residential** | Efficient appliances | | X | | | | | | X | | | | | | | | |
| **R&D** | Clean and/or energy efficiency programmes | | X | | X | | | | X | | | X | X | X | X | | X |
| **Carbon sink programmes** | Afforestation/reforestation programmes | | X | X | X | | | X | | | | X | X | X | | | X |
| | CCS/CCUS | | X | | | | | | | | | X | | | X | X | X |
| | Mitigation of HFCs from refrigeration and ACs | | X | | | | | | | | | | | X | | | |
| | Carbon taxes | X | X | | | | | | | | | | | X | | | |

| Policy/Measure | | BRN | SGP | IDN | THA | VNM | LAO | MYS | PHL | MMR | KHM | CHN | IND | JPN | AUS | NZL | KOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Financing** | Climate funds | | X | X | | | | | | | | | | X | X | X | X |
| | Institutional capacity | | X | | | | | | | | | X | X | X | X | | X |
| **Local level measures** | Demand-side energy management | | X | X | X | X | | | | | | X | X | X | X | | X |
| | Sustainable transport systems | | X | X | X | | | X | | | | X | X | X | X | | X |
| | Sustainable cities | | X | X | X | X | | | | | | X | X | X | | | X |
| | Waste management | | X | | X | | | X | | | X | | | | | | |
| | Use of market-based instruments | | | | | | | | | | | X | | X | X | | |
| | Subsidies, grants, rebates | | X | X | | | | | | | | X | X | X | X | X | X |
| | Investment excise and other tax credits | | X | X | | | | | | | | X | X | X | | | X |
| | Public investment and loans | | X | X | X | | | | | | | X | X | X | X | X | X |
| | Renewable portfolio standards | | | | | | X | | | X | | X | X | X | X | X | |
| | Low-carbon fuels, e.g. hydrogen and biofuels | | X | | | | X | | | | | | | X | | | X |
| **Power** | Power management | X | | | | | | | | | | | | | | | |
| | Regional power grids | | X | | | | | | | | | | | | | | |
| | Increase in share of renewables in electricity generation | X | | X | X | | X | X | X | | X | | | X | | X | |
| | Switch to cleaner/diversified energy sources | | X | X | | | X | | | | X | | | X | | X | |
| | Advanced fossil generation technologies | | | | | | | | | | | | | | | | |
| | Transmission/distribution grid improvements | | | X | X | X | | | | | | X | X | | | | |
| | Retiring old, inefficient plants | | | | | | | | | | | X | | | | | |
| | Feed-in tariffs | | X | X | X | X | | X | X | | | X | X | X | X | X | X |
| **Energy demand** | Retiring old, inefficient plants | | | | | | | | | | | X | | | | | |
| | Sales tax, energy tax, VAT reduction | | X | X | X | X | | | | | | X | X | | X | X | X |
| **Industry** | Efficiency improvement/shift to low-carbon technologies | X | X | | | | | | | | X | | | | | | |
| | Corporate performance ratings | | | X | | | | | | | | | | | | | |
| **Buildings** | Efficient/green buildings | | X | | | | | X | | | X | | | X | | | |

| Policy/Measure | | BRN | SGP | IDN | THA | VNM | LAO | MYS | PHL | MMR | KHM | CHN | IND | JPN | AUS | NZL | KOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Transport** | Mass transit goals/increased use of public transport | X | X | | | | X | X | X | | X | X | X | X | X | | X |
| | Control of individual vehicle ownership | | X | | | | | | | | | | | | | | |
| | Vehicle fuel efficiency goals/efficiency improvement | X | X | X | X | X | | X | X | | X | X | X | X | | | |
| | Vehicle emission standards/improvement | | X | X | X | X | | | X | | | X | X | X | X | | X |
| | Greater use of biofuels/biofuel standards | | X | X | X | | X | | X | | | X | X | | | | X |
| | Cleaner fuels | X | | | | | | | X | | | | | X | | | X |
| | Electrification | X | X | | X | | | | X | | X | | | X | | | X |
| | Phasing out of conventional ICE vehicles | | | | | | | | | | | | | X | | | |
| | Financing schemes for sustainable transport | | | | | | | | X | | | | | | | | |
| | Reducing emissions through walk-cycle-ride | X | X | | | | | | | | X | | | | | | |
| **Agriculture** | Fertiliser management | | | X | | | | | | | | X | X | X | X | | X |
| | Crop carbon sequestration | | | X | | | | | | | | X | X | X | X | | X |
| | Methane mitigation | | | X | | | | | | | | X | X | X | X | X | X |
| | Reduction of open field burning | | | X | X | | | | | | X | X | X | X | | | |
| | Climate-friendly agribusiness value chain | | | | | | X | | | | | | | | | | |
| | Promote climate resilience in agriculture | | | | | | X | X | | | | | | | | | |
| | Promote low-carbon technologies | | | | | | X | | | | X | | | | | | |
| **Residential** | Efficient appliances | | X | | | | | | X | | | | | | | | |
| | Clean and/or efficient cook stoves | | | | | | | | | | X | | | | | | |
| **R&D** | Clean and/or energy efficiency programmes | | X | | X | | | | X | | | X | X | X | X | | X |
| | Carbon sinks | | X | X | X | | | | | | | X | X | X | X | | X |
| **Carbon sink programmes** | Afforestation/reforestation programmes | | X | X | X | | | X | | | | X | X | X | | | X |
| | Forest Cover/REDD+ | X | | X | | X | X | X | | X | X | | | | | | X |
| | CCS/CCUS | | X | | | | | | | | | X | | | X | X | X |
| | Climate resilience in forestry | | | | | | X | | | | | | | | | | |
| | Mitigation of HFCs from refrigeration and ACs | | X | | | | | | | | | | | X | | | |

| Policy/Measure | | BRN | SGP | IDN | THA | VNM | LAO | MYS | PHL | MMR | KHM | CHN | IND | JPN | AUS | NZL | KOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Carbon pricing** | Emission trading systems | | | | | | | | | | | | | X | | X | X |
| | Carbon taxes | X | X | | | | | | | | | | | X | | | |
| | Subsidies/tax incentives | | | X | | | | | | | | | | | | | |
| **Financing** | Climate funds | | X | X | | | | | | | | | | X | X | X | X |
| **Capacity building** | Public awareness | | X | X | X | X | | | | | | X | X | X | X | | X |
| | Institutional capacity | | X | | | | | | | | | X | X | X | X | | X |
| | Human resources development | | X | X | X | X | | | | | | X | X | X | X | | X |
| **Local level measures** | Demand-side energy management | | X | X | X | X | | | | | | X | X | X | X | | X |
| | Net metering | | | | X | | | | | | | | X | X | X | | |
| | Sustainable transport systems | | X | X | X | | | X | | | | X | X | X | X | | X |
| | Green transport infrastructure | | X | | | | | | | | | | | | | | |
| | Sustainable cities | | X | X | X | X | | | | | | X | X | X | | | X |
| | Low-carbon lifestyle | | X | X | | | | | | | | X | X | X | X | | X |
| | Waste management | | X | | X | | | X | | | X | | | | | | |
| | Shift of energy intensive industries | | X | X | | | | | | | | X | X | X | X | | X |
| | Use of market-based instruments | | | | | | | | | | | X | | X | X | | |
| | Water management | | X | | | | X | X | | | | | | | | | |

AC = air conditioner; ASEAN = Association of Southeast Asian Nations; AUS = Australia; BRN = Brunei; CCS = carbon capture and storage; CCUS = carbon capture, utilisation, and storage; CHN = China; HFC = hydrofluorocarbon; ICE = internal combustion engine; IDN = Indonesia; IND = India; JPN = Japan; KHM = Cambodia; KOR = Republic of Korea; LAO = Lao PDR; MMR = Myanmar; MYS = Malaysia; NZL = New Zealand; PHL = Philippines; R&D = research and development; REDD+ = Reducing Emissions from Deforestation and forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks; SGP = Singapore; THA = Thailand, VAT = value-added tax; VNM = Viet Nam.

Sources: ADB and ADBI (2013), Low-Carbon Green Growth in Asia: Policies and Practices. Tokyo: Asian Development Bank Institute; and UNFCCC (n.d.), NDC Registry. https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx (accessed 26 July 2021).

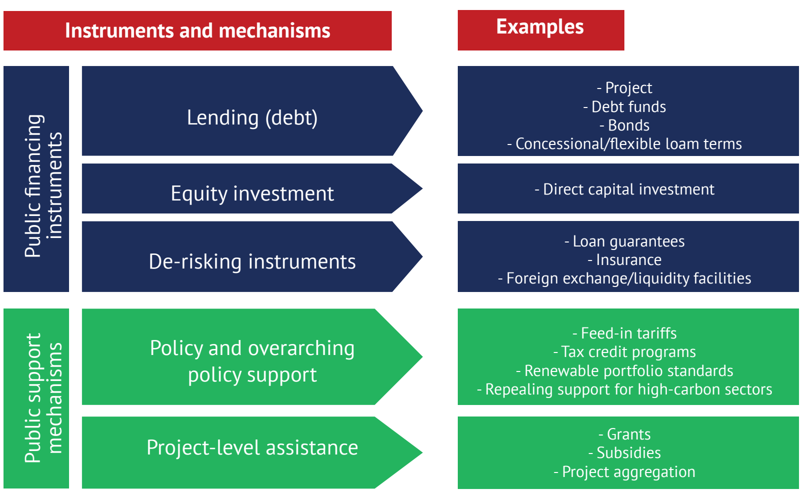
There are several policy approaches to the implementation of NDCs or other climate commitments. The plans and pledges regarding climate action are backed by policies and measures at the national, subnational, and sectoral levels. Figure 3.3 indicates the key policy instruments and financing mechanisms being adopted in ASEAN and East Asia.

Such public support mechanisms and public financing instruments are important elements in the implementation of effective and efficient climate actions.

We note that at the national level, climate action is often integrated into the country's development agenda. Low-carbon policies and measures are introduced in several countries, not with emission reductions as their primary goal, but with the objective of improving energy security, enhancing livelihood creation, reducing air pollution, or improving access to modern and clean energy forms. The Government of Indonesia, for instance, launched the Low-Carbon Development Initiative in 2017, focused on identifying development policies that would help the country promote multiple (social, economic, and environmental) goals simultaneously, while preserving and improving the country's natural resources (Kementerian PPNN/Bappenas, 2019). Realising a more prosperous and sustainable vision for Indonesia includes action on various fronts (Kementerian PPNN/Bappenas, 2019), including increasing renewable energy's share of energy use; reducing energy intensity; and fully enforcing moratoriums on forests, palm oil, mining, and peat land development.

Malaysia's Green Technology Master Plan (2017–2030) outlines multisectoral efforts to reduce GHG emission intensity and support economic growth through the adoption of green technology.

**Figure 3.3 Category of Policy Instruments and Financing Mechanism Being Practised in Developing Countries of ASEAN and East Asia to Reduce Carbon Emissions**




Source: Anbumozhi and Kimura (2018).

Other examples of climate mitigation strategies include the Lao PDR and India. The Lao PDR's climate strategy, The National Climate Change Strategy, sets out mitigation and adaptation measures in seven sectors: agriculture and food security, forestry and land use change, water resources, energy and transport, industry, urban development, and public health (ADB, WREA, and World Bank, 2010). India's National Action Plan on Climate Change (2008) contained eight sub-missions: the National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining Himalayan Ecosystem, Green India Mission, National Mission for Sustainable Agriculture, and National Mission on Strategic Knowledge for Climate Change (Pandve, 2009). This has been followed by several policies and measures in each of these areas to enhance efforts and progress in line with India's NDC, which seeks to achieve an emission intensity reduction of 33%–35% by 2030 compared with 2005 levels, 40% non-fossil fuel-based generation capacity, and enhancing the carbon sink to 2.5–3.0 gigatons of carbon dioxide ($GtCO_2$).

Increasing the share of renewables in the energy mix is, along with energy efficiency, one of the key strategies to achieving emission reduction targets. This strategy offers the dual benefit of enhancing energy security by reducing import dependence on fossil fuels. Initiatives to increase renewables in the ASEAN and East Asia countries include the 10-year Alternative Energy Development Plan (2012–2021) in Thailand, which aims to promote alternative energy usage to 25% of energy consumption and reduce dependence on energy imports. The Renewable Energy Development Strategy, launched in 2015, sets renewable energy targets for Viet Nam. The Energy Five-Year Plan (FYP) is the framework legislation defining energy development in China. In parallel to the main Energy FYP, China has 14 other supporting FYPs, such as the Renewable Energy 13th FYP, Wind FYP, and Electricity FYP. The 13th Renewable Energy Development FYP (2016–2020) was adopted by the National Energy Administration in 2016, establishing targets for renewable energy deployment until 2020. Countries are increasingly including climate-oriented plans and policies in their national development plans and energy sector plans at different levels.

Sectoral approaches are also common in emission mitigation strategies, especially where particular sectors are high energy users and carbon emitters, such as transport and industry.

For instance, Singapore has a long-standing reputation for innovative transport policies and effective land use and transport planning to achieve a sustainable transport system. Discouraging private motorised mobility, promoting public and shared mobility, and adopting an integrated approach to land use and transport planning are the three main pillars of Singapore's approach to sustainable transport (Diao, 2019). Malaysia's National Land Public Transport Master Plan (SPAD, 2012) aims to reach a 40% overall public transport modal share by 2030, almost doubling the current modal share of about 20%. This objective is to be met by implementing measures to enhance connectivity, service levels, safety, and convenience; reduce journey times; and ensure the sustainability of the public transport system. Another example of a sectoral approach to low-carbon growth is India's industry sector. Industry – a major contributing sector to India's GHG emissions – is governed by the Perform, Achieve, and Trade scheme, which is a cap-and-trade market-based approach and has been used to incentivise more efficient technologies within the identified industries (Oak and Bansal, 2019).

Low-carbon green growth initiatives are also taking place at subnational and local levels. Some initiatives, such as carbon pricing, are initially tested at a city/municipality level before being implemented at the sectoral or national level. Other initiatives, such as the development of eco-friendly, carbon-efficient cities, waste, and water management, not only assist in emission reduction but also help in the development of more habitable and sustainable cities.

Fiscal and regulatory measures are prevalent in most ASEAN and East Asia countries, primarily to promote growth in renewable energy use. Feed-in tariffs (FiTs) are used in most countries except Brunei, the Lao PDR, Myanmar, and Cambodia. The use of FiTs has demonstrated huge success in enhancing renewable energy installations, the most recent and classic example being that of Viet Nam. The country has shown rapid growth in solar installations since the introduction of FiTs in 2017, with solar installations increasing more than 50 times from 86 megawatts in 2018 to 4,450 megawatts by June 2019 (Do et al., 2020).

Carbon pricing is also emerging strongly in the region as a tool to curb carbon emissions. Emission trading is prevalent in countries like Japan and Korea as the mechanism to generate a carbon price, while others like Brunei and Singapore impose a carbon tax directly. The Singapore tax scheme under the Carbon Pricing Act, 2018 stipulates that any industrial facility which emits direct GHG emissions equal to or above 2,000 tons of carbon dioxide equivalent (tCO2e) annually has to register as a reportable facility and pay a carbon tax from 1 January 2019 at a rate of US$5 per tCO2e from 2019 to 2023. The country plans to review the carbon tax rate by 2023, with plans to raise it by US$5–US$10 per tCO2e by 2030.

Japan has a well-established history of using a carbon price as a signal to reduce carbon emissions. The first carbon emissions trading system (ETS) implemented in Japan was the Voluntary Emission Trading Scheme, launched in 2005, which covered CO2 emissions from industrial processes (production and energy consumption); offices (energy consumption); and waste management (waste incineration, waste combustion, and waste recycling) (IGES, EDF, and IETA, 2016). In 2012, the scheme was discontinued and replaced with a new subsidy-based voluntary cap-and-trade scheme called Advanced technologies promotion Subsidy Scheme with Emission Reduction Targets (ASSET). Under this programme, entities establish a reduction target based on past emissions and suggest new technologies to use to reach these targets. Japan has also implemented the Joint Crediting Mechanism, a bilateral offset crediting mechanism (Japan with developing countries) to incentivise low-carbon technologies in 17 partner countries (ICAP, 2021). Currently, Japan has three carbon pricing initiatives: the Tokyo ETS (first city-level cap-and-trade system on emissions started in 2010); the Saitama

ETS (initiated in 2011); and the Global Warming Countermeasure Tax, which is a national carbon tax (started in 2012) (Kojima and Asakawa, 2020).

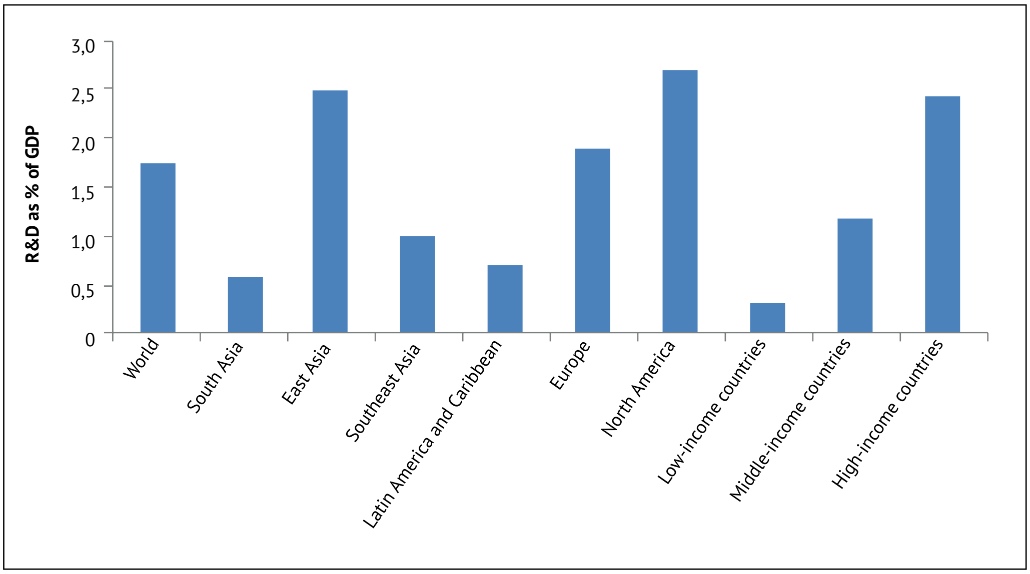
Financing is critical to support low-carbon green growth, as it plays a crucial role in mobilising the funding needed for the transition. However, financing is often one of the key barriers to the penetration of innovative low-carbon technologies, particularly in developing countries. The Swiss Sustainable Finance (2020) report on financing the low-carbon economy suggested that overcoming this barrier necessitates the development of a supportive political framework, which requires close cooperation between all stakeholders – financial players, regulators, and real-economy representatives.

Low-carbon green growth undoubtedly requires more technological progress in low-carbon production and supply, and consequently much higher investments in research and development (R&D) across countries. There are large variations in the levels of investment in R&D amongst countries. According to the United Nations Educational, Scientific and Cultural Organization Institute for Statistics (UNESCO, n.d.), the US leads China in R&D expenditure, followed by Japan, Korea, Germany, India, France, and the United Kingdom (UK). As evident from Table 3.5, R&D expenditure as a share of GDP is high in the more developed countries of the region, although China has also emerged as a country with high R&D expenditure. In countries such as the US, Japan, Korea, and other European countries, R&D investment is largely in the private sector, while government investment contributes to about 55% of India's total R&D expenditure. Compared with other major economies, India's per capita R&D expenditure is quite low – about 13% of the per capita R&D expenditure of China and only 3% of that of the US. As a region, the total R&D expenditure of ASEAN is relatively low, at around 70% of India's total R&D expenditure. However, the per capita R&D expenditure of ASEAN is comparable with that of China due to the huge variation amongst individual countries in the region, and Singapore having an even higher per capita R&D expenditure than the US. On the other hand, the share of R&D expenditure in the regional GDP of ASEAN is less than 1%.

The Asian Development Outlook 2020 (ADB, 2020) examined the variation in R&D expenditure as a share of GDP between regions in terms of the innovation gap. This indicates that the gap between developing Asia and advanced economies is narrowing (Figure 3.4) but, within developing Asia, the innovation gap is widening (ADB, 2020). The analysis also indicates that firms which are larger, older, and/or engaged in information and communication technology or high-tech manufacturing or exporting, are likely to innovate more. Moreover, other than R&D, human capital (both education and training) as well as infrastructure (e.g. institutional conditions such as property rights and the rule of law) are important determinants of innovation.

The mere availability of technologies is not enough, however. Innovation-based growth and development strategies that seek to promote long-term sustainability and focus on livelihood creation can effectively help economies successfully transition not only to low-carbon pathways but also to higher income levels and greater inclusiveness, compared with

**Figure 3.4 R&D Expenditure as a Share of GDP Across Regions, 2017 (%)**




GDP = gross domestic product, R&D = research and development.

Source: UNESCO (n.d.).

incremental innovations in products and/or processes. However, innovation is a multidimensional and complex process. Table 3.6 illustrates the stages of technology development and key policy challenges lying ahead if markets are to adopt new technologies. Investment in early R&D is necessary but not sufficient by itself for successful market penetration. The demonstration and commercialisation of emerging technologies are also vital for ensuring successful business models that enable rapid upscaling and adoption of the technologies.

R&D, knowledge sharing, and capacity building are equally important aspects of low-carbon transitions, particularly in a regional context, where countries can assist each other in case of lack of finance, rigid labour markets, lack of energy alternatives or energy-related lock-ins, resource constraints, and governance barriers. Most of these issues concern developing nations. The role of developed economies is to work together with their developing counterparts to assist them in scaling up and spreading low-carbon transformation in the region.

Current global commitments fall far short of the levels required to limit global warming to 1.5°C as desired under Article 2 of the Paris Agreement, and an analysis by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) has indicated that the emission targets set by AMS are not in line with global goals (UNESCAP, UNEP, and Greenwerk, 2020).

COVID-19 has temporarily pushed down the level of emissions due to reduced economic activity. However, while this dip is likely to be short-lived, the current phase provides an opportunity to keep emissions down. This opportunity increases the need for regional cooperation, strengthening of regional institutions, improving regional infrastructure and connectivity, advancing trade policy,

## **Table 3.5** Key Fiscal, Innovation, and Public Investment Indicators in Asia's Major Economies

| Country | GDP (current US$) | Public debt (% of GDP) | | Population ('000) | GDP per capita (US$) | $CO_2$ emissions/ population (metric ton) | Government expenditure on education (% of GDP) | Current health expenditure (% of GDP) | R&D (% of GDP) | Military expenditure (% of GDP) | Gross debt position (% of GDP) | Tax revenue (% of GDP) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Central government debt | General government debt | | | | | | | | | |
| **Year** | **2019** | **2019** | **2019** | **2019** | **2019** | **2018–2019** | **1999–2019** | **2018** | **2002–2018** | **2019** | **2020** | **2016–2019** |
| Australia | 1,396,567.01 | 34.82 | 46.28 | 25,364.31 | 55,060.30 | 15.32 | 5.10 | 9.28 | 1.87 | 1.90 | 60.41 | 23.30 |
| Bangladesh | 302,571.25 | 35.82 | no data | 163,046.16 | 1,855.70 | 0.51 | 1.30 | 2.34 | 0.14 | 1.30 | 39.62 | 8.80 |
| Brunei Darussalam | 13,469.42 | 2.58 | 28.64 | 433.29 | 31,086.80 | 16.65 | 4.40 | 2.41 | 0.28 | 3.30 | no data | - |
| Cambodia | 27,089.39 | no data | 28.61 | 16,486.54 | 1,643.10 | 0.65 | 2.20 | 6.03 | 0.12 | 2.30 | 31.47 | 19.70 |
| China | 14,342,903.01 | no data | 56.29 | 1,397,715.00 | 10,261.70 | 6.84 | 1.90 | 5.35 | 2.19 | 1.90 | 61.70 | 9.10 |
| India | 2,868,929.42 | 46.16 | 72.34 | 1,366,417.75 | 2,099.60 | 1.71 | 3.80 | 3.54 | 0.65 | 2.40 | 89.33 | 12.00 |
| Indonesia | 1,119,190.78 | 30.18 | 30.49 | 270,625.57 | 4,135.60 | 2.03 | 3.60 | 2.87 | 0.23 | 0.70 | 38.48 | 10.20 |
| Japan | 5,081,769.54 | 201.39 | 237.95 | 126,264.93 | 40,246.90 | 8.45 | 3.20 | 10.95 | 3.26 | 0.90 | 266.18 | 11.90 |
| Lao PDR | 18,173.84 | 62.64 | no data | 7,169.45 | 2,534.90 | 2.53 | 2.90 | 2.25 | 0.04 | 0.20 | 70.94 | |
| Malaysia | 364,681.37 | 52.49 | 57.24 | 31,949.78 | 11,414.20 | 7.23 | 4.20 | 3.76 | 1.44 | 1.00 | 67.58 | 12.00 |
| Mongolia | 13,996.72 | 59.97 | 81.62 | 3,225.17 | 4,339.80 | 6.67 | 4.10 | 3.79 | 0.10 | 0.70 | no data | 16.80 |
| Myanmar | 76,085.85 | 38.84 | no data | 54,045.42 | 1,407.80 | 0.59 | 1.90 | 4.79 | 0.03 | 1.40 | 42.37 | 5.80 |
| New Zealand | 206,928.77 | 31.54 | no data | 4,917.00 | 42,084.40 | 6.49 | 6.30 | 9.21 | 1.37 | 1.50 | 48.02 | 29.00 |
| Pakistan | 278,221.91 | 85.56 | no data | 216,565.32 | 1,284.70 | 0.92 | 2.90 | 3.20 | 0.24 | 4.00 | 87.20 | - |
| Philippines | 376,795.51 | no data | 36.97 | 108,116.62 | 3,485.10 | 1.24 | 2.50 | 4.40 | 0.16 | 1.00 | 48.86 | 14.00 |
| Republic of Korea | 1,646,739.22 | 36.42 | 41.92 | 51,709.10 | 31,846.20 | 11.31 | 4.30 | 7.56 | 4.81 | 2.70 | 48.41 | 15.50 |
| Singapore | 372,062.53 | 129.29 | no data | 5,703.57 | 65,233.30 | 8.40 | 2.90 | 4.46 | 1.94 | 3.20 | 131.19 | 13.30 |
| Sri Lanka | 84,008.78 | 86.78 | no data | 21,803.00 | 3,853.10 | 0.95 | 2.10 | 3.76 | 0.11 | 1.90 | 98.25 | 11.60 |
| Thailand | 543,548.97 | 34.02 | 34.07 | 69,625.58 | 7,806.70 | 3.47 | 4.10 | 3.79 | 1.00 | 1.30 | 50.45 | 14.90 |
| Viet Nam | 261,921.24 | 44.25 | 43.37 | 96,462.11 | 2,715.30 | 2.37 | 4.20 | 5.92 | 0.53 | 2.00 | 46.62 | - |

Sources: World Bank (2019), World Development Indicators. https://data.worldbank.org (accessed 16 February 2021); and IMF (2018), Global Debt Database. https://www.imf.org/external/datamapper/datasets/GDD (accessed 16 February 2021).

## Table 3.6 Public Policy Mechanisms for Supporting Low-Carbon Innovations

| Stage of technology development | Early research | Demonstration and commercialisation | Market update |
|---|---|---|---|
| **Key policy challenges** | Increase the volume of early-stage research<br>Improve the flow of funding to promising research<br>Transfer academic research into commercial environment<br>Do not write off promising technologies too early | Identify scalable, lab-proven technologies<br>Provide soft credit where it is required to achieve target returns<br>Establish clear performance standards<br>Do not try to pick winners, but cull losers aggressively<br>Develop a replicable blueprint for large-volume roll-out<br>Provide support to close the cost gap with mature technologies<br>Ensure the availability of credit despite market and policy risks<br>Ensure the economic system can absorb new technologies and remain stable<br>Support/create lead customers | Ensure energy diversity, providing, if necessary, long-term support for higher-cost technologies<br>Protect public budgets<br>Avoid locking in uncompetitive market structures<br>Shift emphasis to 'polluter pays' rather than maintaining subsidies indefinitely |
| **Enabling policies** | | | |
| **Regulation** | | National/state/local procurement targets<br>Feed-in tariffs<br>Reverse auctions/requests for contract<br>Renewable portfolio standards/ green certificates/PAT<br>Renewable fuel standards | Top-runner requirements<br>Utility regulation |
| **Finance mechanisms for innovation** | Incubators<br>National laboratories<br>Prizes<br>National/state-funded venture capital<br>National/state-run venture capital<br>R&D grants | Project grants | Technology transfer funds<br>National/state/local infrastructure funds |
| **Credit mechanisms** | | Venture loan guarantees<br>Green bonds<br>Loan guarantees<br>Debt funds | Export trade credit<br>Microfinance<br>Sovereign/policy risk insurance<br>National/state/local energy service companies funds |
| **Tax-based policies** | Capital gains tax waivers<br>R&D tax credits | Innovation clusters<br>Accelerated depreciation<br>Investment tax credits<br>Production tax credits | Carbon tax |
| **Carbon market mechanisms** | 0.5 | Monitoring, reporting, and verification | Domestic carbon cap and trade<br>Project-based carbon credits<br>National and multilateral carbon funds |

PAT = Perform, Achieve, and Trade; R&D = research and development.

Source: Compiled by the ERIA Study Team.

and developing cross-border solutions to common problems (World Bank, 2020).

Given that several countries in the region face similar challenges and have similar needs, apart from learning from each other's best practices, ways to work towards aggregating demand and finding scalable solutions through regional cooperation can play a key role in moving towards a sustainable carbon-constrained future.

## 3. Critical Evaluation of Changes in Emission Trajectories During the COVID-19 Pandemic

The unprecedented onset of the COVID-19 pandemic presented both opportunities and threats to the low-carbon transition. Although lockdown restrictions to contain the spread of the pandemic resulted in a decline in emissions and an improvement in air and water quality, there is a high possibility of these positive environmental developments being short-lived. Research on the recovery from the 2008 financial crisis suggested similar trends (Peters et al., 2012).

The pandemic has caused several detrimental impacts on the environment, apart from the possibility of a rebound effect on emissions in the post-pandemic phase. It has caused a surge in the generation of medical waste; haphazard use and disposal of disinfectants, masks, and gloves; and the burden of untreated waste (Rume and Islam, 2020). In the energy sector, climate action has also been negatively affected by delays in and disruptions to renewable energy investments, construction, and supply chains; and the risk of potential investors losing tax incentives, tariffs, or other revenue sources (Königreich, 2020).

### 3.1. Impact of the Pandemic on the Energy Sector and Emissions

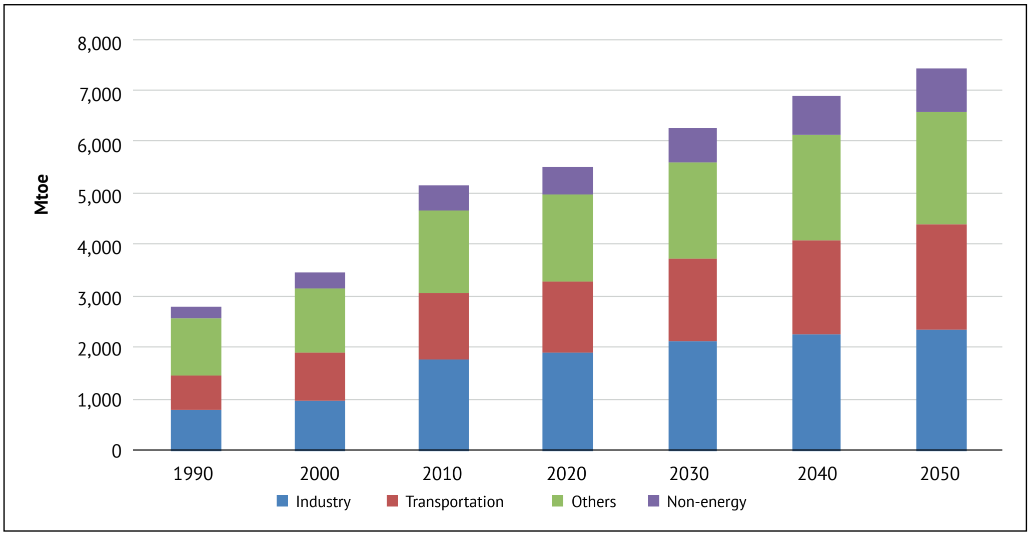
ASEAN achieved an energy intensity reduction of 24.4% from 2005 to 2017 (Putra, Munardy, and Gurning, 2020). The region also achieved a renewable energy share of 14.3% in the total primary energy supply by 2017. The current regional targets, set by the ASEAN Plan of Action on Energy Cooperation (2016–2025), are a 30% energy intensity reduction and a 23% renewable energy share in total energy supply by 2025. Based on the Economic Research Institute for ASEAN and East Asia (ERIA) outlook for final energy consumption (Kimura and Han, 2021), under business-as-usual scenarios, there will be a significant increase in the use of renewable energy by the industry and transport sectors at least until 2050 (Figure 3.5).

Transportation energy demand is projected to grow moderately by about 1.4% per year, and its energy consumption share is projected to be 27.7% by 2050. Industry's annual growth rate in 2017–2050 is projected at about 0.9% per year, but its energy consumption share is projected to be the largest at about 31.7% by 2050. This implies dependence on imports of oil and natural gas. Figure 3.6 shows that the primary energy supply in ASEAN and East Asian countries is expected to grow at an average annual rate of 3.6% between 2020 and 2050.

Oil is currently the dominant energy source, followed by coal and natural gas. However, coal's share is projected to be the largest soon and may reach up to 53% by 2040 – a significant increase from 32.9% in 1990.

The prospect of switching out internal combustion engines that are dependent on oil and gas for hybrid

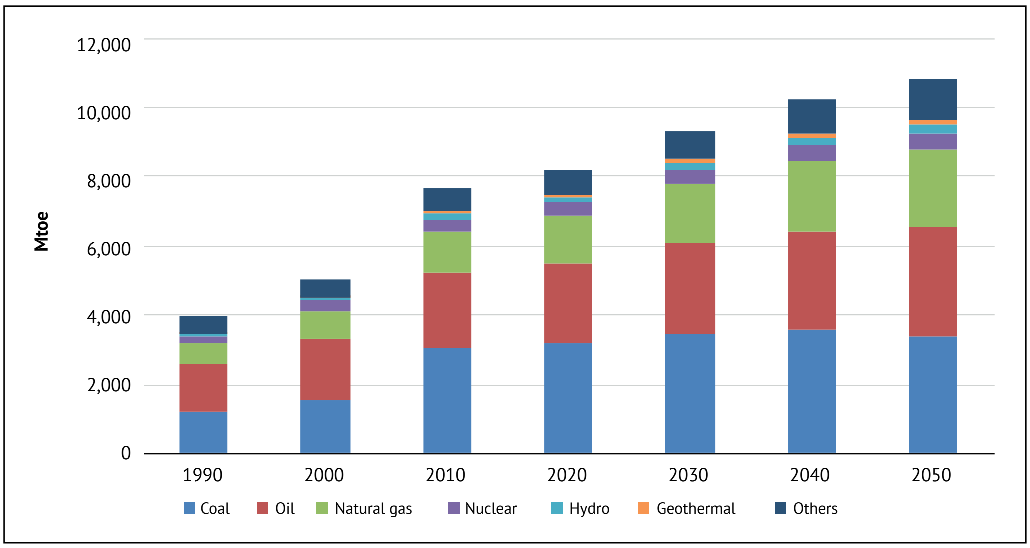
## Figure 3.5 Final Energy Consumption by Sector in ASEAN and East Asian Countries, Business as Usual, 1990–2050




ASEAN = Association of Southeast Asian Nations, Mtoe = million tons of oil equivalent.

Source: Kimura and Han (2021).

## Figure 3.6 Final Energy Supply by Fuel in ASEAN and East Asia, Business as Usual, 1990–2050




ASEAN = Association of Southeast Asian Nations, Mtoe = million tons of oil equivalent.

Source: Kimura and Han (2021).

or electric vehicles is promising and is clearly on ASEAN's agenda. Yet coal use in the ASEAN region is projected to increase rapidly to meet the region's growing electricity demand, with primary energy supply being dominated by coal, oil, and natural gas. Both ASEAN and developing countries face challenges in matching energy demand with low-carbon supply as they transition to a low-carbon economy. There is a heightened need to accelerate the development of greener energy sources, including renewables, hydrogen, and clean technologies. If governments allow massive fossil fuel use in industries during their recovery from the pandemic-induced recession, this will discourage such a development.

The COVID-19 pandemic disrupted the demand and supply of electricity throughout the first and second quarters of 2020. A sharp decline in oil demand resulted from the massive travel and commerce restrictions, and reduced operations in many industries (Campion, 2020). Many power projects were halted due to the disruption. Most oil companies witnessed revenue loss and some of them have cut their national refinery activities as a response to the drop in demand from the transportation sector. For oil producer countries, such as Brunei Darussalam and Malaysia, the revenue from this sector fell sharply.

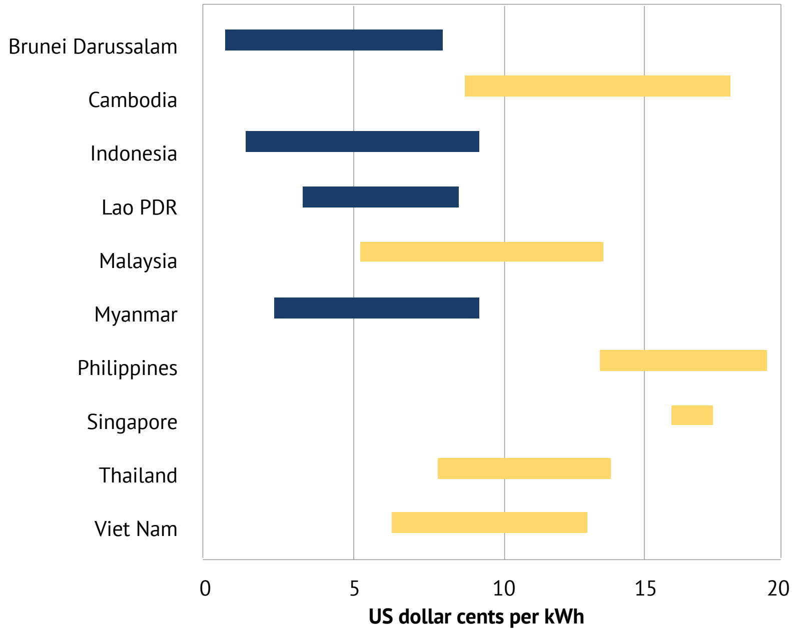
Before the pandemic, the vulnerabilities of the power sector were (i) increasing severity and frequency of natural disasters, (ii) weak power sector financial health, (iii) a fuel mix that relied on fossil fuels, (iv) growing energy demand, and (v) poor air quality and pollution (Lowder, Lee, and Leisch, 2020). Lockdown measures have decreased overall electricity demand, lowering commercial and industrial use while increasing residential consumption, thus changing the shape of load curves. IEA (2020) estimated that global electricity demand decreased by 2.5% in the first quarter of 2020 and observed a 5% contraction by the end of the year. In March and April 2020, the International Financial Corporation (IFC) observed a 15% drop in demand, on average, in many countries (IFC, 2021). Overall electricity demand has decreased, with some countries reporting up to a 20% drop in consumption during periods of full lockdown (from March to October 2020) (ACE, 2020).

Prior to the pandemic, countries had customised their electricity tariffs according to consumption range and use type. The range of electricity tariffs for households is shown in Figure 3.7.

Differences in electricity tariffs across the region are based on the average production cost, which varies depending on the fuel types, tariff components, and subsidy regimes.

The unforeseen impact of the pandemic led countries to extend flexible support to electricity consumers, with discounts and tax rebates. Some countries are offering support to the most affected communities and low-income households in the form of full payment help or deferred electricity bill payments. The various types and duration of relief offered, and the customers targeted in Southeast Asian countries, are summarised in Table 3.7. The targeted consumers include hospitals, residential consumers, commercial facilities, and agriculture.

### Figure 3.7 Pre-COVID-19 Electricity Tariffs for Households in ASEAN Member States




ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, kWh = kilowatt-hour, US = United States.

Source: ACE (2020).

### Table 3.7 Types of Targeted Support to Electricity Consumers in ASEAN Member States

| Electricity tariff relief | | Brunei Darussalam | Cambodia | Indonesia | Lao PDR | Malaysia | Myanmar | Philippines | Singapore | Thailand | Viet Nam |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of relief | Tariff exemption for targeted customers | | | ● | | | ● | | | ● | ● |
| | Tariff reduction for targeted customers | ● | | ● | ● | ● | | ● | | ● | ● |
| | Tariff adjustment for targeted customers | | ● | | | | | | ● | | |
| | Payment extension | | | | | | | | | ● | |
| | Refund | | | | | | | | | ● | |
| Targetted customers | Residential first lowest tier | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | Residential second lowest tier | | | ● | | ● | ● | ● | ● | ● | ● |
| | Residential third lowest tier | | | | | ● | ● | | ● | ● | ● |
| | Industrial | | ● | | | ● | | | | ● | |
| | Commercial | ● | ● | | | ● | | | | ● | ● |
| | Others (agriculture, health, infrastructure, etc.) | ● | | | ● | | | | | | ● |
| **Availability period** | | 1 April–30 September 2020 | April–July 2020 | April–September, extended to 10 December 2020 | No specific deadline | 1 April–31 December 2020 | April–June 2020 | April–June 2020 | "SUC: July or August 2020 U-Save: April 2020–January 2021" | April–June 2020 | May–July 2020 |

SUC = Solidarity Utility Credit, u-Save = Utilities Save.

Source: ERIA Study Team based on ACE (2020).

This has affected renewable energy uptake and energy efficiency improvements related to uptake.

Enormous renewable energy potential can be developed, with potential solar photovoltaic (PV) capacity exceeding 41 terawatts and potential wind capacity exceeding 1.8 terawatts for a range of reasonable levelised costs of energy. The COVID-19 pandemic has affected the renewable energy sector in ASEAN in the following ways:

- Renewable energy project development: Revenues from existing wind and solar projects have been largely resilient to COVID-19 impacts, but projects in the pipeline have experienced slowdowns due to changes in energy markets, regulatory delays, and workers' safety and workforce issues, as illustrated by the hydropower dam projects along the Mekong River. Many of these projects will be delayed but will eventually come online and are expected to rebound in late 2021.

- Supply chain disruption: As for renewable energy construction projects, many of the world's largest solar panel, battery, and wind turbine manufacturers – as well as many raw materials (e.g. steel for turbines and rare earth materials for batteries) – are located in China, and the country's COVID-19 related lockdowns and travel restrictions are likely to have disrupted supply chains. Renewable energy project developers that were completing their projects during this pandemic may have incurred additional costs and delays that could affect their anticipated returns or project milestones.

- Fossil fuel prices and renewables competitiveness: With a global economic slowdown, and the resulting fall in transportation and electricity demand, oil and natural gas prices have plunged. These low prices translate to reductions in the levelised cost of energy from existing oil and gas power generation plants. Currently, the levelised cost of energy from solar PV is competitive with combined-cycle natural gas turbines in several Southeast Asian markets and is anticipated to drop further over the next decade. If the temporary reduction in fossil fuel prices is prolonged, investment in gas-based projects could hamper renewables deployment.

### 3.2 Impact on the Trajectory of GHG Emissions

Daily global GHG emissions dropped by 17% in the first quarter of 2020 compared with 2019 levels. Falling industrial production, fewer cars on the road, and less power generation contributed to temporary improvements in air quality and reductions in emissions and pollutants. While this is positive in mitigating climate change, the drop is due to the COVID-19 pandemic and measures to stop its spread, such as nationwide lockdowns and travel restrictions. For Japan, emissions in 2020 decreased due to the fall in fossil fuel imports (crude oil 11.5%, liquid natural gas 5.7%, and coal 1.0%) in January–June 2020 compared with the same period the previous year.

### 3.3. Impact on digital technology transformation

In 2016, countries in the region recognised the importance of digital and emerging technology in energy development, including automation, high-efficiency energy systems, and new technologies such as batteries and hydrogen technology. Digital technologies are set to make energy systems more interconnected, intelligent, efficient, and sustainable (The ASEAN Post, 2018). Advances in areas such as data analytics, artificial intelligence, and blockchain technology have reached the shores of the energy sector. Digitalised energy systems will be key to ensuring that energy demands are met in a cost-efficient and reliable manner. This system will help to address many challenges related to power generation. Countries like the Philippines, Myanmar, and Cambodia often face power outage issues and skyrocketing utility bills due to the inefficient power systems in place. Machine learning, blockchain, and cloud computing can be used to design a power system to enhance demand response. A digital energy system will also help with balancing system reserves and tapping into power from self-generators such as owners of rooftop solar systems. As Southeast Asia marches towards a digital future, there will be added pressure on utilities providers to modernise their systems. These necessary changes will not only benefit utility companies but will also generate additional revenue for technology providers. Consumers will enjoy savings in the long run as well.

### 3.4. Impact of Pandemic on Agriculture Emissions and Natural Capital

Agriculture and forests account for about 20% of total emissions and make up a significant share of the economy in ASEAN – Cambodia (%20), the Lao PDR (15%), Viet Nam (14%), Indonesia (12.7%), Malaysia (7.3%), the Philippines (8.8%), and Thailand (8%) (Anbumozhi, Kalirajan, and Kimura, 2018). As the majority of the population is heavily reliant on the agriculture sector, forestry, and fisheries, the disruption caused by the COVID-19 pandemic and lockdowns poses the risk of unemployment, which will eventually result in a widespread reduction in living standards due to limited capacity and access to basic necessities (Boss et al., 2020). Across the region, forests cover about 45% of the land area, but contracted at an annual rate of 1.5% from 1990 to 2018. Deforestation releases higher quantities of carbon emissions because of peatland degradation. In 2017, carbon emissions from peatland drainage contributed the equivalent of 1.3%–3.1% of fossil fuel emissions in Southeast Asia. Land use is responsible for about 20%–25% of regional GHG emissions.

Some examples of policy approaches to GHG emissions reduction in agriculture and forestry sectors are listed in Box 3.1.

There are many barriers to implementing carbon emission reduction practices in agrarian economies, which have been reinforced during the pandemic. These include the accessibility of finance, rural poverty, access to digital technologies, technology transfer, and diffusion problems. For rice farming, COVID-19 has affected access to credit, capital inputs, remittance income, and the safety of food and water. During emergencies such as the 2019 drought and the COVID-19 pandemic, farmers need assistance and support, either from the government or the private sector (Fox, Promkhambut, and Yokying, 2020). For Viet Nam, the output of the agriculture, forestry, and fishery sectors in the first 9 months of 2020 was hit by the compound impact of the COVID-19 epidemic, African swine fever, and climate change. Table 3.8 shows the estimated impacts of

## Box 3.1 Economic Policy Approaches Adopted by Major Asian Countries for Climate Change Mitigation in the Agriculture and Forestry Sector

Governments are experimenting with a range of policy instruments to reduce carbon emissions from the agriculture and forestry sectors and meet other public policy objectives:

- Green standards and regulations: Standards and rules for agricultural land and forest management; and controls on deforestation and peatland degradation
- Support measures: For carbon sequestration, and flood and drought control, increasing investments in technologies, targeted outcomes, and production practices
- Economic instruments: Payment of ecosystem services, putting a price on forestation through REDD+ mechanisms or trading schemes
- Trade measures: Lower tariff and non-tariff barriers on climate-smart technologies and products
- R&D: Increase in public R&D of climate-smart agriculture, private R&D, and capacity building
- Information, education, training, and advice: Increasing public awareness for more sustainable patterns of agricultural production and consumption through eco-labelling, training, education, and advice

R&D = research and development; REDD+ = Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.
Source: Compiled by the ERIA Study Team.

## Table 3.8 Estimated Impacts of the Pandemic on Agricultural Production in ASEAN

| Item | Impact |
|---|---|
| **Baseline in 2018** | |
| Volume of agricultural production in 2018 (million tons) | 548.33 |
| Labour productivity in 2018 (tons/worker) | 5.272 |
| **With COVID-19 scenario in 2020** | |
| Estimated agricultural labour force due to COVID-19 (million) | 100.77 |
| Estimated volume of agricultural production (million tons) | 531.295 |
| Change in volume of agricultural production due to decrease in agricultural labour force (%) | 3.11 |
| Reduction in volume of agricultural production (million tons) | −17.034 |
| Estimated GDP in 2020 (US$ billion) | 264.6 |
| Difference in GDP compared with 2000 (US$ billion) | −3.758 |
| Change in GDP (%) | −1.40 |
| Total population in ASEAN (million) | 655.28 |
| Increase in poverty ratio due to agricultural labour force reduction (%) | 2.24 |
| Estimated increase in the number of people living below US$1.90 a day (million) | 14.68 |

ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, GDP = gross domestic product.

Source: Gregorio and Ancog (2020).

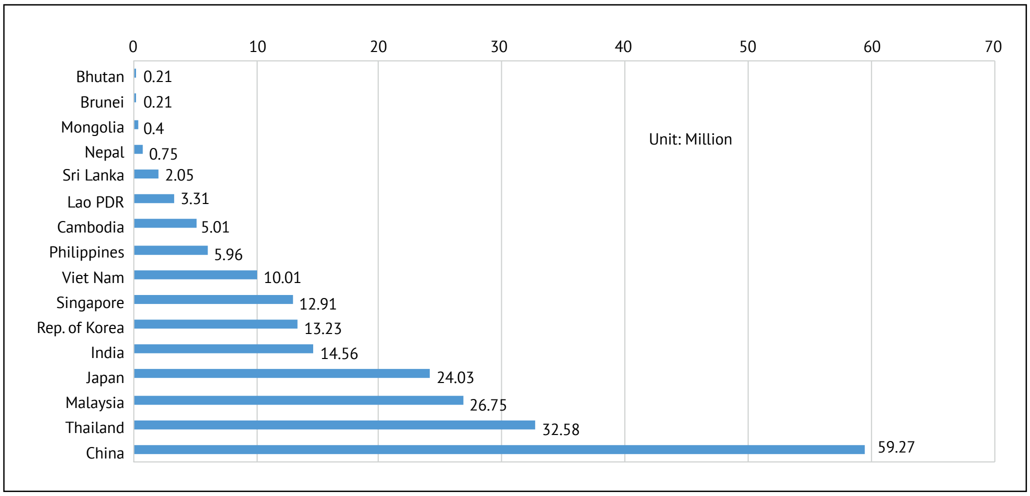
the pandemic on regional agricultural production.

In addition, COVID-19 is changing markets in a fundamental way by altering the shopping behaviour of producers and consumers. Many innovations, such as e-extension, e-trading, and mobile payments, are being implemented. Further, demand is likely to increase for innovations in delivery. Responding to this changing ecosystem requires public–private partnership. Many ASEAN governments are already looking for ways to address COVID-19 disruptions and engage with the changing systems (Boss et al., 2020). Aligning agricultural and forestry policies with low-carbon and digitalisation goals would reduce the costs of implementing these green growth options.

### 3.5 Impact of the Pandemic on the Tourism Sector

The Asia-Pacific region accounts for 30% of the world's international tourism receipts. Figure 3.8 shows the tourist profile of Asia in 2018.

**Figure 3.8 Tourists Visiting Asia in 2018**




Source: The Phnom Penh Post (2018).

For 14 countries with data available in the ASEAN and East Asia region, the International Labour Organization estimated that the jobs and livelihoods of at least 15.3 million workers or 5.9% of workers – 6.4 million women and 8.9 million men – in the tourism sector are at risk because of the pandemic (ILO, 2020). Staff of airlines, hotels, travel agencies, and transport companies across the region are being asked to take paid or unpaid leave, accept reduced wages or, worse, are simply let go. Cambodia, Thailand, and Viet Nam have the highest share of employment in tourism, at 6.7%, 9.0%, and 6.9%, respectively.

Tourism is a particularly important sector for Southeast Asia in the transformation to a low-carbon economy. Transport-related $CO_2$ emissions from the tourism sector have fallen substantially during the pandemic, but are likely to bounce back in 2021 (ACE, 2020). Transport-related $CO_2$ emissions of the tourism sector remain a major challenge, and the sector needs to work closely with the transport sector to support its commitment to accelerate decarbonisation and implement a high-ambition scenario. There is no specific targeted policy progress other than international discussions on a tax on air passengers and company offset programmes. Nevertheless, Asia's tourism sector can no longer be solely dependent on the decarbonisation strategies of related sectors such as green hotel buildings, and must determine its own high-ambition scenario beyond transport – a scenario where tourism would significantly decouple growth from emissions. Transforming tourism for climate action requires embracing a low-carbon pathway through the measurement and disclosure of emissions related to tourism activities, the setting of evidence-based targets, and the adoption of instruments and strategies to scale up mitigation and adaptation, with all stakeholders having to play a role. In this regard, developing a set of actionable policy recommendations in consultation with the United Nations World Tourism Organization member states will be the next step.

### 3.6 Impact of the Pandemic on Supply Chains and Opportunity in the Race to Net Zero

In the first half of 2020, Asia-Pacific exports suffered a severe slump due to shockwaves from the global COVID-19 pandemic and widespread lockdowns that disrupted supply chains, industrial production, and consumer spending. As lockdowns eased in several countries, Asia-Pacific exports rebounded in the last quarter of 2020, helped by improving export orders from China, the EU, and the US, as the automotive, pharmaceutical, and electronics sectors, amongst others, showed strong growth in output during the third quarter of 2020. The rebound in China's economy has helped the recovery in exports from many other Asian economies. China's export sector increased by 11.4% year on year in March 2021, after an increase of 9.9% year on year in March 2020. Korea's exports rose by 7.6% year on year in September 2020. In Malaysia, exports rose by 13.6% year on year in September 2020, with exports of manufactured products up by 16.3% year on year. Singapore's non-oil domestic exports rose by 5.9% year on year in September 2020, with electronics exports surging higher by 21.4% year on year (Biswas, 2021).

Eight supply chains – food, construction, consumer goods, electronics, automotive, professional services, fashion, and freight – account for more than half of global GHG emissions. The ASEAN and East Asia region is a significant participant in all eight global supply chains. Analysis from the ERIA showed that China, the EU, and the US together account for almost three-quarters of ASEAN's global carbon exporters (Anbumozhi, Ramanathan, and Wyes, 2020). The evidence reveals that mature and nurturing markets are increasingly outsourcing their carbon burden to production networks in ASEAN. About 40% of all emissions in these supply chains could be abated at a cost of US$10 per ton of CO2 equivalent using mechanisms such as the increased use of recycled materials, energy efficiency improvements, and increased adoption of renewable energy. Interventions listed in Box 3.2 are estimated to reduce supply chain emissions with only a 1%–4% increase in end-consumer prices in the medium term.

**Box 3.2 Supply Chain Opportunity in the Transition Towards a Low-Carbon Economy**

Major actions taken by companies to support the transition to a low-carbon economy include:

- building a comprehensive carbon emissions baseline, gradually filled with actual supplier data;
- setting ambitious and holistic carbon emission reduction targets and publicly reporting progress;
- revisiting product design choices for a low-carbon economy;
- designing a circular value chain and geographic sourcing strategy;
- setting and tracking ambitious green procurement standards;
- working jointly with small and medium-sized enterprise suppliers through technical assistance programmes to address their emissions; and
- developing internal governance mechanisms to align regulatory incentives with emission targets.

Source: ERIA Study Team

While regulatory and market-based policy instruments could make such interventions broadly accessible, decarbonising the entire supply chain remains a challenge. Even pioneering companies struggle to find and act upon appropriate data on energy use and embedded carbon emissions, particularly in fragmented supply chain landscapes. That can be a challenge in certain sectors such as micro, small, and medium-sized enterprises in electronics and small-holder agribusiness. However, firms working with suppliers across the region with new integrated technology, finance, and business models will be a vital part of the transition to low carbon in the post-COVID-19 era.

## 4. New Challenges in Resource Use and Planning for a Circular Low-Carbon Economy

Resource efficiency contributes directly to mitigating climate change and achieving NDC targets in most cases, without necessarily having any adverse economic effect. In the midst of the pandemic and climate crises, G20 energy ministers in 2020 agreed on a communiqué that endorsed the circular carbon economy (CCE) platform as a tool to manage emissions and foster access to energy. They acknowledged the CCE approach as a holistic, integrated, inclusive, and pragmatic approach that supports and enables sustainable development; and that encourages countries to take advantage of all technologies, forms of energy, and mitigation opportunities, according to resource availability, economics, and national circumstances. The circular economy is a holistic approach to resources management that can guide international efforts towards a more inclusive, resilient, sustainable, and low-carbon energy system (ASEAN, 2021). The CCE in the context of hydrocarbon-rich countries is often used to denote 'reduce, reuse, recycle' activities, as in the production, circulation, and consumption of energy and other resources (Mansouri et al., 2020).

## 4.1. Motivation and Drivers of the CCE

The CCE in the ASEAN context is often used to denote the 4Rs – reduce, reuse, recycle, and remove – in the process of production, circulation, and consumption of energy and other resources. 'Reduce' refers to using less raw materials and energy input to achieve the established purpose of production or consumption. 'Reuse' refers to converting carbon emissions into value-added materials for industry by utilising and advancing approaches such as carbon capture and utilisation (CCU). 'Recycle' means relying on natural resources, including the use of energy carriers like hydrogen, methanol, and ammonia. 'Remove' refers to implementing nature-based solutions such as direct carbon emission capture from industry and the atmosphere (Mansouri et al., 2020). The technologies that could contribute to the CCE are listed in Table 3.9.

**Table 3.9 4R Technologies in Managing Carbon Circularity**

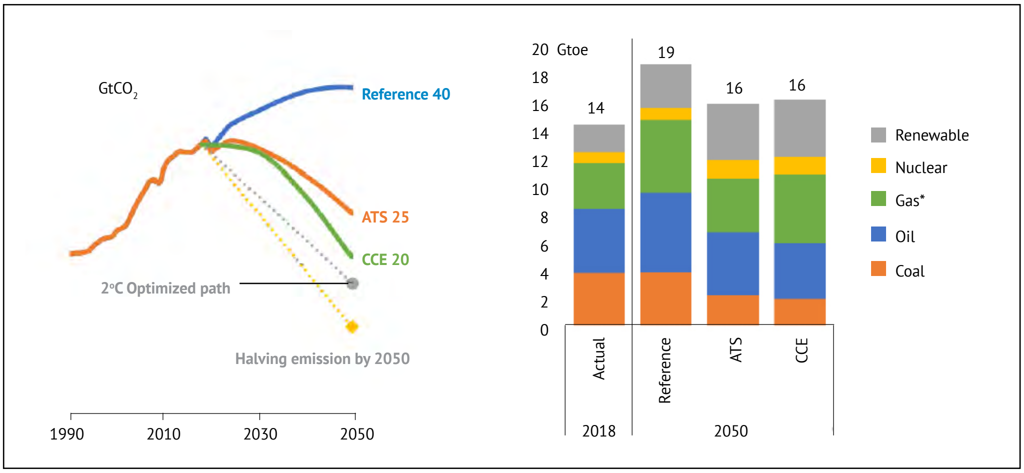
| Reduce | Reuse | Recycle | Remove |
|---|---|---|---|
| Reducing the amount of carbon entering the system | Reusing carbon without chemical conversion | Recycling carbon with chemical conversion | Removing carbon from the system |
| - Energy and materials efficiency<br>- Renewable energy, including hybrid use with fossil fuel<br>- Nuclear energy, including hybrid use with fossil fuel<br>- Advanced ultra-super-critical technologies for coal power plants<br>- Hydrogen (blue/green) fuel cells for long-distance heavy-duty vehicles<br>- Ammonia produced from zero carbon hydrogen (blue/green) for power generation and ships<br>- Direct reduction in steel making by using CO2 free hydrogen (blue/green) | - CCU<br>- Use $CO_2$ at carbon utilisation facilities, such as at greenhouses for enhancing crops<br>- Bio-jet fuels with reed beds<br>- Algal synthesis | - CCU<br>- Artificial photosynthesis<br>- Bioenergy recycling in the pulp and paper industry<br>- Bioenergy with carbon capture and storage<br>- Carbamide (urea production using $CO_2$ as feedstock)<br>- Coal ash concrete curing with absorbing $CO_2$<br>- Electrochemical reduction of $CO_2$<br>- Fine chemicals with innovative manufacturing processes and carbon recycling<br>- Fischer-Tropsch exothermic of carbon dioxide with hydrogen syngas<br>- Hydrogenation to formic acid<br>- Oil sludge pyrolysis<br>- Sabatier synthesis ($CO_2$ methanation: exothermic of carbon dioxide with blue/green hydrogen)<br>- Thermal pyrolysis | - CCS<br>- DAC<br>- Carbon dioxide removal<br>- Fossil fuels-based blue hydrogen |

4R =reduce, reuse, recycle, remove; CCU = carbon capture and utilisation; CO2 = carbon dioxide; DAC = direct air capture.

Source: Masnouri et al. (2020).

The CCE offers a way forward for countries with hydrocarbon resources to make meaningful contributions towards climate change. Figure 3.9 shows scenarios for the CCE and the use of alternative technologies. Estimations at the global level show that carbon emissions could be reduced through the application of the 'circular carbon model' in the energy sector. By transforming waste into energy and material streams, with the application of 4R technologies, the power and transport sectors have high potential for emission reductions. CCE technologies that 'reduce' include hydrogen power generation, 'reuse' technologies include algae biodiesel production; 'recycle' technologies include carbon-absorbing concrete, and 'remove' technologies include CCU. By intensively adopting these technologies, global carbon emissions could be reduced by a maximum of 40% by decarbonising the fossil fuel sector, compared with the reference scenario and alternative renewable energy technology scenarios, as illustrated in Figure 3.9.

**Figure 3.9 Emission Reduction Potential of CCE Technologies**




ATS = advanced technologies scenario, CCE = circular carbon economy, GtCO2 = gigaton of carbon dioxide, Gtoe = gigaton of oil equivalent.

Source: Kobayashi (2020).

National guidelines on the establishment and improvement of a low-carbon and circular economic system were issued in China in 2020. The country aims to meet NDC targets to achieve peak CO2 emissions by 2030 and carbon neutrality by 2060. The guidelines suggested that, by 2025, China's industry, energy, and transportation systems will see a noticeable improvement, with manufacturing, circulation, and consumption systems featuring low-carbon and circular development taking shape. To ensure that the country's future is based on efficient use of resources, strict ecological environmental protection, and effective control of GHG emissions, the guidelines propose undertaking key tasks in six systems (Table 3.10). They also called for efforts to develop an agriculture waste management system; strengthen farmland protection and promote water saving; and build a waste recycling system for renewable resources such as paper, plastics, tyres, metals, and glass.

**Table 3.10 Six Systems to Low-Carbon and Circular Economy Development in China**

| System component | Main contents |
|---|---|
| Production system | – promote green industrial upgrading<br>– accelerate green development of agriculture<br>– improve the green development of the service sector<br>– strengthen green and environmental protection industries<br>– make industrial parks and clusters more circular<br>– build green supply chains |
| Consumption system | – promote the consumption of green products<br>– advocate a green and low-carbon lifestyle<br>– resolutely stop food and beverage waste<br>– promote the sorting, reduction, and recycling of household waste in accordance with local conditions<br>– promote the prevention and treatment of plastic pollution throughout the chain |
| Circulation system | – actively adjust the transport structure<br>– strengthen the organisation and management of logistics and transport<br>– promote low-carbon means of transport<br>– strengthen the recycling and utilisation of renewable resources<br>– establish a green trade system |
| Green infrastructure upgrading | – promote green and low-carbon transformation of the energy system<br>– improve the control of and the intensity<br>– upgrade urban environmental infrastructure<br>– upgrade green transport infrastructure<br>– improve the living environment in both urban and rural areas |
| Green technology innovation system | – encourage research and development of green and low-carbon technologies<br>– accelerate the application of scientific and technological achievements |
| Legal and regulatory system | – strengthen legal and regulatory support<br>– improve the green pricing mechanism<br>– increase fiscal and taxation support<br>– vigorously develop green finance<br>– improve green standards, green certification systems, and statistical and monitoring systems<br>– foster a green trading market mechanism |

Source: State Council of China, Guofa (2021).

The objectives, scope, and comprehensiveness of CCE strategies vary widely across countries. In 2000, Japan enacted the Basic Act for Establishing a Sound Material-Cycle Society, which is very similar to the EU Circular Economy Action Plan. A Sound Material-Cycle Society is a society in which natural resources are conserved, and the environmental load is reduced to the greatest extent possible, by preventing or reducing the generation of waste from products by promoting their cyclical use. Ten years before this act in 1991, the Act on the Promotion of Effective Utilization of Resources – an initiative of the Ministry of Economy, Trade and Industry – required industries to undertake recycling initiatives. China enacted a Circular Economy Promotion Law in 2008.

In ASEAN, the CCE concept has been reflected mostly by the ASEAN Socio Cultural Community and within the ASEAN Economic Community, while some notions related to the circular economy may have been discussed or considered in specific policy areas, such as sustainable consumption under the work on consumer protection. In 2020, Viet Nam started discussing a legal framework for the circular economy, with a focus on resource efficiency. Indonesia is preparing a circular economy ecosystem in which resources and waste are managed sustainably, targeting full implementation by 2024. Thailand is formulating effective zero-waste and waste-to-energy measures with local governments to create a circular economy and meet the Sustainable Development Goals. Malaysia issued version 3.0 of its Guidelines on Green Procurement in October 2020, which guide government ministries and agencies on procuring products, services, and work in the public sector in a way that considers environmental criteria to conserve resources and minimises the negative impacts of human activities.

Reducing GHG emissions has frequently been cited as an important objective of the circular economy in several ASEAN and East Asian countries. This may be due to a combination of the growing importance of the low-carbon green growth agenda and the high GHG reduction potential of recycling. In several AMS, this transition to a circular economy could also be seen as an important opportunity to create new industries and jobs under the ASEAN Comprehensive Economic Recovery Framework (ACRF) broad strategy 5: advancing towards a more sustainable and resilient future.

### 4.2 Circular Economy and Waste Management Before the Pandemic

Solid waste management, including the disposal of municipal solid waste, is a major challenge facing most of the region. The amount of waste generation and the generation of municipal solid waste in AMS are presented in Table 3.11.

**Table 3.11 Waste Generation in ASEAN Member States**

| Country | Per capita MSW generation (kg/capita/day) | Annual MSW generation (ton) | Annual hazardous waste generation (million tons) | Annual e-waste generation (metric kiloton) |
|---|---|---|---|---|
| Brunei Darussalam | 1.40 | 210,480 | | |
| Cambodia | 0.55 | 1,089,429 | | |
| Indonesia | 0.70 | 64,000,000 | | |
| Lao PDR | 0.69 | 77,380 | | 8.00 |
| Malaysia | 1.17 | 12,840,000 | 1,517,434.06 | |
| Myanmar | 0.53 | 841,508 | | |
| Philippines | 0.69 | 14,660,000 | 1,693,856.72 | 39,000 |
| Singapore | 3.76 | 7,514,500 | 411,180 | 110 |
| Thailand | 1.05 | 26,770,000 | 3,300,000 | 368.31 |
| Viet Nam | 0.84 | 22,020,000 | | 1,609.78 |

kg = kilogram, MSW = municipal solid waste, MT = million tons.

Source: UNEP (2017).

The municipal solid waste generated in emerging economies is composed mainly of organic waste, plastic, paper, glass, and metal. Most countries have already established national strategies and reduce, reuse, recycle (3R) policies that cut across green growth, sustainable development, and climate change policy strategies. As illustrated in Table 3.12, countries such as Cambodia, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam have specific laws on waste management. From an institutional perspective, waste management policymaking at the national level is under the jurisdiction of the respective Ministry of Environment, while many other ministries also have roles in regulating specific waste streams.

**Table 3.12 Waste Management and Recycling Policies of ASEAN Member States**

| Country | Policy details |
|---|---|
| Cambodia | • Law on Environmental Protection and Natural Resource Management (1996)<br>• Sub-decree on Solid Waste Management (1999) |
| Indonesia | • Environmental Protection and Management Act No. 32 (EPMA 32/2009)<br>• Law No. 18/2008 on Municipal Solid Waste Management: 3R as the Principal Approach for Waste Management; Law No. 33/3009 on Hazardous Waste<br>• Government Regulation No. 81/2012 on 3Rs and Extend Producer Responsibility President Regulation No. 97/2017 on Policy and National Strategy of MSW<br>• GP No.101/204 Packaging Under Law No. 18/2008; Government Regulation (e-waste) under Law No. 39/2009 |
| Malaysia | • Solid Waste and Public Cleansing Management Act (2007): Aims to improve the collection, recycling, and disposal of solid waste; prescribed recycling and separation of recyclables<br>• National Strategic Plan for Solid Waste Management (2005): Comprehensive efforts to promote the reduction, reuse, and collection of solid waste. There are eight regulations on 3R in the solid waste act.<br>• Environmental Quality Act (1974) |
| Philippines | • National 3R policies: Set the goal of achieving a waste conversion rate of at least 25% (2000)<br>• Ecological Solid Waste Management Act (2000): Mandates management for 'zero waste' as a national policy. Requires local governments to recycle 25% of waste collected.<br>• PD No. 1152: Philippine Environment Code (1977); Republic Act No. 8749: Philippine Clean Air Act (1999); Republic Act No. 9275: Philippine Clean Water Act (2004) |
| Singapore | • Green Plan (2012): Has a 'zero landfill' objective. Includes a national recycling programme for households launched in 2001, with the target of 60% recycling by 2012. The recycling rate rose from 57% in 2009 to 70% by 2030, with the goal of becoming a zero-waste nation.<br>• Environmental Public Health (general waste collection) Regulations; Environmental Public Health (toxic industrial waste regulations) |
| Thailand | • Enhancement and Conservation of National Environmental Quality Act (1992), Factory Act (1992), and Public Health Act (1992); Maintenance of Public Sanitary Order Act (1992)<br>• Regulation on National Waste Management System (2007); Draft Waste Electrical and Electronic Equipment Management Act, Draft Waste Management Act, Draft Promotion of 3Rs and Utilisation of Waste<br>• National Solid Waste Management Master Plan; Action Plan 'Thailand Zero Waste', 2016 |
| Viet Nam | • National 3R Strategy: Sets 3R targets for 2020<br>• Environmental Protection Law (2005): Includes 14 provisions to promote 3R and related activities<br>• Law on Environmental Protection (2014, as amended)<br>• National Solid Waste Management Master Plan to 2025, Vision to 2050 |

3R = reduce, reuse, recycle; ASEAN = Association of Southeast Asian Nations; MSW = municipal solid waste.

Source: ERIA Study Team.

In developing CCE policies that are based on resource efficiency principles, governments have included provisions for measuring baselines, quantifying problems, setting targets, and monitoring progress towards achieving them through benchmarking. Recent reviews of waste management and resource efficiency in the fast-growing economies of Asia have shown that setting national quantitative targets is important to show ambition, create commitment, and send clear policy signals for a circular economy. For example, Anbumozhi and Kim (2016) found that quantitative targets for improving energy efficiency could help avoid disjointed actions and provide a long-lasting context for energy efficiency policies. Resource efficiency targets must be sufficiently clear for key stakeholders – such as specific government agencies, industry, and consumers – to understand them and act on them.

ASEAN has initiatives to measure recycling efficiency. Table 3.13 presents the national targets for achieving material, energy, and water efficiency in selected countries. Some countries have set ambitious resource productivity, recycling, and waste reduction targets in the water and energy sectors. The targets undergo yearly performance measurements and are supervised. Japan, China, and Singapore are countries that have set targets in all three key areas of resource efficiency and recycling, which include material efficiency. Overall, targets for recycling are more commonly used than material or water efficiency targets.

**Table 3.13 Material, Energy, and Waster Efficiency Targets in ASEAN Member States**

| Country | Material efficiency | Energy efficiency | Water efficiency |
|---|---|---|---|
| Philippines | Achieve a waste conversion rate of at least 25% by 2025 | Reach average annual energy savings of 23 million barrels of fuel oil equivalent | |
| Singapore | Reach 60% of household waste recycling by 2025<br>Achieve a recycling rate of 70% by 2030 | Improve energy efficiency by 35% from 2005 levels by 2030 | Reduce domestic water consumption to 140 litres per person per day by 2030 |
| Thailand | | Reduce energy consumption by 13% in 2010 and 20% in 2020 | Reduce water use by 10% between 2020 and 2030 |
| Viet Nam | | Reduce total energy consumption by 3%–5% (2010–2015) and then by 5%–8% (2015–2020) | |

ASEAN = Association of Southeast Asian Nations.

Source: Compiled by the ERIA Study Team from various documents.

Sometimes, disharmony and lack of coordination amongst the implementing institutions and stakeholders cause waste mismanagement. At the local level, provincial governments and municipalities are directly responsible for handling waste management services. In addition to local governments, non-governmental agents such as private sector companies, non-governmental organisations, and community bodies have also been involved in public–private partnerships in the waste sector.

According to a Greenpeace Southeast Asia report released in June 2019, between 2016 and 2018, plastic waste imports in the ASEAN region grew by a staggering 171%, from 836,529 tons to 2,265,962 tons – equivalent to around 423,544 20-foot shipping containers (Greenpeace, 2019). A large amount of waste entering the sea has seriously polluted the marine environment and threatened the fishery, tourism, and other related industries in the region.

The problem of marine waste management has attracted the attention of ASEAN. At the 34th ASEAN Summit in June 2019, AMS leaders unanimously adopted the Bangkok Declaration on marine waste management and pledged to take joint action on the management of marine waste, strengthen the enforcement of relevant laws, maintain regular policy dialogue and information sharing, and explore innovative solutions. While the Bangkok Declaration is a first step, much more needs to be done, such as bans, taxes, comprehensive waste management reform, and significant investment in waste management infrastructure.

### 4.3 Impact of COVID-19 on Medical Waste Generation Recycling

During the pandemic, many types of medical and hazardous waste are being generated. According to the Ministry of Ecology and Environment of China (2020), 196 large and medium-sized cities produced 843,000 tons of medical waste, and the amount increased due to the impact of COVID-19 in 2020. From 20 January to 2 June 2020, the cumulative amount of medical waste treated increased by 25.7% compared with before the epidemic.

During the pandemic, a weak waste management system in cities in Southeast Asia left local administrations with an additional 1,000 tons of medical waste per day (Alcoseba Fernandez, 2020). In March 2020, the volume of medical waste increased by 27% in Malaysia and 30% in Jakarta (Kojima et al., 2020). A survey by the Asian Development Bank showed that Manila and Jakarta are the cities that generated the most COVID-19 related medical waste in ASEAN (ADB, 2020). The total amount of medical waste generated in India is projected to rise to almost 775.5 tons per day by 2022 from 550.0 tons per day in 2018 (Varmani, 2020).

Some governments have existing legislation and regulations in place for the disposal of infectious medical waste from hospitals and households. They should continue to follow these and consider if additional capacity and resources are needed to maintain compliance. Specific initiatives undertaken by the governments include:

- Japan: In 2020, the Ministry of the Environment issued a series of documents (e.g. Countermeasures for

Novel Coronavirus Waste Disposal) and established the Department of Novel Coronavirus Infection Countermeasures to deal with the epidemic.

- Korea: In January 2020, Korea developed the Novel Coronavirus Special Countermeasure for Medical Waste Management (First and Second Edition), which complements specific measures for strengthening the safety management of waste.
- China: In February 2020, China issued the Comprehensive Treatment of Medical Institutions Waste Work Plan to strengthen the construction of medical waste centralised disposal facilities by the end of 2020. The aim was for each city at or above the prefectural level to build at least one medical waste centralised disposal facility at the city level. On 1 September 2020, the Law on the Prevention and Control of Environmental Pollution by Solid Waste came into force. The law increases the regulatory requirements for medical waste, and mentions the disposal of hazardous solid waste caused by emergencies such as major infectious diseases.
- India: The Central Pollution Control Board published the COVID-19 Standard Operating Procedures that deal with the handling, treatment, and safe disposal of medical waste (Ministry of Health and Family Welfare, India, 2020). The board guidelines provide a series of steps for safe disposal of waste generated in isolation wards with COVID-19 patients, sample collection centres and laboratories for COVID-19 suspected patients, and quarantine camps/home-care facilities. The guidelines also outline the duties of common biomedical waste treatment facilities, state pollution control boards, and urban local bodies. Participating states in India have also prepared state-wide guidelines on the management of COVID-19 waste in line with the Biomedical Waste Management Rules (2016), which were formulated on the basis of an initial baseline survey carried out under the project. The procurement of personal protective equipment for medical waste handlers in Karnataka and Maharashtra is also underway.
- Indonesia: On 24 March 2020, Indonesia issued the Circular Letter on Infectious Waste and Household Waste Management during the COVID-19 pandemic, to strengthen the management of the following waste: infectious waste from medical institutions, infectious waste from people during home isolation, and daily household waste from masks or other personal protective equipment. The waste must be labelled as hazardous waste, handed over to a licensed disposal service provider, and burned in a sealed container (performed at least once every 2 days). Local governments have been instructed to provide special containers for mask waste disposal in public places (Aqil and Dipa, 2020).
- Viet Nam: Robust enforcement measures – such as separation at source and more frequent collection (at least twice a day) using sealed bags – allowed Viet Nam to limit the number of infected cases. The collected waste must be treated within a day, referring to several technical standards. Meanwhile, liquid waste must be disinfected and then delivered to concentrated wastewater plants for further treatment.

## 4.4. Opportunities and Country Strategies for Handling Solid Waste and Promoting the CEE

### 4.4.1. Ban on non-recyclable solid waste imports

The main characteristics of the CCE and the number of technical, economic, or social enabling policy factors required are illustrated in Table 3.14. The attributes differ according to the type of economic system and institutional arrangement. While the list of enabling policy factors is not exhaustive, it demonstrates the wide range of changes that will be needed to trigger or advance the circular economy transition. Central to achieving the necessary systemic changes, however, will be finding synergetic economic and social incentives, e.g. through financial mechanisms that encourage consumers and producers to hire rather than buy a product, while stimulating the eco-design of the products (Anbumozhi, Ramanathan, and Wyes, 2020).

**Table 3.14 Characteristics and Enabling Factors of the Circular Carbon Economy**

| Key characteristics of a circular carbon economy | Enabling policy factors |
|---|---|
| **Less input and use of natural resources**<br>• minimised and optimised exploitation of raw materials, while delivering more value from fewer materials<br>• reduced import dependence on natural resources<br>• efficient use of all natural resources and blue hydrogen<br>• minimised overall energy and water use | **Eco-design and innovation**<br>• products designed for a longer life, enabling upgrading, reuse, refurbishment, and remanufacture<br>• product design based on the sustainable and minimal use of resources and enabling high-quality recycling of materials at the end of a product's life<br>• substitution of hazardous substances in products and processes, enabling cleaner material cycles |
| **Increased share of renewable and recyclable resources and energy**<br>• non-renewable resources replaced with renewable ones within sustainable levels of supply<br>• increased share of recyclable and recycled materials that can replace the use of virgin materials<br>• closure of material loops<br>• sustainably sourced raw materials | **Repair, refurbishment, and remanufacture**<br>• repair, refurbishment and remanufacture given priority, enabling reuse of products and components<br><br>**Recycling**<br>• high-quality recycling of as much waste as possible, avoiding down-cycling (converting waste materials or products into new materials or products of lesser quality)<br>• use of recycled materials as secondary raw materials<br>• well-functioning markets for secondary raw materials<br>• avoidance of mixing and contaminating materials<br>• cascading use of materials where high-quality recycling is not possible |
| **Reduced emissions**<br>• reduced emissions throughout the full material cycle through the use of less raw material and sustainable sourcing<br>• less pollution through clean material cycles<br><br>**Fewer material losses/residuals**<br>• build-up of waste minimised<br>• incineration and landfill limited to a minimum<br>• dissipative losses of valuable resources minimised | **Business models**<br>• focus on offering product–service systems rather than product ownership<br>• collaborative consumption<br>• collaboration and transparency along the value chain<br>• industrial symbiosis (collaboration between companies whereby the waste or by-products of one become a resource for another) |
| **Keeping the value of products, components, and materials in the economy**<br>• extended product lifetime, keeping the value of products in use<br>• reuse of components<br>• value of materials preserved in the economy through high quality recycling | **Eco-innovation**<br>• technological innovation<br>• social innovation<br>• data, monitoring, and indicators |

Source: Anbumozhi and Kim (2016).

4.4.2. Enabling policy factors of the CCE

On 10 May 2019, 187 countries took a major step forward by adding plastic to the Basel Convention, a treaty that controls the flow of hazardous waste from one country to another. The Basel Convention Plastic Waste Amendments requires exporting countries to obtain the consent of receiving countries before shipping contaminated, mixed, or non-recyclable plastic waste. This revision provides an important tool to stop dumping unwanted plastic waste.

As of November 2020, China had imported 7.18 million tons of solid waste, 41% less than the previous year's total. On 19 January 2020, China issued The Policy Options on Further Strengthening Plastic Pollution Control, indicating that it would strengthen the treatment of plastic pollution in accordance with the idea of banning one batch, replacing one batch with recycling, and regulating one batch. In addition to restricting the use of plastic, there will be a total ban on the import of waste plastic. On 1 September 2020, the revised Solid Waste Law came into effect, which clearly stipulates that the country will gradually realise zero imports of solid waste. The main objective is to continue to strengthen the clean-up and rectification of solid waste distribution centres and 'scattered and polluted' enterprises, strengthen the supervision of solid waste use and recycling, and investigate and punish illegal environmental behaviour in the solid waste use and processing industries. As a result of the progressive target setting, the amount of solid waste to be recycled in China increased to 350 million metric tons in 2020 from 246 million tons in 2015.

Faced with public opposition and rising pollution, Asian countries are stepping up efforts to ban foreign waste and implement emergency policies. In 2019, Malaysia's Ministry of Environment and Water shut down 139 recycling plants, 109 of which were illegal. The ministry has also banned the import of plastic waste during the epidemic, and the ban will be fully implemented by December 2021. Viet Nam has taken similar steps, such as banning import licences for plastics. Thailand has been implementing a ban on all imports of plastic scrap and waste since January 2021. Indonesia has legislated to stop the import of certain types of plastic waste from Western countries. These policies have closed the gate of waste imports to some extent.

4.4.3. Zero-waste circular cities

With socio-economic development and improved waste management, the establishment of waste-free cities has become the planning goal of more countries and cities. A zero-waste city refers to an advanced urban development and management model that aims to promote green lifestyles, minimise the amount of waste produced, strengthen recycling programmes, and ensure that waste released into the environment is harmless. In 2014, the EU released 'Towards a Circular Economy: A Zero Waste Programme for Europe' and the 'Circular Economy Package'. European countries have established a Waste Free Europe Network, while Japan has established the Waste Free Research Institute. In 2015, the US Conference of Mayors issued a resolution 'Supporting the Principle of Waste Free Cities'; and in 2018, 23 cities around the world jointly issued a declaration on 'Building Waste Free Cities'. In 2000, Japan published the

Basic Law for Promoting the Formation of a Recycling Society; and in 2019 it issued 'The 4th Fundamental Plan for a Establishing a Sound Material-Cycle Society' to achieve a cumulative 25% reduction in single-use plastics by 2030, a 60% rate of recycling for containers and packaging by 2030, and 100% effective utilisation of used plastics by 2035, including circular economy measures. The international community established the Zero Waste International Alliance in 2002 to guide the development of zero waste in the world. On 28 August 2018, leaders from 23 cities and regions signed the C40 Cities' Advancing Towards Zero Waste Declaration to reduce the amount of waste generated by each citizen by 15%, reduce the amount of waste sent to landfills and incineration by 50%, and increase the diversion rate to 70% by 2030. Asian policymakers now incorporate zero waste concepts in their strategies. Singapore has taken the lead in experimenting and reforming the waste management ecosystem (Box 3.3).

**Box 3.3 Sustainable Waste Management Ecosystem in Singapore**

Singapore disposes of much of its waste through waste-to-energy initiatives – of the 7.23 million tons of solid waste generated in 2019, more than 40% was incinerated. According to the National Environment Agency, incineration reduces waste by up to 90%, saving landfill space, and the heat recovered produces steam that is used to generate electricity. Despite awareness-raising campaigns to encourage a 3R (reduce, reuse, recycle) mindset, and designating 2019 as a 'Year Towards Zero Waste', Singapore's domestic recycling rate dropped from 22% in 2018 to 17% in 2019. To increase the recycling rate, Singapore has launched initiatives such as the Zero Waste Masterplan and the Resource Sustainability Act, 2019 – aiming to establish itself as a sustainable, resource-efficient, and climate-resilient nation, and a regional Circular Economy Centre of Excellence, driving green investment efforts around the region and the world. The Resource Sustainability Act sets out regulatory measures targeting the following three waste streams, which generally have high generation and low recycling rates: electrical and electronic waste, food waste, and packaging waste. Singapore will realise this vision by introducing Southeast Asia's first extended producer responsibility law, holding firms accountable for the responsible disposal of post-consumer waste. Measures include mandatory reporting for companies that produce or use packaging; and extended producer responsibility for e-waste by 2021, food waste by 2024, and packaging by 2025. The Zero Waste Masterplan, launched by Singapore's Ministry of Environment and Water Resources in 2019, aims to reduce the incinerated rubbish sent to Semakau Landfill each day by 30% by 2030, since Singapore's Semakau Landfill is projected to hit capacity by 2035. The plan also targets increasing the overall recycling rate to 70% by 2030, from 60% in 2018, by adopting a circular economy approach to waste and resource management practices and shifting towards more sustainable production and consumption. The plan sets targets for food waste, electronic waste, packaging waste, and research and development. Singapore also plans to improve its circular economy capabilities by investing S$45 million in research on circular solutions and S$25 million in research on waste-to-energy solutions.

Source: Minh (2021).

### 4.5. Enabling policy factors of circular economy

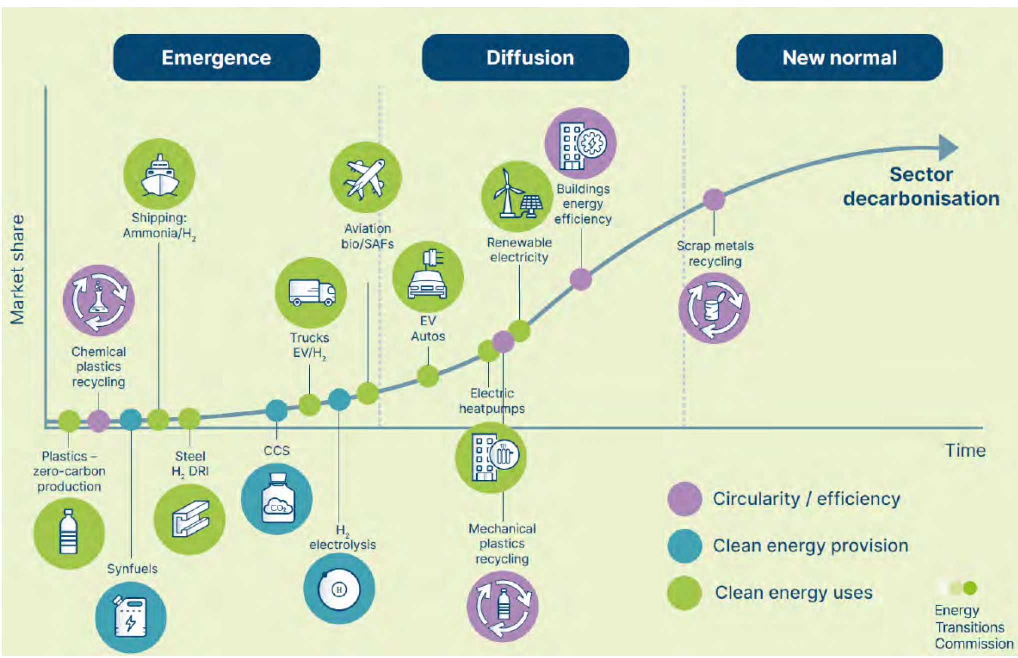
Creating a CCE requires fundamental changes throughout the value chain, from product design and technology to new business models, new ways of preserving natural capital (extending product lifetimes) and turning waste into a resource (recycling), new modes of consumer behaviour, new norms and practices, and education and finance. Integration between policy levels and policy domains, as well as within and across value chains, is also essential. Action will be needed at all levels, from the regional to the local, and by all stakeholders, including governments and businesses.

## 5.Trajectories of Investments and Rethinking Financing to Deliver Transformative Low-Carbon Actions

There is an urgent need to scale up investment significantly in low-carbon circular and more resource-efficient alternatives and to shift investment away from carbon-intensive processes and products. The low-carbon transition requires utilising all sources of finance – public, private, and international, including institutional investors.

Figure 3.10 shows a route map involving the adoption of several sector decarbonisation strategies and decisions on niche low-carbon technologies that are potentially costly, difficult to diffuse under current policy conditions, and politically unpopular.

**Figure 3.10 Circular and Clean Energy Technology and Investment Road Map for Net Zero Future**




CCS = carbon capture and storage, CO2 = carbon dioxide, DRI = direct reduced iron, EV = electric vehicle, GHG = greenhouse gas, H2 = hydrogen, SAF = sustainable aviation fuel.

Source: Energy Transitions Commission (2020).

The IEA estimated that the total annual energy investment will surge to US$15 trillion by 2050 (IEA, 2021). This unparalleled increase in investment is estimated to add 0.4% a year to annual global GDP growth as the world emerges from the COVID-19 crisis.

### 5.1 Low-Carbon Investment Challenges During the COVID-19 Pandemic

Although the economic crisis caused by the COVID-19 pandemic is different from other previous crises, experience in designing previous economic recovery packages has shown that 'green new deals' often have advantages over traditional fiscal stimuli, both in the short and long term. For example, green recovery packages focusing on investment in renewable energy will have positive impacts in the short and long term while ensuring the implementation of national emissions reduction commitments. In the short term, investments in renewable energy create more direct jobs in production and distribution, construction, and installation in the context of high unemployment. Such investments promote jobs in the supporting supply chain, helping to increase GDP in the short run (GGGI, 2020).

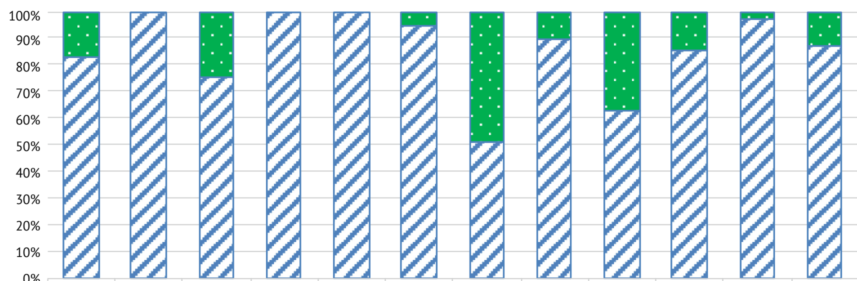
Following the 2007–2009 financial crisis, governments announced about US$520 billion for green measures such as railways, energy efficiency, grid modernisation, renewable energy, and water and waste management (Figure 3.11). Based on the analysis of 10 major economies, the amount announced for green stimulus spending in response to the COVID-19 recession is at a similar level, although the leading countries are different (Jaeger, 2020).

Experience from past crisis responses has also shown that investments in infrastructure, health services, water, and sanitation have positive effects on creating jobs when the needed skill sets already exist (GGGI, 2020). Some examples of stimulus packages to recover from the 2008 financial crisis include the following, categorised by country:

- US: The green recovery package in response to the 2008 financial crisis, worth US$21 billion, created economic value equal to 1.2–2.1 times the economic value during 2009–2011.
- EU: Green investments in the European Economic Recovery Plan accounted for 13.2% of the total stimulus, worth 200 billion, or about 1.5% of the EU's GDP. One-third of the stimulus was invested in energy efficiency and other green initiatives. The economic impacts of the green investment ranged from 0.6% to 1.1% of GDP at the national level and up to 1.5% of GDP at the European level.
- China: The green component of the Stimulus Package of China in 2008–2009 was about US$221 billion, accounting for one-third of the total stimulus package, which was about 12.5% of GDP. Around 5.25% was invested in energy savings, pollution control, and ecological improvement. There was about a 0.68% increase in total employment for every 1% increase in the share of solar PV generation.
- Korea: The Green New Deal, 2009–2012 plan, worth US$38.1 billion, represented about 4% of GDP. Some 80% was allocated to green measures such as renewable energies (US$1.80 billion), energy-

efficient buildings (US$6.19 billion), low-carbon vehicles (US$1.80 billion), railways (US$7.01 billion), and water and waste management (US$13.89 billion). It was intended to create 950,000 jobs, although this was not achieved. Many green stimulus plans are not properly evaluated ex post.

**Figure 3.11 Global Stimulus Packages and Green Investments During 2008 Crisis (as of 1 July 2009)**




| | Australia | Brazil | China | India | Indonesia | Japan | Rep. of Korea | United States | EU | Total G20 | Total Other | Global Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green Stimulus ($ billion) | 9.3 | | 216.4 | | | 36.0 | 36.3 | 94.1 | 22.8 | 454.7 | 8.6 | 463.3 |
| Fiscal Stimulus ($ billion) | 43.8 | 3.6 | 647.5 | 13.7 | 5.9 | 639.9 | 38.1 | 787.0 | 38.8 | 2,702.2 | 314.1 | 3,016.3 |

EU = European Union.

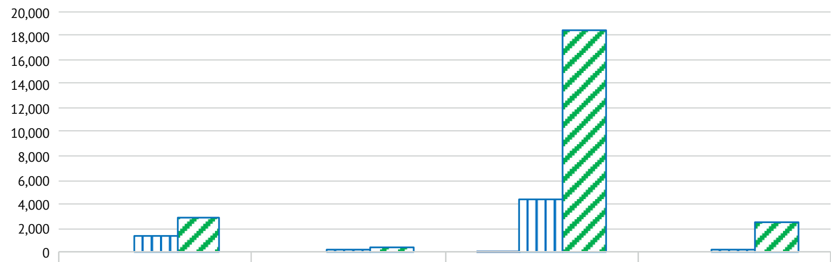
Source: ERIA Study Team analysis based on Barbier (2010).

Prioritising the use of economic recovery packages to invest in and support low-carbon circular areas demonstrates the important role of the government in implementing the Paris Agreement commitments. However, in the stimulus package to recover from the COVID-19 pandemic, the share of the green recovery is much less than the green stimulus for recovery from the financial crisis in 2008, which was estimated to be US$10 trillion at the G20 level.

The total value of the global stimulus package for economic recovery from the COVID-19 pandemic (up to April 2021) was US$18,360.1 billion, out of global GDP of about US$84,537.7 billion (21.72% of GDP) in 2020 (IMF, 2021b); the green stimulus comprised US$2,629.8 billion (14.32% of the total stimulus package). The stimulus package in 2008 was US$3,016.3 billion, of which US$463.3 billion comprised the green stimulus (15.36% of the total stimulus package). The total value of the stimulus package for recovering from the COVID-19 pandemic was US$206.8 billion (6.71% of GDP) amongst AMS and up to US$4,424.2 billion (17.23% of GDP) in the six ASEAN Partner countries, compared with US$1,383.0 billion in 2008 (Figure 3.12).

Global efforts to implement national fiscal measures to cope with the COVID-19 pandemic are estimated at US$18,363.7 billion, of which developed economies accounted for 86.45%, emerging markets economies 13.27%, and low-income and developing countries 0.28% (Figure 3.13).

**Figure 3.12 Stimulus Packages After the 2008 Financial Crisis and After the Onset of COVID-19** (US$ billion)

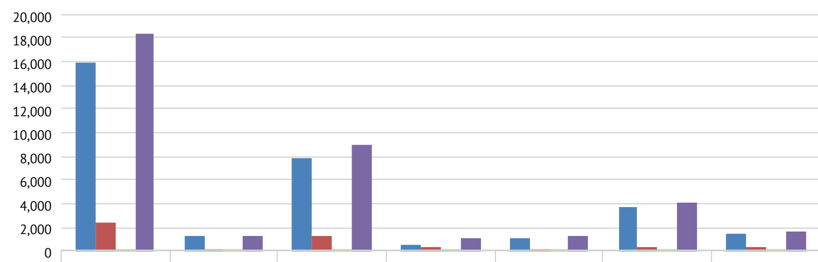



| | Stimulus package of 2008 finacial crisis – Total | Stimulus package of 2008 finacial crisis – Green measure | Stimulus package of COVID-19 – Total | Stimulus package of COVID-19 – Green measure |
|---|---|---|---|---|
| ASEAN | | | 206.8 | 206.8 |
| 6 partners of ASEAN | 1,383.0 | 298.0 | 4,424.2 | 48.1 |
| Global Total | 3,016.3 | 463.3 | 18,363.7 | 2,629.8 |

ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease.

Source: ERIA Study Team, calculated from Barbier (2010); IMF (2021a); Vivid Economics (2021); Sharma (2020); European Commission (2021); Carbon Brief (2021); and Clarke (2020).

**Figure 3.13 Country Fiscal Measures in Response to the COVID-19 Pandemic** (US$ billion)




| | Total | Health sector | Non-health sector | Accelerated spending/ deferred revenue | Equity injections, loans, asset purchase, or debt assumptions | Guarantees | Quasi-fiscal operation |
|---|---|---|---|---|---|---|---|
| Developed economies | 15,875.3 | 1,197.5 | 7,823.6 | 599.5 | 1,092.2 | 3,757.5 | 1,405.1 |
| Emerging markets economies | 2,436.2 | 143.0 | 1,185.5 | 378.5 | 82.5 | 353.8 | 279.6 |
| Low-income developing countries | 52.2 | 6.3 | 29.2 | 8.5 | 3.5 | 1.1 | 2.0 |
| Global | 18,363.7 | 1,346.8 | 9,038.2 | 986.5 | 1,178.1 | 4,112.3 | 1,686.7 |

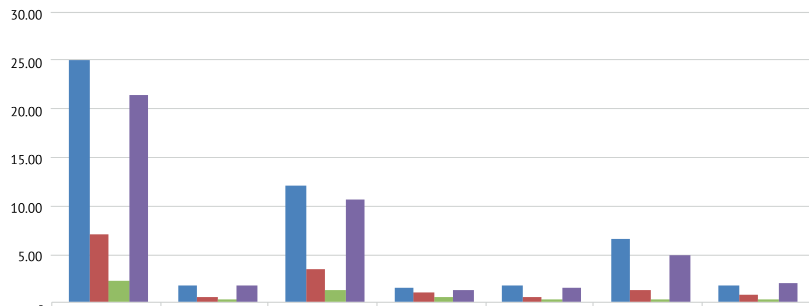
COVID-19 = coronavirus disease.

Source: ERIA Study Team calculations based on IMF (2021a).

Support packages increase with the level of development of an economy – not only in absolute value but also in the level of support as a share of GDP. The world's total average support package accounts for 21.72% of GDP – 25.31% of GDP in developed economies, 7.12% in emerging economies, and 2.22% in low-income and developing countries (Figure 3.14).

The expenditure structure of support packages varies greatly between developed and developing countries. Non-health sector spending occupies the largest share of the support packages of all countries – about 49.3% in developed economies, 48.7% in emerging markets, and 55.8% in developing countries. Although all countries focus significantly on non-health sector spending, differences emerge in other areas. Developed economies spend up to 23.7% on credit guarantees to businesses, while direct spending on the health sector is 7.5%, compared with 2.0% on the guarantee and 12.0% on the health sector in low-income developing countries (Figure 3.15).

### Figure 3.14 Country Fiscal Measures in Response to the COVID-19 Pandemic (share of GDP, %)

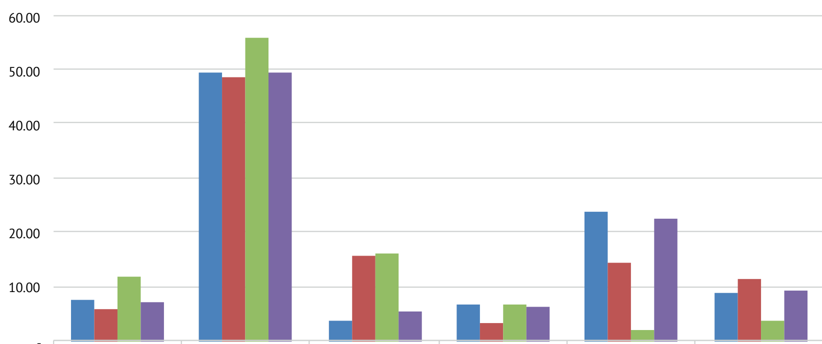



| | Total | Health sector | Non-health sector | Accelerated spending/ deferred revenue | Equity injections, loans, asset purchase, or debt assumptions | Guarantees | Quasi-fiscal operation |
|---|---|---|---|---|---|---|---|
| Developed economies | 25.31 | 1.75 | 12.12 | 1.51 | 1.75 | 6.51 | 1.67 |
| Emerging markets economies | 7.12 | 0.50 | 3.32 | 1.03 | 0.36 | 1.23 | 0.68 |
| Low-income developing countries | 2.22 | 0.28 | 1.28 | 0.37 | 0.15 | 0.05 | 0.09 |
| Global | 21.72 | 1.59 | 10.69 | 1.17 | 1.39 | 4.86 | 2.00 |

COVID-19 = coronavirus disease, GDP = gross domestic product.

Source: ERIA Study Team calculations based on IMF (2021a, 2021b).

### Figure 3.15 Share of Fiscal Measures in Response to the COVID-19 Pandemic (%)




| | Health sector | Non-health sector | Accelerated spending/deferred revenue | Equity injections, loans, asset purchase, or debt assumptions | Guarantees | Quasi-fiscal operation |
|---|---|---|---|---|---|---|
| Developed economies | 7.5 | 49.3 | 3.8 | 6.9 | 23.7 | 8.9 |
| Emerging markets economies | 5.9 | 48.7 | 15.5 | 3.4 | 14.5 | 11.5 |
| Low-income developing countries | 12.0 | 55.8 | 16.2 | 6.6 | 2.0 | 3.9 |
| Global | 7.3 | 49.2 | 5.4 | 6.4 | 22.4 | 9.2 |

COVID-19 = coronavirus disease.

Source: ERIA Study Team calculations based on IMF (2021a).

The support packages of the AMS totalled US$206.8 billion (5.58% of GDP), while those of the six ASEAN Partner countries totalled US$4,631.7 billion (16.10% of GDP). Table 3.15 shows the efforts of the AMS – introducing stimulus packages to avoid supply disruptions and create demand – although many of them are not high on the Greenness Index (Vivid Economics, 2021). As with other countries in the world, the stimulus package of the ASEAN+6 focused on the non-health sector, at 41.07%, compared with 49.22% globally.

However, the AMS and the six ASEAN Partners have different priorities. The focus on the non-health sector is higher in the AMS, at 53.90% of the stimulus package, compared with 40.49% in the six ASEAN Partners. Support for the health sector was 10.49% in the AMS and 3.24% in the six ASEAN Partners. The AMS prioritised implementing guarantees (15.29%) and equity injections, loans, asset purchase, or debt assumptions (9.88%), while the six ASEAN Partners prioritised quasi-fiscal operations (34.70%) and accelerated spending/deferred revenue (12.06%) (Table 3.15).

**Table 3.15 Fiscal Measures in Response to the COVID-19 Pandemic of the ASEAN+6**

| Country | Amount (US$ billion) | | | | | | | Share of GDP (%) |
|---|---|---|---|---|---|---|---|---|
| | Total | Health sector | Non-health sector | Accelerated spending/ deferred revenue | Equity injections, loans, asset purchase or debt assumptions | Guarantees | Quasi-fiscal operations | |
| **Global** | **18,363.7** | **1,346.8** | **9,038.2** | **986.5** | **1,178.1** | **4,112.3** | **1,686.7** | **21.72** |
| **ASEAN+6** | **4,631.0** | **165.2** | **1,902.0** | **541.2** | **41.4** | **431.4** | **1,545.1** | **16.10** |
| **Of which** | | | | | | | | |
| **ASEAN** | **206.8** | **21.7** | **110.8** | **7.8** | **20.4** | **31.6** | **9.8** | **5.58** |
| Singapore | 70.4 | 0.6 | 53.9 | | 15.9 | | | 20.72 |
| Indonesia | 57.3 | 18.9 | 29.1 | | 2.4 | 6.9 | | 5.41 |
| Malaysia | 27.0 | 0.4 | 14.7 | | | 12.0 | | 7.99 |
| Thailand | 21.3 | | | | | 10.4 | 8.0 | 4.23 |
| Viet Nam | 14.2 | 0.0 | 4.8 | 7.8 | 0.4 | | 1.2 | 4.17 |
| Philippines | 13.1 | 1.5 | 8.3 | | 0.9 | 2.4 | | 3.62 |
| Cambodia | 1.7 | 0.1 | | | | | 0.6 | 6.38 |
| Myanmar | 1.634 | 0.189 | | | 0.8 | | | 2.01 |
| Brunei | 0.1 | | | | | | | 1.21 |
| Lao PDR | 0.003 | 0.003 | | | | | | 0.02 |
| **6 ASEAN Partners** | **4,424.2** | **143.5** | **1,791.1** | **533.5** | **21.0** | **399.8** | **1,535.3** | **17.23** |
| Japan | 2,473.4 | 89.9 | 710.8 | 243.5 | | 147.0 | 1,282.1 | 48.99 |
| China | 1,135.2 | 21.3 | 689.3 | 231.9 | | 58.0 | 134.8 | 7.71 |
| Rep. of Korea | 279.1 | 8.5 | 65.0 | 39.6 | | 60.1 | 105.9 | 17.11 |
| India | 246.8 | 9.8 | 80.3 | 18.5 | 8.9 | 116.9 | 12.4 | 9.11 |
| Australia | 243.4 | 11.5 | 207.8 | | 10.4 | 13.8 | | 17.91 |
| New Zealand | 46.2 | 2.5 | 37.8 | | 1.8 | 4.1 | | 22.06 |

ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, GDP = gross domestic product.
Note: ASEAN+6 refers to the 10 ASEAN Member States plus Australia, China, Japan, India, New Zealand, and the Republic of Korea.
Source: ERIA Study Team calculations based on IMF (2021a, 2021b).

### 5.2 Closing the Low-Carbon Financing Gaps Through Stimulus Packages

Many countries are struggling to mobilise long-term finance to meet low-carbon infrastructure needs. Annual investment in transmission and distribution grid expansion currently requires US$260 billion, rising to US$820 billion in 2030 (IEA, 2021) at the global level. The number of public charging points for electric vehicles needs to rise from around 1 million in 2021 to 40 million in 2030, requiring an annual investment of almost US$90 billion until 2030. The required roll-out of hydrogen and carbon capture, utilisation, and storage (CCUS) after 2030 means laying the groundwork now: annual investment in CO2 pipelines and hydrogen-enabling infrastructure needs to increase from the current US$1 billion to around US$40 billion in 2030.

The integration of low-carbon investments in economic recovery stimulus packages is one way to generate finance. The intensity of green components is observed mainly in developed countries. The US has seen a significant change in its approach to climate change since January 2021, with the highest allocation for green measures in the world, at US$1,465.17 billion, accounting for 25.02% of the post-COVID-19 recovery stimulus packages. Developing and least developed countries' packages mainly provide direct support to healthcare, pandemic containment activities, vulnerable businesses, and people. Table 3.16 shows the profile of stimulus packages in AMS and ASEAN Partner countries. The recovery packages of most AMS did not support the achievement of environmental objectives. However, no green allocation does not mean that developing and least developed countries have stopped implementing the Paris Agreement commitments on GHG emissions reduction. Whether they hindered the achievement of NDCs requires further analysis, as the implementation of several low-carbon measures is affected by the decline in state budget revenues due to lockdowns during the pandemic.

Most spending and committed green recovery funds have been in developed economies. In June 2020, the United Nations Conference on Trade and Development warned that developing countries would need an additional US$2.5 trillion to support the overall economy to overcome the unprecedented COVID-19 crisis. The support packages of selected countries and regions around the world are summarised below.

- EU: The Next Generation EU recovery fund and the Just Transition Fund (climate action fund) total 750 billion (US$847 billion). The Next Generation EU will provide 500 billion in non-refundable aid and 250 billion in loans to member countries, of which 25% will be for climate actions, including 30 billion to promote the Just Transition Fund for coal-dependent countries.

- Germany: The recovery programme of 80 billion (US$90.4 billion) focuses on innovation, sustainability, and support for cities. It aims to digitise clean energy infrastructure and support a green recovery in cities in areas such as public transport and circular economies.

**Table 3.16 Stimulus Packages of COVID-19 and Green Measures by Country**

| Region | Country | Total stimulus package | | Green measures | |
|---|---|---|---|---|---|
| | | Total (US$ billion) | Share of GDP (%) | Total (US$ billion) | Share of stimulus (%) |
| **Global total** | | **18,363.7** | **21.72** | **2,629.8** | **14.32** |
| **ASEAN** | | **206.8** | **5.58** | **-** | **-** |
| **Six ASEAN Partners** | | **4,424.2** | **20.48** | **48.1** | **1.09** |
| **ASEAN** | **Singapore** | **70.4** | **20.72** | **-** | **-** |
| | Indonesia | 57.3 | 5.41 | - | - |
| | Malaysia | 27.0 | 7.99 | - | - |
| | Thailand | 21.3 | 4.23 | - | - |
| | Viet Nam | 14.2 | 4.17 | - | - |
| | Philippines | 13.1 | 3.62 | - | - |
| | Cambodia | 1.7 | 6.38 | - | - |
| | Myanmar | 1.6 | 2.01 | - | - |
| | Brunei | 0.1 | 1.21 | - | - |
| | Lao PDR | 0.003 | 0.02 | - | - |
| **6 ASEAN Partners** | Japan | 2,473.4 | 48.99 | 19.3 | 0.78 |
| | China | 1,135.2 | 7.71 | 1.5 | 0.14 |
| | Rep. of Korea | 279.1 | 17.11 | 11.2 | 4.02 |
| | India | 246.8 | 9.11 | 0.8 | 0.32 |
| | Australia | 243.4 | 17.91 | 13.6 | 5.60 |
| | New Zealand | 46.2 | 22.06 | 1.6 | 3.42 |
| **Others** | US | 5,856.0 | 27.98 | 1,465.2 | 25.02 |
| | EU | 1,460.0 | 10.61 | 847.0 | 58.01 |

ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, EU = European Union, GDP = gross domestic product, UK = United Kingdom, US = United States.

* The total green recovery packages are calculated based on the projects that have information about the amount, updated to April 2021.

Source: ERIA Study Team calculations from IMF (2021a, 2021b); Vivid Economics (2021); Sharma (2020); Carbon Brief (2021); and Clarke (2020).

- Korea: Fiscal investment of W114.1 trillion is planned by 2025 to help create new markets and promote the private sector. The goal of the Korean New Deal is to transform the economy from a fast follower to a leader, from a carbon-dependent economy to a green economy, with the society becoming more inclusive. It will also invest fiscal resources and improve regulations to promote innovation and investment by the private sector (ADB and ACGF, 2020).
- 50.54 million), will promote economic recovery with resilience and greenness. The transport sector stimulus package of £283 million (US$357.57 million) aims to help restore bus and tram services and improve safety during the pandemic.
- US: In December 2020, Congress passed a US$900 billion bipartisan stimulus package to stabilise the US economy. Direct aid, unemployment benefits, healthcare measures such as vaccine procurement, and business loans dominated the package, alongside US$17 billion of

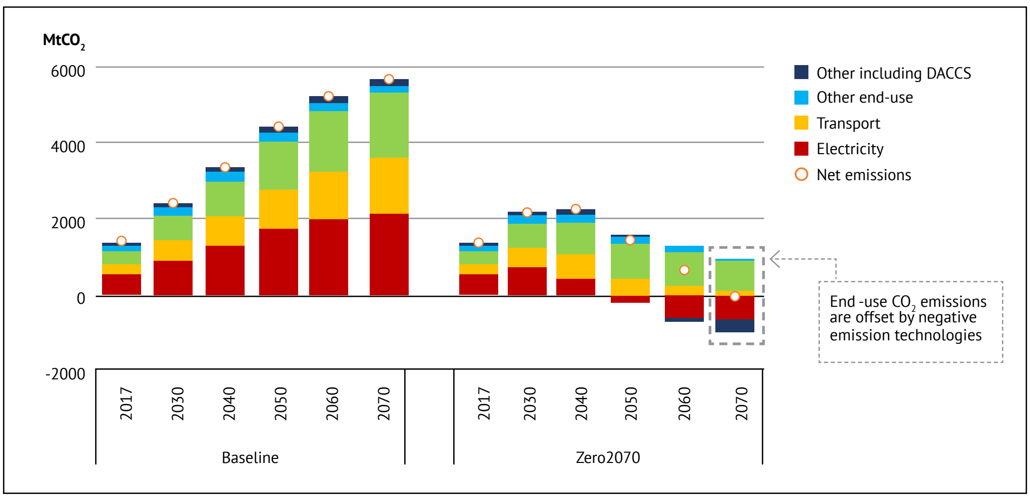
support for the aviation industry. This stimulus also included a US$35 billion commitment to clean energy, diversified across a range of quantified policies (Vivid Economics, 2021). A new target for the US is to achieve a 50%–52% reduction from 2005 levels in economy-wide net GHG pollution in 2030 (White House, 2021).

### 5.3 Reframing Investment Signals and Incentives in Support of Low-Carbon Green Infrastructure

There are major opportunities to achieve a net zero emission future by improving energy efficiency in certain sectors. Figure 3.16 shows that energy and transport are the largest GHG emission sectors, accounting for 66.3% of total GHG emissions from burning fossil fuels. High-income and upper middle-income countries are assumed to reach zero emissions by 2050 in the scenario represented in the figure. It will take another 20 years beyond 2050 for low-income countries and least developed countries to achieve net zero energy-related CO2 emissions, by 2060 and 2070, respectively.

A wide range of technologies, including renewables, nuclear, CCS, and import of hydrogen and ammonia, are necessary for deep emission reduction by 2070. The share of these technologies collectively reaches 79% of primary energy supply in 2070 in the ASEAN carbon neutrality scenario (Figure 3.16).

**Figure 3.16 ASEAN Carbon Neutrality Scenario in 2050 and Beyond**




ASEAN = Association of Southeast Asian Nations, $CO_2$ = carbon dioxide, DACCS = direct air capture for carbon storage, $MtCO_2$ = million tons of carbon dioxide.

Source: IEEJ-ERIA (2020); and IEA (2021), CO2 Emissions from Fuel Combustion. https://www.iea.org/subscribe-to-data-services/co2-emissions-statistics (accessed 4 September 2021).

Massive investment challenges remain to be addressed. A summary of the recovery packages of 20 countries[2] and the EU (Carbon Brief, 2021)[3]showed that they accorded the highest priority for support to the transport, energy, and buildings sectors (Table 3.17). The sectoral distribution of the green recovery packages of the 20 countries and the EU that collected data is as follows:

- Transport sector: The total spending is US$602.64 billion, with 77 projects, accounting for 33.20% of the total amount and 38.12% of the total number of projects. The highest amount is in the US (US$486.17 billion), followed by Italy (US$39.36 billion), France (US$27.99 billion), Germany (US$22.11 billion), and Spain (US$16.68 billion).
- Energy sector: The total spending is US$562.93 billion, with 39 projects, accounting for 31.01% of the total amount and 19.31% of the total number of projects. The highest amount is in the US, at US$500.00 billion, followed by Germany (US$25.34 billion), Italy (US$15.55 billion), and Spain (US$5.66 billion).
- Building sector: The total spending is US$456.65 billion, with 31 projects, accounting for 25.15% of the total amount and 15.35% of the total number of projects. The highest amount is the US (US$398.00 billion), followed by Italy (US$18.11 billion), Spain (US$8.01 billion), and France (US$7.66 billion).
- Industry sector: The total spending is US$76.93 billion, with 14 projects, accounting for 4.24% of the total amount and 6.93% of the total number of projects. The highest amount is in the US (US$46.00 billion), followed by the EU (US$11.78 billion) and Sweden (US$6.29 billion).
- R&D sector: The total spending is US$44.95 billion, with 22 projects, accounting for 2.48% of the total amount and 10.89% of the total number of projects. The highest amount is in the US (US$35.00 billion), followed by Spain (US$4.01 billion), Italy (US$2.95 billion), and France (US$2.71 billion).
- Employment sector: The total spending is US$22.04 billion, with three projects, accounting for 1.21% of the total amount and 1.49% of the total number of projects. Only the EU (US$34.17 billion) and New Zealand (US$0.77 billion) spend in this sector.
- Agriculture sector: The total spending is US$34.94 billion, with four projects, accounting for 1.92% of the total amount and 1.98% of the total number of projects. Only the EU (US$17.68 billion), Italy (US$3.74 billion), France (US$0.47 billion), and Chile (US$0.15 billion) spend in this sector.
- Nature sector: The total amount is US$14.36 billion, with 12 projects, accounting for 0.79% of the total amount and 5.94% of the total number of projects. Most countries in Europe spend in this sector, including Italy (US$11.99 billion), Germany (US$0.82 billion), and Sweden (US$0.55 billion), as well as India in Asia (US$0.80 billion).

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[2] Canada, Chile, China, Colombia, Denmark, Finland, France, Germany, India, Ireland, Italy, New Zealand, Nigeria, Norway, Poland, Korea, Spain, Sweden, the UK, the US, and the EU.

[3] The green recovery packages are calculated based on the projects that have information about the amount, updated to April 2021.

## Table 3.17 Post-COVID-19 Green Recovery Package Projects by Sector of 20 Countries and the EU

| No. | Sector/Subsector | Total | Share | Americas | | | | Europe | | | | | | | | | | | | Asia | | | | Africa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | US | Canada | Colombia | Chile | EU | Germany | Italy | France | Spain | UK | Sweden | Denmark | Poland | Finland | Norway | Ireland | New Zealand | Rep. of Korea | China | India | Nigeria |
| **A** | **Total amount (US$ billion)** | **1,815.44** | **100.0** | **1,465.17** | **4.80** | **4.18** | **3.05** | **63.63** | **54.05** | **94.17** | **41.29** | **38.84** | **12.97** | **8.59** | **5.46** | **2.36** | **1.04** | **0.41** | **0.29** | **1.58** | **11.22** | **1.54** | **0.80** | |
| **I** | **Energy (US$ billion)** | **562.93** | **31.01** | **500.00** | **2.00** | **4.18** | | | **25.34** | **15.55** | **2.36** | **5.66** | **1.47** | | **0.38** | **1.00** | **0.04** | **0.24** | **0.01** | | **4.70** | | | |
| 1.1 | Electricity bills | 12.96 | 2.30 | | | | | | 12.96 | | | | | | | | | | | | | | | |
| 1.2 | Renewable electricity | 17.13 | 3.04 | | 2.00 | 4.18 | | | | 6.95 | | 3.77 | 0.22 | | | | | | 0.01 | | | | | |
| 1.3 | Hydrogen | 20.73 | 3.68 | | | | | | 12.38 | 3.76 | 2.36 | 1.89 | 0.33 | | | | | 0.01 | | | | | | |
| 1.4 | Renewable electricity/ | 4.70 | 0.83 | | | | | | | | | | | | | | | | | | 4.70 | | | |
| 1.5 | Carbon capture and storage | 0.66 | 0.12 | | | | | | | | | | 0.28 | | 0.38 | | | | | | | | | |
| 1.6 | Energy efficiency | 0.02 | 0.00 | | | | | | | | | | | | | | 0.02 | | | | | | | |
| 1.7 | Nuclear | 0.43 | 0.08 | | | | | | | | | | 0.43 | | | | | | | | | | | |
| 1.8 | No information | 506.30 | 89.94 | 500.00 | | | | | | 4.84 | | | 0.21 | | | 1.00 | 0.02 | 0.23 | | | | | | |
| **II** | **Transport (US$ billion)** | **602.64** | **33.20** | **486.17** | **1.20** | | | | **22.11** | **39.36** | **27.99** | **16.68** | **5.33** | **0.91** | | **0.24** | **0.17** | **0.04** | **0.13** | **0.77** | | **1.54** | | |
| 2.1 | Public transport | 257.13 | 42.67 | 197.17 | 1.20 | | | | 10.43 | 29.19 | 5.54 | 8.01 | 4.19 | 0.40 | | 0.09 | 0.12 | | 0.02 | 0.77 | | | | |
| 2.2 | Electric vehicles | 184.64 | 30.64 | 174.00 | | | | | 6.96 | | 0.75 | | 1.12 | 0.12 | | 0.15 | | | | | | 1.54 | | |
| 2.3 | Car tax | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4 | Automotive | 12.57 | 2.09 | | | | | | 2.36 | | 10.20 | | 0.01 | | | | | | | | | | | |
| 2.5 | Aviation | 11.20 | 1.86 | | | | | | 1.18 | | 10.02 | | | | | | | | | | | | | |
| 2.6 | Shipping | 1.21 | 0.20 | | | | | | 1.18 | | | | | | | | | 0.03 | | | | | | |
| 2.7 | Oil and gas | | | | | | | | | | | | | | | | | | | | | | | |
| 2.8 | Cycling and walking | 1.69 | 0.28 | | | | | | | 0.06 | 1.48 | | | | | | 0.05 | | 0.10 | | | | | |
| 2.9 | Adaptation | 0.01 | 0.00 | | | | | | | | | | | | | | | | 0.01 | | | | | |
| 2.10 | R&D | 0.49 | 0.08 | | | | | | | | | 0.49 | | | | | | | | | | | | |
| 2.11 | Green jobs | 0.01 | 0.00 | | | | | | | | | 0.01 | | | | | | | | | | | | |
| 2.12 | Hydrogen | 0.01 | 0.00 | | | | | | | | | | 0.01 | | | | | | | | | | | |
| 2.13 | No information | 133.68 | 22.18 | 115.00 | | | | | | 10.11 | | 8.17 | | 0.39 | | | | 0.01 | | | | | | |

| No. | Sector/Subsector | Total | Share | Americas | | | | Europe | | | | | | | | | | | | Asia | | | | Africa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | US | Canada | Colombia | Chile | EU | Germany | Italy | France | Spain | UK | Sweden | Denmark | Poland | Finland | Norway | Ireland | New Zealand | Rep. of Korea | China | India | Nigeria |
| **III** | **Industry (US$ billion)** | **76.93** | **4.24** | **46.00** | | | | **11.78** | | **2.47** | **2.81** | **4.48** | **0.32** | **6.29** | **0.33** | **0.26** | **0.70** | **0.01** | | | **1.48** | | | |
| 3.1 | Energy efficiency | 0.14 | 0.18 | | | | | | | | | | | | 0.14 | | | | | | | | | |
| 3.2 | Circular economy | 3.46 | 4.50 | | | | | | | 2.47 | 0.59 | | | 0.03 | 0.01 | | 0.35 | 0.01 | | | | | | |
| 3.3 | Steel | 0.04 | 0.05 | | | | | | | | | | 0.04 | | | | | | | | | | | |
| 3.4 | Electric vehicles | 0.81 | 1.05 | | | | | | | | 0.81 | | | | | | | | | | | | | |
| 3.5 | No information | 72.48 | 94.22 | 46.00 | | | | 11.78 | | | 1.41 | 4.48 | 0.28 | 6.26 | 0.18 | 0.26 | 0.35 | | | | 1.48 | | | |
| **IV** | **Buildings (US$ billion)** | **456.65** | **25.15** | **398.00** | **1.60** | | **2.90** | | **3.07** | **18.11** | **7.66** | **8.01** | **5.63** | **0.84** | **4.75** | **0.83** | **0.05** | | **0.12** | **0.04** | **5.04** | | | |
| 4.1 | Energy efficiency | 379.42 | 83.09 | 338.00 | 1.60 | | | | 2.95 | 17.87 | 7.66 | | 5.59 | 0.84 | 4.75 | | | | 0.12 | 0.04 | | | | |
| 4.2 | Adaptation | 53.02 | 11.61 | 50.00 | | | 2.90 | | 0.12 | | | | | | | | | | | | | | | |
| 4.3 | Heating | 0.13 | 0.03 | | | | | | | | | | | | | 0.08 | 0.05 | | | | | | | |
| 4.4 | Construction | | | | | | | | | | | | | | | | | | | | | | | |
| 4.5 | No information | 24.08 | 5.27 | 10.00 | | | | | | 0.24 | | 8.01 | 0.04 | | | 0.75 | | | | | 5.04 | | | |
| **V** | **Agriculture (US$ billion)** | **22.04** | **1.21** | | | | **0.15** | 17.68 | | **3.74** | **0.47** | | | | | | | | | | | | | |
| 5.1 | Trees | 0.15 | 0.68 | | | | 0.15 | | | | | | | | | | | | | | | | | |
| 5.2 | No information | 21.89 | 99.32 | | | | | 17.68 | | 3.74 | 0.47 | | | | | | | | | | | | | |
| **VI** | **Employment (US$ billion)** | **34.94** | **1.92** | | | | | 34.17 | | | | | | | | | | | | 0.77 | | | | |
| 6.1 | Green jobs | 34.94 | 100.0 | | | | | 34.17 | | | | | | | | | | | | 0.77 | | | | |
| 6.2 | No information | | | | | | | | | | | | | | | | | | | | | | | |
| **VII** | **R&D (US$ billion)** | **44.95** | **2.48** | 35.00 | | | | | 2.71 | 2.95 | | 4.01 | 0.15 | | | | | 0.12 | 0.01 | | | | | |
| 7.1 | Negative emissions | 0.14 | 0.31 | | | | | | | | | | 0.14 | | | | | | | | | | | |
| 7.2 | Renewable electricity | | | | | | | | | | | | | | | | | | | | | | | |
| 7.3 | No information | 44.81 | 99.69 | 35.00 | | | | | 2.71 | 2.95 | | 4.01 | 0.01 | | | | | 0.12 | 0.01 | | | | | |
| **VIII** | **Nature (US$ billion)** | **14.36** | **0.79** | | | | | | 0.82 | 11.99 | | | 0.07 | 0.55 | | 0.03 | 0.08 | | 0.02 | | | | **0.80** | |
| 8.1 | Trees | 1.70 | 11.84 | | | | | | 0.82 | | | | | | | | 0.08 | | | | | | 0.80 | |
| 8.2 | No information | 12.66 | 88.16 | | | | | | | 11.99 | | | 0.07 | 0.55 | | 0.03 | | | 0.02 | | | | | |
| **B** | **Total number of projects** | **202** | **100.0** | **15** | **3** | **2** | **4** | **9** | **23** | **19** | **19** | **13** | **24** | **10** | **6** | **14** | **10** | **10** | **8** | **3** | **3** | **2** | **2** | **3** |

| No. | Sector/Subsector | Total | Share | Americas | | | | Europe | | | | | | | | | | | | Asia | | | | Africa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | US | Canada | Colombia | Chile | EU | Germany | Italy | France | Spain | UK | Sweden | Denmark | Poland | Finland | Norway | Ireland | New Zealand | Rep. of Korea | China | India | Nigeria |
| **I** | **Energy** (number of projects) | **39** | **19.31** | 2 | 1 | **1** | | 2 | 5 | 3 | 1 | 2 | 6 | | 2 | 5 | 2 | 4 | 1 | | 1 | | | **1** |
| 1.1 | Electricity bills | 1 | 2.56 | | | | | | 1 | | | | | | | | | | | | | | | |
| 1.2 | Renewable electricity | 10 | 25.64 | | 1 | 1 | | 1 | 1 | 1 | | 1 | 1 | | | | | 1 | 1 | | | | | 1 |
| 1.3 | Hydrogen | 9 | 23.08 | | | | | 1 | 3 | 1 | 1 | 1 | 1 | | | | | 1 | | | | | | |
| 1.4 | Renewable electricity/ Hydrogen | 2 | 5.13 | | | | | | | | | | | | 1 | | | | | | 1 | | | |
| 1.5 | Carbon capture and storage | 2 | 5.13 | | | | | | | | | | 1 | | 1 | | | | | | | | | |
| 1.6 | Energy efficiency | 1 | 2.56 | | | | | | | | | | | | | | 1 | | | | | | | |
| 1.7 | Nuclear | 1 | 2.56 | | | | | | | | | | 1 | | | | | | | | | | | |
| 1.8 | No information | 13 | 33.33 | 2 | | | | | | 1 | | | 2 | | | 5 | 1 | 2 | | | | | | |
| **II** | **Transport** (number of projects) | **77** | **38.12** | 6 | 1 | | 1 | 1 | 12 | 6 | 13 | 8 | 6 | 4 | | 4 | 3 | 3 | 4 | 1 | | **2** | **1** | **1** |
| 2.1 | Public transport | 24 | 31.17 | 4 | 1 | | | | 4 | 2 | 1 | 2 | 2 | 2 | | 1 | 2 | | 2 | 1 | | | | |
| 2.2 | Electric vehicles | 18 | 23.38 | 1 | | | | 1 | 4 | 2 | 2 | | 2 | 1 | | 3 | | | | | | 2 | | |
| 2.3 | Car tax | 1 | 1.30 | | | | | | 1 | | | | | | | | | | | | | | | |
| 2.4 | Automotive | 8 | 10.39 | | | | | | 1 | | 6 | | 1 | | | | | | | | | | | |
| 2.5 | Aviation | 3 | 3.90 | | | | | | 1 | | 2 | | | | | | | | | | | | | |
| 2.6 | Shipping | 3 | 3.90 | | | | | | 1 | | | | | | | | | 2 | | | | | | |
| 2.7 | Oil and gas | 2 | 2.60 | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| 2.8 | Cycling and walking | 5 | 6.49 | | | | | | | 1 | 2 | | | | | | 1 | | 1 | | | | | |
| 2.9 | Adaptation | 1 | 1.30 | | | | | | | | | | | | | | | | 1 | | | | | |
| 2.10 | R&D | 1 | 1.30 | | | | | | | | | 1 | | | | | | | | | | | | |
| 2.11 | Green jobs | 1 | 1.30 | | | | | | | | | 1 | | | | | | | | | | | | |
| 2.12 | Hydrogen | 1 | 1.30 | | | | | | | | | | 1 | | | | | | | | | | | |
| 2.13 | No information | 9 | 11.69 | 1 | | | 1 | | | 1 | | 4 | | 1 | | | | 1 | | | | | | |
| **III** | **Industry** (number of projects) | **22** | **10.89** | 1 | | | | 1 | | 1 | 3 | 1 | 3 | 4 | 3 | 1 | 2 | 1 | | | 1 | | | |
| 3.1 | Energy efficiency | 1 | 4.55 | | | | | | | | | | | | 1 | | | | | | | | | |
| 3.2 | Circular economy | 6 | 27.27 | | | | | | | 1 | 1 | | | 1 | 1 | | 1 | 1 | | | | | | |
| 3.3 | Steel | 1 | 4.55 | | | | | | | | | | 1 | | | | | | | | | | | |
| 3.4 | Electric vehicles | 1 | 4.55 | | | | | | | | 1 | | | | | | | | | | | | | |
| 3.5 | No information | 13 | 59.09 | 1 | | | | 1 | | | 1 | 1 | 2 | 3 | 1 | 1 | 1 | | | | 1 | | | |

| No. | Sector/Subsector | Total | Share | Americas | | | | Europe | | | | | | | | | | | | Asia | | | | Africa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | US | Canada | Colombia | Chile | EU | Germany | Italy | France | Spain | UK | Sweden | Denmark | Poland | Finland | Norway | Ireland | New Zealand | Rep. of Korea | China | India | Nigeria |
| **IV** | **Buildings** (number of projects) | **31** | **15.35** | 5 | 1 | | 2 | 1 | 2 | 4 | 1 | 1 | 5 | 1 | 1 | 2 | 2 | | 1 | 1 | 1 | | | |
| 4.1 | Energy efficiency | 19 | 61.29 | 3 | 1 | | 1 | 1 | 1 | 3 | 1 | | 4 | 1 | 1 | | | | 1 | 1 | | | | |
| 4.2 | Adaptation | 3 | 9.68 | 1 | | | 1 | | 1 | | | | | | | | | | | | | | | |
| 4.3 | Heating | 2 | 6.45 | | | | | | | | | | | | | 1 | 1 | | | | | | | |
| 4.4 | Construction | 1 | 3.23 | | | | | | | | | | | | | | 1 | | | | | | | |
| 4.5 | No information | 6 | 19.35 | 1 | | | | | | 1 | | 1 | 1 | | | 1 | | | | | 1 | | | |
| **V** | **Agriculture** (number of projects) | **4** | **1.98** | | | | 1 | 1 | | 1 | 1 | | | | | | | | | | | | | |
| 5.1 | Trees | 1 | 25.00 | | | | 1 | | | | | | | | | | | | | | | | | |
| 5.2 | No information | 3 | 75.00 | | | | | 1 | | 1 | 1 | | | | | | | | | | | | | |
| **VI** | **Employment** (number of projects) | **3** | **1.49** | | | | | 2 | | | | | | | | | | | | 1 | | | | |
| 6.1 | Green jobs | 3 | 100.0 | | | | | 2 | | | | | | | | | | | | 1 | | | | |
| 6.2 | No information | | | | | | | | | | | | | | | | | | | | | | | |
| **VII** | **R&D** (number of projects) | **14** | **6.93** | 1 | | | | 1 | 3 | 2 | | 1 | 2 | | | | | 2 | 1 | | | | | 1 |
| 7.1 | Negative emissions | 1 | 7.14 | | | | | | | | | | 1 | | | | | | | | | | | |
| 7.2 | Renewable electricity | 1 | 7.14 | | | | | | | | | | | | | | | | | | | | | 1 |
| 7.3 | No information | 12 | 85.71 | 1 | | | | 1 | 3 | 2 | | 1 | 1 | | | | | 2 | 1 | | | | | |
| **VIII** | **Nature** (number of projects) | **12** | **5.94** | | | 1 | | | 1 | 2 | | | 2 | 1 | | 2 | 1 | | 1 | | | | 1 | |
| 8.1 | Trees | 4 | 33.33 | | | 1 | | | 1 | | | | | | | | 1 | | | | | | 1 | |
| 8.2 | No information | 8 | 66.67 | | | | | | | 2 | | | 2 | 1 | | 2 | | | 1 | | | | | |

COVID-19 = coronavirus disease, EU = European Union, R&D = research and development, UK = United Kingdom, US = United States.

Note: The green recovery packages are calculated based on the projects that have information about the amount, updated to April 2021.

Source: ERIA Study Team based on Carbon Brief (2021).

Table 3.18 presents the share of green policy solutions applied by a selection of countries within and outside ASEAN as follows: green infrastructure investments (41.4%), subsidies or tax reductions for green products (15.6%), green R&D subsidies (14.8%), bailouts with green strings attached (10.5%), nature-based solutions (5.7%), and conservation and wildlife protection programmes (4.4%) (Vivid Economics, 2021).

Table 3.19 details the policy solutions used in support packages that have a substantial impact on the environment (brown policy). About 18.3% of countries (19.1% of selected non-ASEAN+6 countries[4] and 17.5% of selected ASEAN+6 countries) apply policies related to subsidies or tax reductions for environmentally harmful products. Some 17.5% of countries (10.0% of selected non-ASEAN+6 countries and 25.0% of selected ASEAN+6 countries)[5]apply subsidy policies related to environmentally harmful activities. Some 15.8% of countries (19.1% of selected non-ASEAN+6 countries and 12.5% of selected ASEAN+6 countries) apply subsidy policies related to an environmentally related bailout without green strings. Some 14.4% of countries (16.4% of selected non-ASEAN+6 countries and 12.5% of selected ASEAN+6 countries) apply subsidy policies related to the deregulation of environmental standards. Some 9.4% of countries (6.4% of selected non-ASEAN+6 countries and 12.5% of selected ASEAN+6 countries) apply subsidy policies related to environmentally harmful infrastructure investments.

## 5.4 Overcoming Barriers in Shifting Investments Towards Low-Carbon Green Infrastructure

As countries struggle to restart their economies, low-carbon investments are most effective in economies that integrate energy, climate, and investment policies in a coordinated way. Boxes 3.4 and 3.5 exemplify such an approach in Viet Nam and Korea, respectively, during the pandemic crisis.

Nevertheless, policy obstacles are also associated with embedded financial systems and regulations that hinder the allocation of long-term finance to long-term low-carbon infrastructure investments. Such barriers include the way that long-term investments are regulated, climate risks are valued, private financing outcomes are reported, and public finance is allocated and delivered (Table 3.20).

[4]Argentina, Brazil, Canada, Colombia, Denmark, the EU, Finland, France, Germany, Iceland, Italy, Mexico, Norway, Russia, Saudi Arabia, South Africa, Spain, Sweden, Switzerland, Turkey, the UK, the US.
[5]Australia, China, India, Indonesia, Japan, the Philippines, Singapore, and Korea.

## Table 3.18 Share of Environmental Policy Measures in the Recovery Packages of Selected Countries (%)

| Policy | | Selected ASEAN+6 countries* | | | | | Selected non-ASEAN+6 countries** | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | Energy | Industry | Transport | Waste | Agriculture | Energy | Industry | Transport | Waste | |
| Green policy | Bailouts with green strings attached | | | | | | 9.1 | 13.6 | 27.3 | 40.9 | 13.6 | 10.5 |
| | Green infrastructure investments | 12.5 | 75.0 | 37.5 | 62.5 | 12.5 | 31.8 | 77.3 | 45.5 | 54.5 | 4.5 | 41.4 |
| | Green R&D subsidies | | 37.5 | 12.5 | 12.5 | 12.5 | | 22.7 | 27.3 | 22.7 | | 14.8 |
| | Subsidies or tax reductions for green products | | 37.5 | 12.5 | 37.5 | | | 36.4 | 4.5 | 27.3 | | 15.6 |
| | Nature-based solutions | 25.0 | | | | | 31.8 | | | | | 5.7 |
| | Conservation and wildlife protection programmes | 12.5 | | | | | 31.8 | | | | | 4.4 |
| Brown policy | Subsidies for environmentally harmful activities | (25.0) | (25.0) | (37.5) | (37.5) | | (4.5) | (18.2) | (18.2) | (9.1) | | (17.5) |
| | Environmentally harmful infrastructure investments | | (37.5) | (25.0) | | | | (22.7) | | (9.1) | | (9.4) |
| | Deregulation of environmental standards | (12.5) | (25.0) | (25.0) | | | (13.6) | (22.7) | (27.3) | (13.6) | (4.5) | (14.4) |
| | Environmentally related bailout without green strings | | | (12.5) | (50.0) | | (9.1) | (13.6) | (18.2) | (54.5) | | (15.8) |
| | Subsidies or tax reductions for environmentally harmful products | | (12.5) | (25.0) | (50.0) | | (4.5) | (36.4) | (31.8) | (18.2) | (4.5) | (18.3) |
| | Balance between green and brown policy | 12.5 | 50.0 | (62.5) | (25.0) | 25.0 | 72.7 | 36.4 | 9.1 | 40.9 | 9.1 | 16.8 |

( ) = measures having negative impacts, ASEAN = Association of Southeast Asian Nations, R&D = research and development. ASEAN = Association of Southeast Asian Nations, R&D = research and development.

* Australia, China, India, Indonesia, Japan, the Philippines, Singapore, and the Republic of Korea.

** Argentina, Brazil, Canada, Colombia, Denmark, the European Union, Finland, France, Germany, Iceland, Italy, Mexico, Norway, Russia, Saudi Arabia, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

Source: ERIA Study Team calculations based on Vivid Economics (2021).

## Table 3.19 Environmental Policy Measures in Recovery Packages by Country

| Country | Sector | Green policy | | | | | | Brown policy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bailouts with green strings attached | Green infrastructure investments | Green R&D subsidies | Subsidies or tax reductions for green products | Nature-based solutions | Conservation and wildlife protection programmes | Subsidies for environmentally harmful activities | Environmentally harmful infrastructure investments | Deregulation of environmental standards | Environment-related bailout without green strings | Subsidies or tax reduction for environmentally harmful products |
| **I. Selected ASEAN+6 countries** | | | | | | | | | | | | |
| Australia | Agriculture | | | | x | | | | x | | | |
| | Energy | x | x | | | | x | x | | | | |
| | Industry | x | | | | | x | | | | | |
| | Transport | x | | | | | | | | x | | |
| | Waste | | | | | | | | | | | |
| China | Agriculture | | x | | | | x | | | | | |
| | Energy | | x | | | | | | x | x | | |
| | Industry | | x | | | | | | | x | | |
| | Transport | | x | | x | | | | | | x | x |
| | Waste | | | | | | | | | | | |
| India | Agriculture | | | | | x | | | | | | |
| | Energy | | x | | x | | | x | x | x | | x |
| | Industry | | | | x | | | x | x | x | | |
| | Transport | | x | | x | | | | | | | |
| | Waste | | | | | | | | | | | |
| Indonesia | Agriculture | | | | | | | | | | | |
| | Energy | | x | x | x | | | | | | | |
| | Industry | | | | | | | | | | | |
| | Transport | | x | | | | | | | | | |
| | Waste | | | | | | | | | | | |
| Japan | Agriculture | | | | | | | | | | | |
| | Energy | | x | | | | | | | | | |
| | Industry | | | | | | | | | | | |
| | Transport | | | | | | | | | | | x |
| | Waste | | | | | | | | | | | |
| Philippines | Agriculture | | | | | | | x | | | | |
| | Energy | | | | x | | | | | | | |
| | Industry | | | | | | | | x | | | x |
| | Transport | | | | | | | x | | | | |
| | Waste | | | | | | | | | | | |
| Republic of Korea | Agriculture | | | | | | | | | | | |
| | Energy | | x | x | | | | | | | | |
| | Industry | | x | x | | | | | | | x | |
| | Transport | | x | x | x | | | x | | | x | x |
| | Waste | | x | x | | | | | | | | |

| Country | Sector | Green policy | | | | | | Brown policy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bailouts with green strings attached | Green infrastructure investments | Green R&D subsidies | Subsidies or tax reductions for green products | Nature-based solutions | Conservation and wildlife protection programmes | Subsidies for environmentally harmful activities | Environmentally harmful infrastructure investments | Deregulation of environmental standards | Environment-related bailout without green strings | Subsidies or tax reductions for environmentally harmful products |
| Singapore | Agriculture | | | | | | | x | | | | |
| | Energy | | | | | | | | | | | |
| | Industry | | | | | | | x | | | | x |
| | Transport | | | | | | | x | | | x | x |
| | Waste | | | | | | | | | | | |
| **II. Selected non-ASEAN+6 countries** | | | | | | | | | | | | |
| Argentina | Agriculture | | x | | | | | | | | | |
| | Energy | | | | | | | | | | | x |
| | Industry | | | | | | | | | x | | x |
| | Transport | | | | | | | | | | | |
| | Waste | | | | | | | | | | | |
| Brazil | Agriculture | | | | | | | | | x | | |
| | Energy | | x | | x | | | | | x | | |
| | Industry | | x | | | | | | | x | | |
| | Transport | | | | | | | | | | x | |
| | Waste | | | | | | | | | | | |
| United States | Agriculture | | | | | | x | | | x | | |
| | Energy | | | x | x | | | x | x | x | | x |
| | Industry | | | | | | | | | x | | |
| | Transport | x | x | | | | | | | x | x | |
| | Waste | | | | | | | | | x | | |
| Canada | Agriculture | x | | | | x | | | | | x | |
| | Energy | x | x | | | | | x | x | x | x | |
| | Industry | x | | | | | | x | | | | |
| | Transport | x | x | | | | | x | x | | | |
| | Waste | x | | | | | | | | | | |
| EU | Agriculture | x | | | | x | | | | | | |
| | Energy | x | x | x | | | | | | | | |
| | Industry | x | | | | | | | | | | |
| | Transport | x | x | | x | | | | | | | |
| | Waste | x | | | | | | | | | | |
| France | Agriculture | | x | | | | | | | | | |
| | Energy | | x | | x | | | | | | | |
| | Industry | x | x | | | | | x | | x | | |
| | Transport | x | x | x | x | | | | | | | |
| | Waste | x | x | | | | | | | | | |
| Germany | Agriculture | | x | | | x | | | | | | |
| | Energy | | x | x | x | | | | | | | |
| | Industry | | x | x | x | | | | | | | |
| | Transport | | | | | | | | | | x | |
| | Waste | | | | | | | | | | | |

| Country | Sector | Green policy | | | | | | Brown policy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bailouts with green strings attached | Green infrastructure investments | Green R&D subsidies | Subsidies or tax reductions for green products | Nature-based solutions | Conservation and wildlife protection programmes | Subsidies for environmentally harmful activities | Environmentally harmful infrastructure investments | Deregulation of environmental standards | Environment-related bailout without green strings | Subsidies or tax reductions for environmentally harmful products |
| Italy | Agriculture | | | | | | | | | | | |
| | Energy | | x | | x | | | | | | | x |
| | Industry | | | | | | | | | | | |
| | Transport | | x | | x | | | | | | x | x |
| | Waste | | | | | | | | | | | |
| Mexico | Agriculture | | | | | | | | | | | |
| | Energy | | | | | | | | x | | | |
| | Industry | | | | | | | | | | | |
| | Transport | | | | | | | | x | | | |
| | Waste | | | | | | | | | | | |
| Russia | Agriculture | | | | | | | | | | | |
| | Energy | | | | | | | x | | | | x |
| | Industry | | | | | | | x | | | | x |
| | Transport | | | | | | | x | | | x | x |
| | Waste | | | | | | | | | | | |
| Saudi Arabia | Agriculture | | | | | | | | | | | |
| | Energy | | | | | | | x | | | | x |
| | Industry | | | | | | | | | | | |
| | Transport | | | | | | | | | | | |
| | Waste | | | | | | | | | | | |
| South Africa | Agriculture | | | | | | | | | | | |
| | Energy | | x | | | | | | x | x | x | x |
| | Industry | | | | | | | | | x | x | |
| | Transport | | | | | | | | | | | |
| | Waste | | | | | | | | | | | |
| Spain | Agriculture | | x | | | | | | | | | |
| | Energy | | x | | | | | | | | | |
| | Industry | | x | | | | | | | | | |
| | Transport | | x | | x | | | | | | x | |
| | Waste | | | | | | | | | | | |
| Colombia | Agriculture | | | | | x | x | | | | | x |
| | Energy | | x | | | | | | | | | |
| | Industry | | | | | | | | | | | x |
| | Transport | | x | | | | | | | | | |
| | Waste | | | | | | | | | | | |
| Turkey | Agriculture | | | | | | | | | | | |
| | Energy | | x | | x | | | | | x | x | x |
| | Industry | | | | | | | | | | | |
| | Transport | | | | | | | | | x | x | |
| | Waste | | | | | | | | | | | |

| Country | Sector | Green policy | | | | | | Brown policy | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bailouts with green strings attached | Green infrastructure investments | Green R&D subsidies | Subsidies or tax reductions for green products | Nature-based solutions | Conservation and wildlife protection programmes | Subsidies for environmentally harmful activities | Environmentally harmful infrastructure investments | Deregulation of environmental standards | Environment-related bailout without green strings | Subsidies or tax reductions for environmentally harmful products |
| Denmark | Agriculture | | | | | x | x | | | | | |
| | Energy | | x | | | | | | | | | |
| | Industry | x | x | x | | | | | | | x | |
| | Transport | x | x | | | | | | | | x | |
| | Waste | | | | | | | | | | | |
| Finland | Agriculture | | | | | x | x | | | | | |
| | Energy | x | x | x | | | | | | | | |
| | Industry | x | x | x | | | | | | x | | x |
| | Transport | x | | x | | | | | | x | | x |
| | Waste | | | | | | | | | | | |
| Iceland | Agriculture | | | | | | | | | | | |
| | Energy | | x | | | | | | | | | |
| | Industry | | x | x | | | | x | | | | x |
| | Transport | | | | x | | | | | | x | |
| | Waste | | | | | | | | | | | |
| Norway | Agriculture | | x | | | | | | | | | |
| | Energy | | x | x | | | | | x | | | x |
| | Industry | | x | x | | | | | | | x | x |
| | Transport | | x | x | x | | | | | | x | x |
| | Waste | | | | | | | | | | | |
| Sweden | Agriculture | | x | | | x | x | x | | | x | |
| | Energy | | x | | x | | | | | | | |
| | Industry | | x | | | | | | | | | x |
| | Transport | x | x | x | | | | | | | x | |
| | Waste | | | | | | | | | | | |
| Switzerland | Agriculture | | x | | | | x | | | | | |
| | Energy | | x | | | | | | | | | |
| | Industry | | | | | | | | | | x | |
| | Transport | x | x | | | | | | | | | |
| | Waste | | | | | | | | | | | |
| UK | Agriculture | | | | | | x | | | x | | |
| | Energy | | x | | x | | | | | | | |
| | Industry | x | x | x | | | | | | | | |
| | Transport | x | x | x | | | | | | | x | |
| | Waste | | | | | | | | | | | x |

ASEAN = Association of Southeast Asian Nations, EU = European Union, R&D = research and development, UK = United Kingdom.

Source: ERIA Study Team calculations from Vivid Economics (2021).

**Box 3.4 Viet Nam's Pandemic Adaptation Policies Towards Green Growth**

In the face of negative impacts on the economy from social distancing policies, the Government of Viet Nam issued pandemic adaptation policies towards green growth.

1. Policies adapted to COVID-19 and green growth

These policies ensure to promote the application of information technology in production, business, health, education, and public service provision, etc., in response to COVID-19 and towards green and sustainable growth.

- The remote medical examination and treatment policy aims to implement social distancing policies and promote green growth by limiting people's movement and using resources effectively. According to Directive No. 16/CT-TTg, an important preventive measure against the COVID-19 pandemic is restricting people's access to medical facilities for essential services. Accordingly, the Prime Minister instructed the Ministry of Information and Communications to coordinate with the Ministry of Health in implementing the remote medical examination and treatment model for households, villages, communes, wards, and districts. On 18 April 2020, the Ministry of Health organised the first pilot project at Hanoi Medical University Hospital. Many live television stations have been deployed for medical examination and treatment, especially in meeting serious diseases, including patients with COVID-19.

- Policies in education and training: Official Letter No. 1061/BGD T-GDTrH dated 25 March 2020 of the Ministry of Education and Training on the instruction for teaching on the internet and/or on television for general education institutions when students are absent from school because of COVID-19 during the 2019/20 school year to support students' study and help them complete the general education programme.

- Policy on online public service provision: To adapt to the social distancing policy, the Government of Viet Nam issued Decree No. 45/2020/ND-CP dated 8 April 2020, on the implementation of administrative procedures in the electronic environment. To encourage society to use online public services, on 7 February 2020, the Computerization Department of the Ministry of Information and Communications issued Official Letter 100/THH-TTDVCTT on propagating and encouraging people to increase the use of online public services to limit exposure to crowds.

- The Prime Minister signed and approved a project to plant 1 billion trees from 2021 to 2025 (Decision No. 524/QD-TTg dated 1 April 2021). The project includes 690 million trees in urban and rural areas; and 310 million trees in protection forests, special-use forests, and new production forests in order to contribute to protecting the ecological environment, improving the landscape and responding to climate change, developing the socio-economic situation, improving people's quality of life, and contributing to the sustainable development of the country. Funding for implementation of the project involves mobilising all social resources and diversifying capital sources for planting and protecting trees from the state budget (expenditure for development investment and recurrent expenditure); and other sources of funding, aid, and legally mobilised sources from organisations, households, individuals, and communities (domestic and foreign).

2. Policies in support of inclusive growth during the COVID-19 pandemic

Implementing Resolution No. 42/NQ-CP to directly support people, workers, businesses and households facing difficulties due to COVID-19, with a total budget of about D62,000 billion. The Prime Minister issued Decision No. 15/2020/QD-TTg dated 24 April 2020 on the implementation of policies to support people facing difficulties caused by the COVID-19 pandemic, applied from 1 April 2020.

Several policies could still lead to an increase in GHG emissions and contravene the government's emission reduction policy, such as policies on electricity price reductions and electricity bill reductions for electricity consumers affected by the COVID-19 pandemic (Official Letter No. 2698/BCT-DTDL dated 16 April 2020 of the Ministry of Industry and Trade), or the 30% reduction in environmental protection taxes on flying fuel (Resolution 979/2020/UBTVQH14, effective 1 August 2020). Although these policies are temporary, they are not likely to change behaviour in electricity and fossil fuel consumption. The results of the monthly carbon dioxide equivalent emission calculations showed that the 10% electricity price support and the 30% reduction in the environmental protection tax on flying fuel for airlines helped to reduce difficulties for people and businesses. However, these solutions did not increase electricity demand because they did not last long enough to affect energy consumption behaviour. Nevertheless, these forms of support are contrary to efforts to raise awareness and fulfil Viet Nam's commitment to reduce GHG emissions (Hoa et al., 2020).

COVID-19 = coronavirus disease, GHG = greenhouse gas.

Source: ERIA study team

## Box 3.5 The Republic of Korea's Pandemic Adaptation Policies Towards Green Growth

The COVID-19 pandemic has brought changes to ways of thinking and living, accelerating a move to a digital and eco-friendly economy. As quarantine has become a part of everyday life, demand for remote services surge and remote working is considered usual. The Republic of Korea will invest W76 trillion (US$61.9 billion) by 2025 to strengthen digitisation, eco-friendly growth, and social safety nets, in a sweeping move to reinvigorate the economy hit by the COVID-19 pandemic.

Goal: Transform the economy from a fast follower to a leader, from a carbon-dependent economy to a green economy, creating a more inclusive society

2+1 policies: Digital New Deal and Green New Deal (2) + stronger safety nets (1), which will be implemented with strong fiscal support and improved regulations to promote the private sector

Projects: 10 major projects out of a total of 28 projects (12 for the Digital New Deal, 8 for the Green New Deal, and 8 for social safety nets)

Investment plans

- W6.3 trillion was planned to be invested during 2020 through the third supplementary budget; W67.7 trillion (cumulative) will be invested by 2022; and W160.0 trillion (cumulative) will be invested by 2025 (W114.1 trillion of fiscal investment), with 1.901 million jobs created during the period

- Investment plans by projects:
  - Digital New Deal: W58.2 trillion (W44.8 trillion from fiscal investment), 903,000 jobs created
  - Green New Deal: W73.4 trillion (W42.7 trillion from fiscal investment), 659,000 jobs created
  - Stronger safety nets: W28.4 trillion (W26.6 trillion from fiscal investment), 339,000 jobs created

Expected outcomes

1. Smart country

- Smart industries: W43 trillion of data markets are expected to be created, 18 smart hospitals will be in service, and up to 40% of work will be done remotely

- Smart government: 80% of public services will become digital, and the government will use cloud computing 100%

- Smart cities: High-precision road maps will be available for almost all roads across the country, and 108 smart city management platforms will be set up

2. Green country

- Clean environment: Up to 225,000 public rental houses will be remodelled to be energy-efficient and eco-friendly, 25 cities will be transformed to be smart and eco-friendly, and 723 hectares of urban forests will be planted to reduce fine dust

- Use of low-carbon green energy: 1,130,000 electric cars and 200,000 hydrogen fuel cell cars will be in use across the country, renewable energy production capacity will reach 42.7 gigawatts, and 5 million households will get electricity through smart grids

- Green industries: Up to 1,750 factories will be transformed into clean factories, fine dust reduction systems will be installed in 13,182 small manufacturers, and 10 smart energy platforms will be built

3. Safe country

- Income guarantee: Up to 21 million workers will be covered by employment insurance programs, and 1.13 million households will be made eligible for social security benefits

- Human resources: 100,000 high-tech workers will be available for the artificial intelligence and Smart Works sectors, and 20,000 high-tech workers will be in place for green industrial convergence

- Digital inclusion: Internet access will be made available to all rural areas of the country, and 70% of older persons (aged 70 or older) will be able to enjoy mobile internet access

COVID-19 = coronavirus disease.

Source: Ministry of Economy and Finance, Korea (2020); Lee (2020).

## Table 3.20 Examples of Policy Misalignments that Undermine Low-Carbon Investments in Developing Countries of ASEAN and East Asia

| | | |
|---|---|---|
| Investment environment | Energy policies | - Lack of open and competitive electricity markets<br>- Regulatorwy barriers to international investment in low-carbon energy projects, such as limits on foreign direct investment and restricted access to assets<br>- Market design and energy pricing mechanisms that favour carbon-intensive fossil fuel investments |
| | Climate policies | - Lack of ambitious targets, beyond nationally determined contributions and binding sectoral objectives<br>- Lack of stability in climate policy and retroactive changes, and divergence with sectoral emission reduction objectives |
| | Trade policies | - Tariff and non-tariff barriers for low-carbon goods and services<br>- Lack of embedded standards in multilateral free trade agreements and bilateral trade negotiations |
| | Competition policies | - Lack of transparency, investor protection, and intellectual property rights in low-carbon technologies; and weak enforcement of targets<br>- Unequal treatment in the power sector and subsidy regimes for fossil fuel-producing state-owned enterprises and independent producers of low-carbon energy |
| | Governance policies | - Lack of long-term scenarios for low-carbon investment planning and procurement of technology and finance<br>- Lack of stakeholder consultation in progressive target setting and policy design |
| Financial support mechanism | Fiscal policies | - Insufficient carbon pricing and market incentives for low-carbon technology diffusion |
| | Financial market | - Financial incentives favouring short-termism in performance appraisal of equity and credit markets<br>- Unintended consequences of financial regulations focusing on long-term fiscal stability<br>- Lack of taxonomy in the deployment of innovative financial instruments for new types of investors, such as bond markets and institutional investors |
| | Banking sector conduct | - Corporate reporting that does not reflect the climate risk<br>- Lack of clarity in fiduciary duty and stewardship with respect to environmental, social, and governance issues<br>- Lack of guidelines and responsible investment codes |
| | Public financing policies | - Ongoing support to carbon-intensive investments<br>- Continued subsidy support to fossil fuel use<br>- Lack of capacity to assess the risks associated with stranded assets |

ASEAN = Association of Southeast Asian Nations.

Source: ERIA Study Team.

Removing these barriers will require key architectural reforms to financial regulations, corporate governance, and public spending in the post-COVID-19 era. While investment decisions are motivated by concerns other than climate change, some of the potential challenges confronting private investments can be transformed into opportunities for regional cooperation. Developing countries in ASEAN, as well as China and India, have strengths in their abundant human capital and enjoy the latecomer advantage of having a large window of opportunity to leapfrog to low-carbon and green investments – frameworks and regional cooperation mechanisms that have been tried and tested in advanced countries.

## 6. Conclusions

This chapter has discussed the existing similarities, emerging convergence, and differences in economic and emission trajectories and policy actions across countries to promote low-carbon green growth. The interesting question is whether current policies and plans in developing Asia are aligned with the objective of net zero emissions adopted by major economies. To answer this question, the chapter has reviewed strategies and actions undertaken amidst the COVID-19 pandemic. The main conclusions of the analysis on current trajectories are presented below.

**Developing and emerging economies of the region are acting on the transition towards a low-carbon economy in a progressive way.**

Close examination of carbon emission profiles and policy actions helps to illustrate how, despite having very low per capita GHG emissions, many developing and emerging economies of ASEAN and East Asia are making efforts towards substantial reductions in carbon emissions, resource use, and energy consumption. From a climate change mitigation perspective, countries are keenly aware of the opportunities associated with low-carbon green growth and the risks of being locked into high-carbon infrastructure. Decoupling economic growth from carbon emissions is increasingly a policy goal being prioritised for national benefit rather than as a result of international pressures or concerns. Perhaps more importantly from the perspective of many low- and middle-income AMS, the assessment shows that low-carbon green development can support a range of other policy goals, including local environmental protection, poverty alleviation, energy security, economic competitiveness, the development of new industries and jobs, investment in knowledge and innovation, and local environmental protection. This combination helps to explain the strong interest from many developing countries in low-carbon growth trajectories.

**Stronger transformative policy actions are required to achieve a net zero future.**

Although the current NDC targets, incremental actions, and trajectory of each country are ambitious when considered against the respective country's baseline, none would lead to the realisation of a low-carbon development pathway consistent with 1.5°C climate stabilisation targets and a net zero future by 2050. GHG emissions are still growing, reflecting rapid increases in GDP and per capita income growth, and the associated demand for energy, transport, and natural resources consumption. Furthermore, the lack of substantial decoupling of emissions in the energy and transport sectors, combined with a lack of effective sectoral technology road maps, means that the global emission budget will continue to be used up by the region at an alarming rate. For countries in the region to adopt even more ambitious abatement targets, new approaches – such as embracing the concept of the CCE; supporting the development of new technologies (e.g. hydrogen, CCUS, and electric vehicles); and reducing the costs of existing clean energy and energy efficiency technologies – will be needed. All countries will need to explore more radical approaches to economic development, including more holistic waste management, conservation of forests, stricter codes for new buildings, more aggressive targets for the tourism sector, large-scale low-carbon resilient interventions along supply chains, and the pricing of the environmental externalities of fossil fuel production and consumption.

**Low-carbon green growth planning needs to be mainstreamed into national development plans.**

The country assessments of policies and practices have demonstrated that it is possible to integrate low-carbon green growth objectives into sectoral plans and across sectors – rather than treating low-carbon green growth as an add-on to be solved through stand-alone climate policies and clean energy investment projects. Precisely because both climate change and the COVID-19 pandemic are economy-wide challenges, greening the economic recovery packages towards sustainable development can help to build bridges between different branches of government, and integrate the long-term low-carbon perspective to challenge the status quo. Making low-carbon green growth a government-wide issue to be tackled by national development plans, rather than the preserve of any particular line ministry, was a key lesson before the pandemic, and one that could have lasting consequences in terms of government coordination on climate change, energy, economic, and fiscal policy at the national level. Central to this was the strong priority given to intergovernmental and stakeholder engagement in setting the new targets for NDCs, greening the stimulus packages, and ensuring immediate implementation. This is important in building consensus around hard decisions on carbon pricing and the introduction of other market-based instruments.

**Potential to accelerate the low-carbon transition as part of the pandemic recovery is high.**

In the ASEAN and East Asian countries studied, there is potential for large-scale reductions in GHG emissions. A significant percentage of the emission savings could come at a negative cost, meaning they will contribute to economic recovery and job creation. This includes measures such as increasing co-generation, improving vehicle efficiency, and reducing electricity system losses. However, even win–win investments frequently face hurdles that require a concerted policy response. The economic recovery and stimulus packages being implemented since the onset of the COVID-19 pandemic offer an opportunity. There is a leadership role to be played by central governments and the private sector through strong technological and innovation policies that could help ensure the required investments in low-carbon solutions in the near future. Transitioning to a net zero carbon future at the regional – ASEAN and East Asia – level is a process. Targets and political commitments can change quickly, but successful delivery requires strong institutional mechanisms to analyse policy options and make hard implementation decisions as part of the ACRF. Implementing the relatively low-cost emission abatement options identified as part of the ACRF will send a signal to investors and help to build the capacity needed for more ambitious action towards a net zero future. This emphasises the need to see low-carbon green growth planning as a continuous process that will respond over time to the interaction between domestic policy objectives and the ACRF's five broader strategies.

**Financing new infrastructure investments must be transformative, prioritising a net zero future.**

The overall response of most countries during the economic recovery from the pandemic demonstrates that less priority has been given to low-carbon infrastructure planning. There has not been a very strong willingness to act now. However, where low-carbon resilient planning has been successfully mainstreamed into development policymaking or economic recovery packages, more successful long-term outcomes can be expected. Although there are many low or negative cost opportunities to reduce or avoid GHG emissions, there is still a net cost to adopting a low-carbon pathway, even if this is relatively small in comparison to the economic growth that can be expected over the same period with the introduction of new low-carbon technologies. The scale of funding required necessitates the use of a wide range of financing mechanisms, including incentives where appropriate to direct investment into low-carbon technology development, early-stage start-ups, R&D supporting innovation, and stimulating private sector investment.

International climate finance will also be important but, recognising its limitations in the face of such high demands, prioritisation will be required. To ensure funding for low-carbon projects (economy-wide and sector-specific circular zero emission planning), transformative policy changes such as carbon pricing and market-based mechanisms are proposed as high priorities as they are likely to achieve the greatest return. Finally, as national level scenario modelling is unable to take account of external developments, such as the actions of other countries, and is largely based on existing and known technologies, it is likely to be conservative about the potential for emission reductions, particularly in the future. An international paradigm shift towards a global low-carbon economy could have major implications for the economic assumptions underpinning each country's development plan – e.g. by reducing the cost of key technologies, improving the incentives for energy efficiency, or creating markets for new products and services.

**A new generation planning toolbox for low-carbon green growth is needed.**

Not all countries in the region have good-quality data and scenario modelling capacity to visualise different policy pathways towards a net zero future and the net costs and benefits. To be effective in this context, scenario modelling tools at the regional level need to be open access so that the assumptions can be scrutinised and a degree of customisation made possible. In many cases, appropriate tools do not exist, leading policymakers to make several suboptimal decisions. It seems likely that, in a world where substantial action on low-carbon technology transfer and investments is partially funded through international financial mechanisms linked to the United Nations Framework Convention on Climate Change process, transparency in terms of data acquisition will also be crucial for the monitoring, reporting, and verification of actions undertaken at the country level. Academia, officials, and the corporate sector involved in low-carbon/zero emission planning activities can help to continue this effort by improving the tools that are available; enhancing the capacity of countries to collect, verify, and incorporate useful data; and ensuring that best practice is shared. Finally, there is increasing interest in integrating resilience considerations in future work. Many energy, transport, and agricultural systems are sensitive to external shocks such as financial crises, pandemics, and climate impacts. As many of the low-carbon infrastructure investments are long-term in nature, there are potential synergies in considering development pathways that deliver low-carbon, circular economy, and resilience benefits.

**Shift the emphasis from planning to implementation, including through regional cooperation.**

Geopolitically, interest in low-carbon development and a net zero future has grown substantially since 2016 because of the Paris Agreement, rapid technological progress, and the increasing cost and price volatility of fossil fuels. Many countries now have, or are considering, carbon emission reduction targets at the national level, or are putting together new collective targets for the region at the United Nations Framework Convention on Climate Change and the United Nations Climate Change conference (COP26). However, concepts such as the G20's CCE, Japan's Cool Earth plan, and Korea's Green New Deal are only a means to an end, and are best seen as part of a modular and continuous progressive process of policy development and investment at the country level. There is a risk that international processes could overemphasise the economy-wide planning stage at the expense of near-term investment planning and detailed policy development for sectoral actions and implementation. Such programmes – when designed to be flexible to local needs and in conformity with regional cooperation architecture arrangements such as the ACRF, the ASEAN Economic Community Blueprint, and the Regional Comprehensive Economic Partnership – could lead to a very different and more cost-efficient outcome in terms of international technology transfer, mobilisation of private finance, and capacity building for decision-making. One way of viewing new NDC targets and emerging concepts such as the CCE is to see them as investment plans that outline a country's objectives for the sector in question, the regional cooperation policies needed to implement them, and the individual investments needed to deliver them – broken down into those that will be government-funded, those that require private sector investment, and those where international financing is required. New low-carbon planning, undertaken at the regional level but with multisectoral coordination, would inevitably be central to a net zero future.

# Chapter 4

## Post Covid -19 New Green Deal as Long-term Sustainable and Inclusive Growth Strategy

**Chapter 4**

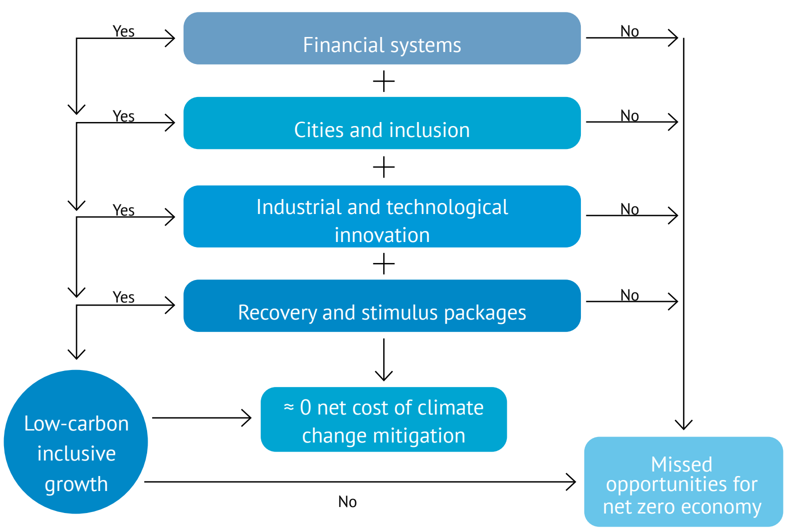
## Post Covid -19 New Green Deal as Long-term Sustainable and Inclusive Growth Strategy



Transformation to a low-carbon economy is system-wide, entailing many policy pathways in various interacting systems. Chapter 3 makes this clear when describing and assessing the experience of cross-country policy implementation progress. The coronavirus disease (COVID-19) crisis opens up many opportunities to build more innovative, sustainable, resilient, and socially inclusive economies. How can this aspiration be realised after COVID-19? We might assume that it can be achieved when the actions of important stakeholders and recovery and stimulus policies are well aligned. However, the system perspective cautions us to develop a deeper appreciation of the complex multiplicity of pathways (sometimes even interacting negatively with one another).

This chapter reviews the key actions taken by governments, industries, cities, and the financial sector during the pandemic, using four layers – financial systems, industrial and technological innovation, cities and inclusion, and recovery and stimulus packages – as an interacting actors framework. First, it considers coordinated action on economic recovery as a once-in-a-generation opportunity to accelerate the transition to low-carbon green and inclusive growth; here, the central importance of addressing inequalities must be taken into account so that actions and outcomes benefit all sectors of society. Next, the chapter focuses on the potential of green industrial restructuring that drives innovation, creates jobs, and expands aggregate demand for low-carbon goods and services. A special focus is on harnessing emerging digital technologies, which is important in underpinning inclusive growth. As a third topic for the chapter, urbanisation – specifically cities – as a transformative force cannot be overemphasised. Neglecting cities risks missing global carbon emission targets and social well-being. Finally, the chapter highlights the importance of financial systems in general and the banking sector in particular in reshaping the low-carbon green growth agenda during and beyond the economic recovery. The four-actor multilayer strategic framework, illustrated in Figure 4.1, highlights how opportunities will be missed in meeting long-term sustainability goals without such actions.

**Figure 4.1 A Four-Layer Interacting Actors Framework for a Systemic Strategy of Low-Carbon Green and Inclusive Growth**




Source: ERIA Study Team.

The chapter elaborates on this framework and provides examples of policy actions taken during the pandemic, identifies obstacles to overcome (including potential negatively interacting linkages amongst four-layered actors and actions), and discusses the implications for designing and implementing a comprehensive economic recovery framework. In the Association of Southeast Asian Nations (ASEAN) context, it is hoped that the findings of this chapter will contribute directly to the updating and refinement of the ASEAN Comprehensive Recovery Framework (ACRF) implementation plan and its enabling factors.

## 1. Pandemic Recovery, Stimulus Packages, and Policy Architecture Types

The COVID-19 pandemic has led to suffering and economic crisis of historic proportions. Concerns have also been raised about how the economic fallout might affect the Paris Agreement and the Sustainable Development Goals (SDGs). Many strategies towards sustainable and inclusive growth involve externalities – situations where important stakeholders do not have to face the consequences of their actions. A critical concern is the degree of alignment and coordination of short- and medium-term responses during the pandemic with longer-term sustainable development policies beyond the pandemic.

Designing cost-effective coordinated actions by important players such as national governments, industries, cities, and financial systems is not easy. Policymakers must identify market and policy failures and overcome opposition from groups with vested interests in the status quo. When policymakers take this challenge seriously, there can be significant benefits not only in the form of improved environmental outcomes but also in greater social inclusivity and fairness, higher economic growth, and better energy security. Just as climate change mitigation can generate co-benefits from reduced local pollution, there can be co-benefits for economic growth and well-being from tackling a broad range of environmental problems with appropriate tools and incentives. The key message is that a comprehensive set of actions and supporting policy instruments needs to be pursued if development prospects are to be enhanced and Asia's ambitious emission reduction and renewable energy targets are to be achieved. If countries grasp this opportunity, growth can be stronger, more sustainable, and more equitable.

### 1.1 Navigating the Pandemic and a Multiphased Recovery

World gross domestic product (GDP) contracted by 3.3% in 2020 due to a sharp decline in demand as well as supply disruptions, although it is projected to recover to 6.0% in 2021 (IMF, 2021). The economic outlook for countries depends on infection rates, containment measures, the scale and effectiveness of economic recovery measures, and reliance on the implementation of measures to stimulate consumer demand. The pandemic has also had a significant impact on employment – the unemployment rate rose from 6.4% in March 2020 to 7.2% in November 2020 (ILO, 2021).

The pandemic is at various stages in ASEAN and East Asian countries. Many countries have successfully contained the first wave of the virus, while some (Australia, India, Indonesia, Japan, Malaysia, and Myanmar) are struggling with the increasing waves of infections and new variants, and others are combating periodic local outbreaks (China, the Republic of Korea (henceforth, Korea), New Zealand, Thailand, and Viet Nam). A small group of countries is still striving to flatten the pandemic curve (Cambodia, the Philippines, the Lao People's Democratic Republic (Lao PDR), and Singapore). Since October 2020, countries across the region have gradually exited from economy-wide containment measures in varying phases (Table 4.1), but major restrictions on inter-country, intra-regional, and international travel restrictions remain in place, with some sectors (tourism, restaurants, and manufacturing) hit harder than others. Disruptions to regional supply chains have impacted international trade in intermediate goods and services, and created long-term implications for export-led growth.

During the increase in infections or the

**Table 4.1 COVID-19 Impacts and the Phased Approach to Economic Recovery**

| Phase | Phase 1: Emergency rescue | Phase 2: Economic recovery | Phase 3: New normal form |
|---|---|---|---|
| Status of epidemic and containment measures | - Spread of infection<br>- Complete lockdowns | - Decrease or lull in economic activity<br>- Travel restrictions and vaccinations | - Containment or low level of infections<br>- Herd immunity |
| Purpose of policy | - Emergency | - Recovery | - Sustainable and inclusive growth |
| Economic measures | - Deferment of tax payments<br>- Cash transfers<br>- Unemployment payments<br>- Bailout finance | - Economic stimulus for demand and job creation | - R&D support<br>- Public infrastructure investment in support of low-carbon growth |
| Option of green recovery | - Limited – finance with environmental conditions is good practice | - Recommended – a balance between economic recovery and green growth is needed, using green investment and avoiding lock-in effects | - Recommended – SDGs are a useful instrument for prioritising policy decisions |

COVID-19 = coronavirus disease, R&D = research and development, SDG = Sustainable Development Goal.

Source: ERIA Study Team.

emergency phase, the government priority was to control the spread of the disease, using containment measures such as lockdowns or restrictions on movement to reduce human contact. Economic activities were temporarily curtailed, and some industries and households were greatly affected in terms of income. The core of the policy response was the provision of bridge funding until economic activity recovers. However, the COVID-19 pandemic has hit both aggregate supply – especially labour supply – and demand, especially savings amongst consumers who have secure employment and less opportunities for spending. Sectors have been affected very differently. Overall, some degree of Keynesian recession is likely, but certain sectors could quickly constitute supply constraints in the recovery, while consumers with temporarily high savings could start spending when supply chains recover and more travel is allowed following vaccinations.

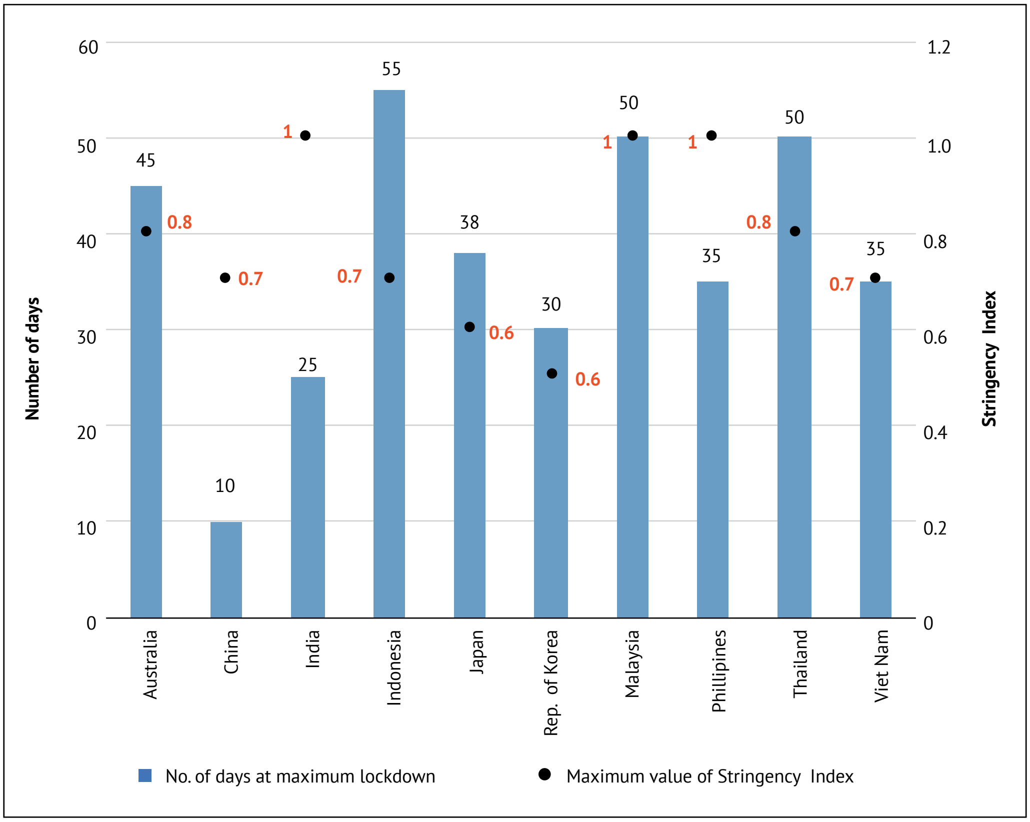
In the recovery phase, the spread of the virus has been controlled to some extent. During this phase, the revival of lost income through job creation and stimulating demand are important policy objectives of governments. Policy outcomes are expected to be realised quickly. However, during this phase, the risk of the spread of infection has not been eliminated, and a balance between infection control and economic stimulus measures is considered important. During the emergency and recovery phases, the government priorities are dealing with basic income, education, and healthcare. Nevertheless, continuing climate change actions, resilience, and a reduction in income disparities are necessary for long-term sustainable and inclusive growth. Once the risk of the spread of infection is reduced and the economic recovery is on track, it will be necessary to shift the emphasis of policies to sustainable growth as the long-term policy goal. This phase could be termed a new normal.

### 1.2 Exiting the Emergency Phase and Early Economic Recovery

Asian authorities generally responded earlier to the epidemic than other regions in the Americas, Europe, and Africa, mainly because of their learned experience. On average, ASEAN and East Asian countries tightened domestic lockdowns after a significant outbreak, defined as 100 cumulative cases, although some countries were slower to act, waiting 10–25 days. The sequencing of closures was also similar across countries, with international travel restrictions imposed first, followed by school, office, and industry closures. The stringency and duration of the emergency phase differed markedly across the countries, as illustrated in Figure 4.2.

The lockdown stringency Index measures the level of the emergency, based on an average of five subsector indexes – retail, services, industry, travel, and public gatherings – normalised to lie between 0 and 1, with 1 indicating that the sector is fully closed and zero signifying that it is fully open (IMF, 2020). Several countries imposed near complete lockdowns for more than a month (India, Indonesia, the Philippines, and New Zealand), while others allowed industrial sectors to continue operating (Australia, Brunei, Thailand, and Viet Nam). However, some countries (e.g. Japan, Korea, Cambodia, and the Lao PDR) have not implemented mandatory shutdowns during the emergency phase, relying on voluntary social distancing and setting up new tracing infrastructure to contain the virus. Limited healthcare capacity, including testing and tracing capabilities, as well as large populations have affected the length of the emergency phase in countries such as India, Indonesia, and the Philippines; and thus their economic impacts (WHO, 2020).

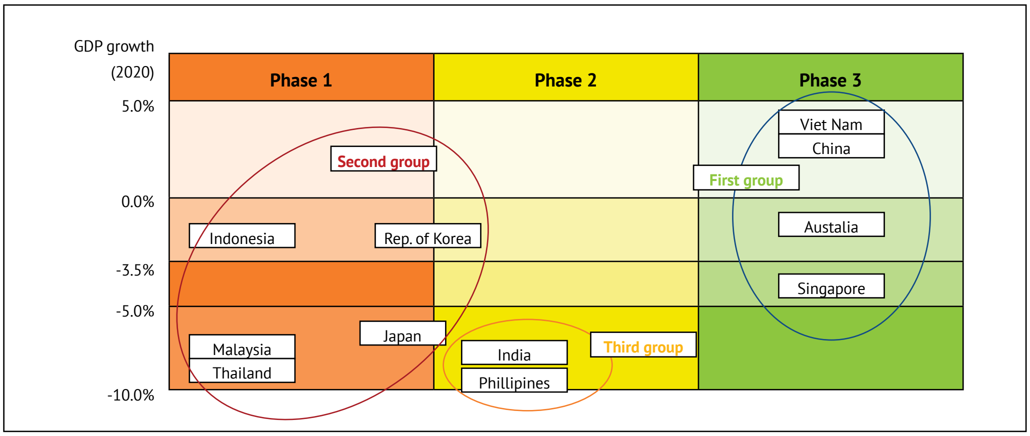
**Figure 4.2 Stringency Index of the First Lockdown During the Emergency Phase**




Source: ERIA Study Team.

Figure 4.3 maps the economic impacts in the context of three phases, measured in terms of GDP contraction. In emergency phase 1, the objective is to help individuals, households, and firms to weather the crisis. The aim of the second phase stimulus measures is to drive the economy by supporting domestic demand. The weight of emergency measures is low at this point in China, Viet Nam, and Singapore; and these countries are expected to shift to economic recovery phase 2 and then new normal measures in phase 3. In China and Viet Nam, the weight of phase 2 measures is low because their economies have recovered well, so jumping from phase 1 to phase 3 measures may be a realistic policy. The economic impact of the pandemic was very severe in the second and third quarters of 2020. Apart from Viet Nam and China, all countries in the region experienced economic contractions based on year-to-year comparisons. Four countries were particularly hard hit – Malaysia (–17.1%), the Philippines (–16.5%), Singapore (–13.2), and Thailand (–12.2%). Singapore has been controlling the infections well – its globally integrated economy is still experiencing depression but it has started implementing low-carbon green recovery measures in phase 2.

**Figure 4.3 Mapping the Economic Recovery and the Phases of the Epidemic**




GDP = gross domestic product.

Note: This is a snapshot of the country groupings as of 1 June 2021. However, many health uncertainties persist and phase 3 does not imply exit from the coronavirus disease (COVID-19).

Source: ERIA Study Team.

The second and third group countries need an appropriate combination of phase 1 and 2 measures now. For the second group, the weight of phase 3 measures, which focus on sustainable growth, may be currently low, but it is desirable to start preparations early.

## 1.3 From Economic Recovery to Inclusive Green Recovery

When countries in the region gradually reopened after curbing the spread of the virus during phase 2, they undertook several measures to revive their economies. For example, China, which was the first country to contain COVID-19, is implementing economic recovery measures such as a transfer of CNY60 billion to local governments to support new infrastructure and the circular economy. The disease continues to spread in the United States, Europe, Japan, Korea, India, and ASEAN Member States (AMS) such as Indonesia and Thailand, with a disproportional impact on the poor and most vulnerable people, and it is poised to exacerbate already rising income and wealth inequality. In addition to the challenge of achieving an inclusive economic recovery, each country is facing various long-term climate and other environmental sustainability issues. Hence, policy measures that could bring co-benefits and low-carbon growth are being proposed.

The International Energy Agency (IEA) has proposed the Sustainable Recovery Plan, an indicative economic countermeasure that focuses on energy-related emission reduction actions (IEA, 2020). According to this plan, as outlined in Table 4.2, if the world invests US$1 trillion (equivalent to 0.7% of global GDP) in climate change-related investments over the next 3 years (2021–2023), GDP growth could be boosted by 1.1% annually.

The International Renewable Energy Agency (IRENA) has stated that the energy transition will contribute to economic recovery and job creation, and estimates that investing an additional US$2 trillion annually in a renewable energy-led transition over the 3 years starting in 2021 will increase GDP growth by 1% (IRENA,

**Table 4.2 IEA Analysis of Countermeasures in the Energy Sector**

| Sector | Recommended options and benefits |
|---|---|
| Electricity | - Improving electricity grids with the integration of wind, and solar installations; re-powering existing distribution systems; maintaining hydro and nuclear power; and managing gas- and coal-fired generation<br>- 1–14 jobs created per US$1 million invested |
| Transport | - Improving the efficiency of the vehicle fleet, electric cars, high-speed rail and urban transport, cycling infrastructure, electric vehicle recharging, and mass transport |
| Buildings | - Enhancing the energy efficiency of buildings and appliances with short payback periods<br>- 10–15 jobs created per US$1 million invested<br>- Increasing access to clean cooking; lowering liquefied petroleum gas prices |
| Industry | - Supporting SMEs for energy efficiency improvement, enhancing the energy efficiency of motors and agricultural pumps, and adopting resource recycling and circular economy practices<br>- 10 and 18 jobs creation per US$1 million invested |
| Fuels | - Reducing methane emissions (cost-effective reduction of greenhouse gas emissions); supporting the biofuel sector (hit hard by COVID-19)<br>- Sustainable biofuels create around 15–30 jobs per US$1 million invested |

COVID-19 = coronavirus disease, IEA = International Energy Agency, SMEs = small and medium-sized enterprises.

Source: IEA (2020).

2020a). However, these plans require more attention from governments in terms of implementation. In April 2020, the European Union (EU) Green Recovery Alliance was launched in response to the recommendation that the European Green Deal should contribute to the post-COVID-19 economic recovery. Some member countries have put green or low-carbon investments at the centre of their economic recovery, e.g. Germany directed €40 billion of its €130 billion economic stimulus package at climate change mitigation.

Several temperate Southeast Asian countries are agrarian and have abundant natural resources such as forests. These countries recognise that addressing the pandemic crisis requires coordinated actions across sectors to enhance human security and sustainability. Thus, the AMS formulated the ACRF in November 2020 to serve as the consolidated exit strategy for the region from the COVID-19 crisis. The ACRF articulates the ASEAN response, through the different stages of recovery, by focusing on the key sectors and segments of society that are most affected by the pandemic, setting five broad strategies and identifying measures for recovery in line with sectoral and regional priorities. Figure 4.4 presents the details of the strategic actions and enabling factors. It is important for AMS to be pragmatic in their approach to a comprehensive recovery. Reinventing the wheel and duplication of efforts or mechanisms need to be avoided, and all efforts must be results-oriented. The progress on the five strategies of the ACRF will determine the shape of the recovery and the future of the region. The importance of synergies amongst the five strategies during the recovery phases is also important, as they overlap and interweave, but essentially involve the priorities of resilient, inclusive, and sustainable growth. The ACRF has also identified a number of cross-cutting enabling factors such as policy measures and responses, resource mobilisation, institutions and governance mechanisms, stakeholder engagement and partnership, and effective monitoring.

**Figure 4.4 ASEAN Comprehensive Recovery Framework**

**ASEAN Comprehensive Recovery Framework**

**Strategy 1: Enhancing Health Systems**

- Building and sustaining current health gains and measures
- Maintaining and strengthening essential healtn services
- Strengthening vaccine security and self-reliance including its equitable access affordability, safety and quality
- Enhancing capacity of human resources for health
- Strengthening prevention and preparedness, detection, and response and resilience
- Enhancing capacity of public health services to enable health emergency response including ensuring food safety and nutrition im emergencies

**Strategy 2; Strengthening Human Security**

- Further strengthening and broadening of social protection and social welfare, especially for vulnerable groups
- Ensuring food security, food safety, and nutrition
- Promoting human capital development
- Ensurine responsive labour policies for the new normal through social dialogue
- Mainstreaming gender equality throughout the recovery scheme and actions of ASEAN
- Mainstreaming human rights in the process of post-pandemic recovery toward resilient region

**Strategy 3: Maximising the Potential of Intra-ASEAN Market and Broader Economic Integration**

- Keeping markets open for trade and investment
- Strengthening supply chain connectivity and resilience
- Enabline trade facilitation in the new normal
- Elimination of Non-Tariff Barriers (NTBs) and cutting down market-distortine policies
- Setting up travel bubble/ corridor framework Strengthening transport facilitation/connectivity
- Accelerating sectoral recovery (tourism, MSMEs), and safeguarding employment in most afterted sertors
- Streamlining and expeditine investment process and facilitation and joint promation initiatives
- Enhancing Public and Private Partnership (PPP) for regional connectivity
- Signing and early entry into force of ROFP

**Strategy 4: Accelerating Inclusive Digital Transformation**

- Preparing for the Fourth Industrial Revolution
- Promoting e-Commerce and the digital economy
- Promoting e government and e-services
- Promoting financial inclusion including through digital financial services and regional payment connectivity
- Providing digital platform and related policy for promoting MSME digital upskilling and providing digital technology and fintech to arcess markets
- Enhancing connectivity
- Promotine IT in education
- Improving digital legal framework and institutional capacity
- Strengthening data governance and cybersecurity
- Strengthenine consumer protection
- Promoting the adoption of digital technologies in ASEAN businesses

**Strategy 5: Advancing towards a More Sustainable and Resilient Future**

- Promoting sustainable development in all dimensions
- Facilitating transition to sustainable energy
- Building Green infrastructure and addressing basic infrastructure gaps
- Promoting sustainable and responsible investment
- Promoting high-value industries, sustainability, and productivity in agriculture
- Managing disaster risks and strengthening disaster management
- Promoting sustainable financing

**Enabling Factors:** (1) Policy Measures and Responses; (2) Financing and Resource Mobilisation; (3) Institutions and Governance Mechanisms; (4) Stakeholder Engagement and Partnerships; and (5) Effective Monitoring

ASEAN = Association of Southeast Asian Nations; ICT = information and communication technology; MSMEs = micro, small, and medium-sized enterprises; NTB = non-tariff barrier; PPP = public–private partnership; RCEP = Regional Comprehensive Economic Partnership.

Source: ASEAN (2020).

## 1.4 Evolution of Stimulus Measures and Green Shoots

The pandemic has led many countries to initiate economic recovery packages that are unprecedented in content and scale. Table 4.3 lists the policy measures taken under three phases to revive economic activities, showing significant heterogeneity across countries. The policy actions announced during the emergency and recovery phases were modest in magnitude and quality in terms of implementing a green and climate-smart recovery. Vivid Economics (2021) analysed the green measures of various countries and categorised their investment as follows: (i) positive expenditures towards green growth – investment in renewable energy and energy conservation, research and development (R&D) investment in carbon capture and storage (CCS) and hydrogen, bailout finance for industries with conditions for emission reduction, low-carbon railways, material recycling, etc.; (ii) negative spending – fossil fuel development, thermal power generation, support for industries that do not impose environmental standards; and (iii) neutral – other activities. Compared with Southeast Asian countries, the EU, France, the United Kingdom (UK), and Korea have a higher percentage of positive green contributions, while China, the United States, India, and Russia have a higher percentage of negative contributions. Korea has a high percentage of positive contributions, but also a high percentage of negative contributions, resulting in a negative overall evaluation.

**Table 4.3 Policy Measures Taken During COVID-19 Crisis**

| Country epidemic and its impacts | Phase 1: Emergency/rescue | Phase 2: Recovery | Phase 3: Sustainable growth/ recommendation |
|---|---|---|---|
| **Indonesia**<br>- Number of infections increased since April 2020 but was lower during 2020. It increased in 2021. New infections reached more than 50,000 in July 2021.<br>- GDP: −2.1% (2020), modest drop | - First stimulus (February): cash payments for social assistance, food, etc.<br>- Three principles: health/life, purchasing power, and bankruptcy | - Measures are a mixture of emergency support and fast recovery<br>Second stimulus (March 2020): exports and imports, and financial sector support | - No special package. Third stimulus (March 2021) includes some green components, such as microgrid construction.<br>- 'Net zero by 2060' announced in August 2021 |
| **Malaysia**<br>- First peak was in early April 2020. Number of infections are still increasing. New infections reached more than 40,000 people per day in August 2021.<br>- GDP: Biggest drop was −7.7% in Q2 2020 but started recovery with a decline of 2.7% in Q3 2020.<br>- GDP: 5.6% (2020) | - First stimulus (February 2020): tax relief and loan deferment for people. Guarantee and loan moratorium for business.<br>- SME Aid programme (April) | - Second stimulus (March 2020): greater support for people and business than during the first stimulus, with more focus on economic recovery<br>- Short-term recovery plan: improving people's skills, tax relief, digitalisation support and financing for SMEs, and promoting a 'Buy Malaysian' campaign | - No major special packages aligned with sustainable growth strategy, such as Green Technology Master Plan, National Renewable Energy Policy, Shared Prosperity Vision 2030 – poses challenges in attracting both domestic and foreign green investments. |
| **Thailand**<br>- First peak ended in March 2020, but increased in April 2021 and peaked in August 2021.<br>- GDP: −6.1% (2020) | - Phase 1 stimulus (March 2020): tax relief, cash payments, SME support | - Phase 2 stimulus (March 2020): filing of tax returns in addition to the first phase packages<br>- Phase 3 stimulus (April 2020): SMEs through banks, households, liquidity for financial sector | - No special packages<br>- Agriculture (e.g. bio circular economy); energy (e.g. electric vehicles); environment (e.g. green tourism); digital transformation |
| **Viet Nam**<br>- First wave was in April 2020 and second wave was in August 2020, but the number of infections was very low compared with other countries during 2020.<br>- GDP: Q2 2020 was lower but still positive in 2020 (2.9%). Economic impact is mostly through trade. | - Labour support, e.g. through cash payments<br>- Support to business through bank credits, tax payment extensions, and loan payment deferrals | - No special programme but various measures, including the removal of barriers for production and business, were taken (e.g. access to finance, fiscal and credits policies) | - No special packages but aligned with the National Energy Development Strategy or policies |

| Country epidemic and its impacts | Phase 1: Emergency/rescue | Phase 2: Recovery | Phase 3: Sustainable growth/ recommendation |
|---|---|---|---|
| **Japan**<br>- First wave was in April 2020 but new infections increased in July 2020 and peaked in August 2020. It increased ageing December 2020 and waves are repeating, with a fifth wave in August 2021.<br>- GDP: −9.9% April–June 2020; and started recovery; −4.8% (2020)<br>- Unemployment: uneven impact on non-regular workers | - Supplemental budget (April and June 2020): employment support, working capital support, rent support, and medical care support | - Basic policy for 2021 budget preparation (July 2020): some climate measures (e.g. hydrogen, quality infrastructure) included but not high priority<br>- Ad hoc measures: Go to Travel campaign (suspended in December 2020 due to the increase in new infections) | - No special measures<br>- (Recommendation)<br>- Innovation, fiscal system reform and market mechanism, local economy and local finance, global/regional approach |
| **China**<br>- First wave ended in February 2020 and second wave was not observed<br>- GDP: dropped in January–March 2020 but was already above the 2019 level in July–September 2020. Positive | - Social security reduction, refund of insurance payment | - Six guarantees, including employment, livelihood, food and energy, and industrial supply chain<br>- Tax reduction, cash handouts, infrastructure construction<br>- Local economy support by local governments (fund transfers to local governments) | - 'Net zero emissions by 2060' announced in September 2021 (details not released). Concrete measures will be part of the next five-year plan.<br>- Optimisation of energy structure, transportation, technology innovation, support measures: e.g. green finance, carbon market. |
| **Republic of Korea**<br>- First wave was in March 2020. Number of new infections in 2020 was low, but increased and reached more than 20,000 people per day in August 2021. Waves are repeating in 2021.<br>- GDP: −1.0% (2020) | - Emergency relief grant: cash payments to all, medical leave subsidies, subsidies to vulnerable people and business, unemployment assistant fund | - Part of Green New Deal: no specific short-term recovery package | - Aiming for smart, green, and safe country.<br>- Digital New Deal (e.g. 5G, digital learning, remote healthcare)<br>- Green New Deal (e.g. green infrastructure, low-carbon energy)<br>- Stronger safety net (e.g. digital skills training)<br>- Net zero by 2050 announced in October 2050 |

| Country epidemic and its impacts | Phase 1: Emergency/rescue | Phase 2: Recovery | Phase 3: Sustainable growth/ recommendation |
|---|---|---|---|
| **Australia**<br>- First wave was in March 2020 and second wave was in August 2020. Cases were low in 2020 but reached 1,400 people in August 2021.<br>- GDP: –7% in June 2020; –2.4% in 2020<br>- Unemployment: 1.3 million jobs lost in April but recovered | - Financial assistance for retaining workers and amendment of credit regulations for avoiding bankruptcy | - No special package, but included in 2021 budget under items such as infrastructure investment | - No special package but aligned with Technology Investment Roadmap Discussion Paper: hydrogen, energy storage, CCS, etc.<br>- (Recommendation)<br>- Clean recovery (renewable industry): investment in wind and solar |
| **India**<br>- First wave ended in September 2020, but number of infections increased in 2021 and reached 40,000 people per day in August 2021.<br>- GDP: –8.0% (2020)<br>- Emissions: first drop in 4 decades | - Food security system<br>- Economic relief measures (cash and food)<br>- RBI's finance to banks<br>- Economic package (US$280 billion) | - Self-reliant India: economy, infrastructure, system, vibrant demography, and demand | - No special package<br>- (Recommendation)<br>- Potential: Power sector, transportation, industry |
| **EU**<br>- Peak of first wave was between March and April 2020 and second wave started in September 2020. Number of infections varies from country to country. Wave of infections repeated in 2021, but new infections decreased in many member countries after Q2 2021.<br>- GDP: –6.6% (2020) (Euro area) | - By member states | - Green Deal under Multiannual Financial Framework and Next Generation EU: 30% of expenditure is allocated to climate change<br>- By member states: France focused on manufacturer support and stimulus for buying products such as cars. | - Green Deal by EU: EU released 'Fit For 55' in July 2021, which includes a comprehensive climate policy.<br>- By member states: Germany announced a futuristic investment package in addition to stimulus and crisis management packages and expressed a strong international responibility to lead green technological innovation |

CCS = carbon capture and storage, COVID-19 = coronavirus disease, EU = European Union, GDP = gross domestic product, Q = quarter, RBI = Reserve Bank of India, SMEs = small and medium-sized enterprises.

Source: ERIA Study Team.

## 1.5 Multi-Speed Recovery and Uncertainties in Co-Benefit Policies

The five broad strategies of the ACRF provide an opportunity to deliver on the promise of inclusive and low-carbon green growth in Southeast Asia. However, undertaking specific policy reforms – in healthcare, social safety nets, economic markets, technological innovations, and the corporate sector – would be beneficial during the recovery phase, while facilitating a speedier return to pre-pandemic economic output and sustaining growth. These are the key elements that policymakers need to get right, in line with the ACRF and three phases of economic recovery, as illustrated in Table 4.4.

**Table 4.4 A Phased Approach to Implementing the ACRF Strategies**

| ACRF | Phased approach |
|---|---|
| Broad strategy 1: Enhancing health systems | Emergency phase 1 |
| Broad strategy 2: Strengthening human security | Emergency phase 1 |
| Broad strategy 3: Maximising the potential of the intra-ASEAN market and broader economic integration | Recovery phase 2 and new normal phase 3 |
| Broad strategy 4: Accelerating inclusive digital transformation | Recovery phase 2 and new normal phase 3 |
| Broad strategy 5: Advancing towards a more sustainable and resilient future | Recovery phase 3 and new normal phase 3 |

ACRF = ASEAN Comprehensive Recovery Framework.

Source: ERIA Study Team.

In emergency phase 1, when the focus is on tackling the health emergency, the ratio of green investment to total public spending was low since the government put higher priority on livelihood support and avoiding corporate bankruptcy. In countries which are less or moderately affected by COVID-19, there is little need for phase 2 measures, and jumping from phase 1 to phase 3 may be a realistic option. For these countries, in phase 3, it is important to steadily implement the policies for low-carbon or sustainable growth decided before the COVID-19 crisis. For example, collaboration with the National Energy Development Strategy in Viet Nam and the Green Technology Master Plan and National Renewable Energy Plan in Malaysia is expected to be implemented as part of the green recovery. An interesting form of green spending in the emergency phase is bailout finance with environmental conditions. While some countries have implemented cash transfers for the entire population, the emphasis is gradually shifting to supporting more vulnerable people and small businesses. India and Indonesia have been providing more direct assistance in the form of food or food coupons.

During recovery phase 2, policies to create or stimulate demand are being implemented. In China, public expenditure such as the development of railway infrastructure by local governments is creating demand in industries such as steel and cement. Japan's Go to Travel campaign provided subsidies to stimulate demand during the emergency phase. In Malaysia, the Buy Malaysian Products campaign is aimed at stimulating domestic supply. However, from a medium-term perspective, stimulus measures for industries with structural problems will have a small effect on demand creation and a negative effect in the long run. Considering the balance with the promotion of structural adjustment, employment support is an important measure. In Malaysia, technical training support is being provided.

Remote working in business is widely recommended as a countermeasure against infection. Since digitalisation is an effective long-term growth strategy, it is thought to have both emergency phase and new normal sustainable phase effects. In Japan, in addition to the development of digital infrastructure, the digitalisation of education (e.g. the provision of computers for education) is being undertaken. In Korea, the promotion of 5G, digital learning, remote healthcare, small and medium-sized enterprise (SME) support, and transportation digital logistics is being implemented. In Malaysia, support is being provided to SMEs that are lagging in digitalisation. In general, digitalisation promotion measures are being made in accordance with the current situation in each country.

The development of low-carbon energy technology and infrastructure is considered a sustainable development policy for new normal long-term growth. However, it is limited and only the EU and Japan have explicitly proposed measures for the post-COVID-19 era. It is expected that AMS and other countries, which will eventually enter the new normal phase, should consider aligning new investment policies with existing long-term policies. Several studies have analysed the positive impacts of energy-related measures, including job creation effects (IEA, 2020), at the global level. In ASEAN, some investments lead to increased imports and job creation, but the impact is limited depending on their supply chain and industry structure. Green recovery measures may vary from country to country, but retrofit efficiency investments tend to bring more jobs and economic benefits to the local economy. Low-technology sectors, such as forestry and land reclamation, may provide more jobs than the energy sector, but more capital- and carbon-intensive sectors also need to transform. As the pandemic crisis is not a typical Keynesian demand-led recession or one caused by the seizing up of financial intermediaries, additional job creation could be considered co-benefits. Since infrastructure investment, such as smart grid construction or a zero-emission energy supply chain, is unlikely to generate service sector development in the immediate short term, even though demand for construction workers has increased, it may be suitable for new normal sustainable development phase 3 measures.

### 1.6 Stimulus Measures, Fiscal Space, and Macroeconomic Policy Framework

The government's accommodative response to the pandemic during the emergency and economic recovery phases has channelled new funds into the national economy. The new funds have helped the industries compensate to some extent the slowdown in private and external demand. However, this policy has reduced the fiscal space of several advanced and emerging economies countries in the region, reversing the trend that had been observed at least until the outbreak of COVID-19. The expenditure – non budget outlays and equity loans – rose by an average of 10.5% of GDP in 2020 (Table 4.5).

**Table 4.5 Fiscal Expenditure and Public Debt**

| Country | Additional spending and forgone revenue | Equity, loans, and guarantees | General government gross debt (2020) |
|---|---|---|---|
| Australia | 16.1 | 1.8 | 63.1 |
| Brunei Darussalam | 1.2 | - | 2.57 |
| Cambodia | 4.1 | 2.3 | 31.6 |
| China | 4.8 | 1.3 | 66.8 |
| India | 3.3 | 5.1 | 89.6 |
| Indonesia | 4.5 | 0.9 | 36.6 |
| Japan | 15.9 | 28.3 | 256.2 |
| Korea, Rep. of | 4.5 | 10.2 | 48.7 |
| Lao PDR | 0.0 | 0.0 | 68.0 |
| Malaysia | 4.5 | 3.5 | 67.5 |
| Myanmar | 1.1 | 0.9 | 39.3 |
| New Zealand | 19.3 | 2.8 | 41.3 |
| Philippines | 2.7 | 0.9 | 47.1 |
| Singapore | 16.0 | 4.7 | 128.4 |
| Thailand | 8.2 | 4.2 | 49.6 |
| Viet Nam | 1.4 | 0.5 | 46.6 |

Notes: Estimates as of 17 March 2021. Numbers in United States (US) dollars and percentage of gross domestic product (GDP) are based on IMF (2021) unless otherwise stated. Country group averages are weighted by GDP in US dollars, adjusted by purchasing power parity. General government gross debt is defined as the ratio of public debt to GDP.

Source: Compiled by the ERIA Study Team, based on IMF (2021), Database of Fiscal Policy Responses to COVID-19. https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19.

On the other hand, revenue shortfalls in corporate and individual income tax, the suspension of social security payments, and a reduction in value-added tax (VAT) and custom duties have narrowed the fiscal space. The level of interest payments was also reduced, given the low interest rates in both domestic and international markets (ADB, 2020a). The pandemic, in some countries, will halt the fall in the equilibrium interest rate, as huge government spending and borrowing will reduce the surplus in savings and lead to a rise in the interest rate.

Some governments could finance high deficits by using cash reserves accumulated in previous years, borrowing from domestic financial markets, or approaching international financial institutions and development partners. Ample liquidity in domestic markets has allowed governments to issue bonds and borrow at attractive rates.

## 2. Green Industries, Technology, and Innovation

Industrialisation and its positive drivers during the pandemic recovery and new normal phase could lead to the economic transformation that is required to address climate change and other environmental issues. Industries have the opportunity to deploy existing low-carbon technologies, new green service models, and digital solutions to scale up and accelerate the transformation into low-carbon green growth.

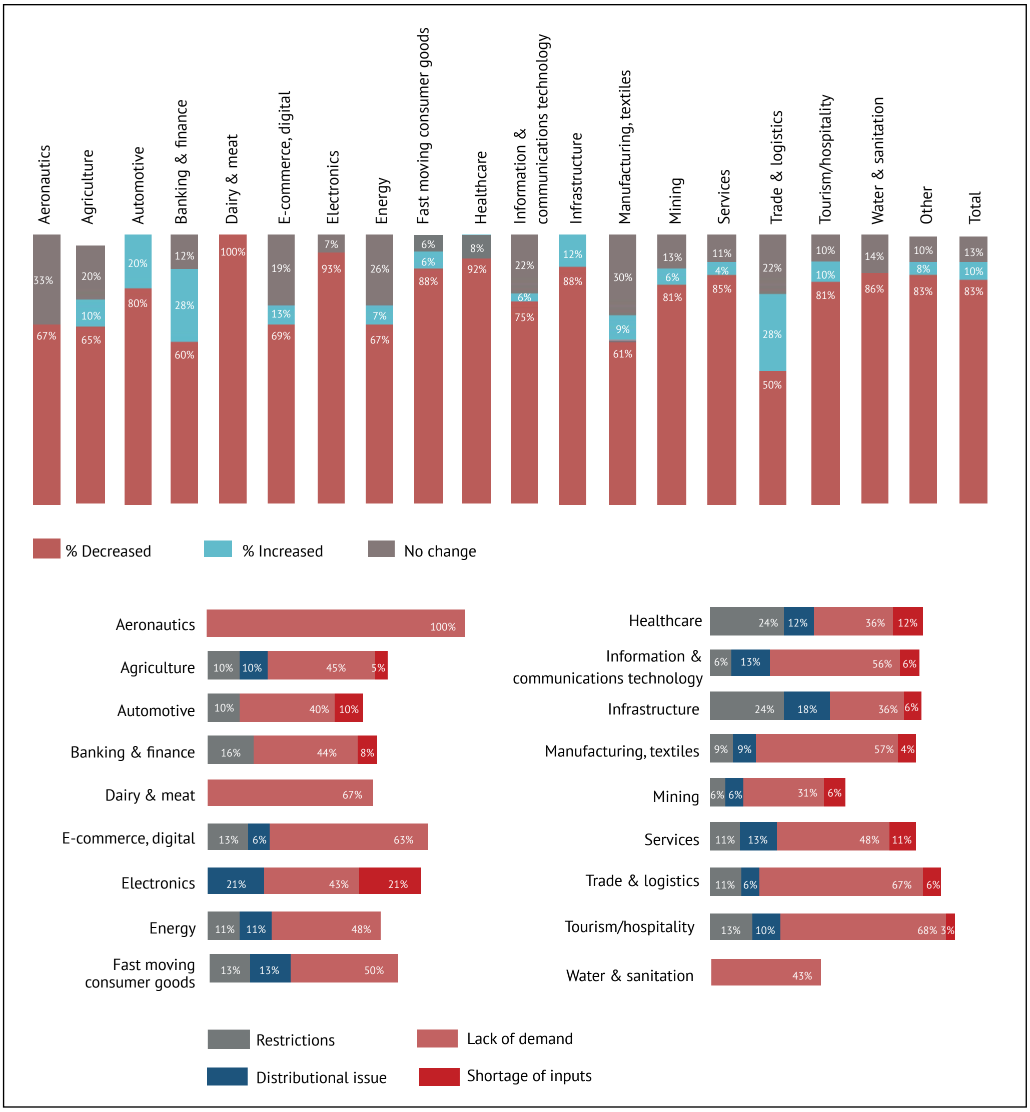
### 2.1 Economic Impacts of COVID-19 on Industry

The COVID-19 pandemic and associated lockdown measures instantly affected industry operations, with significant variation across sectors. Almost all firms in Asia experienced a negative impact due to the pandemic, with impacts on output, revenue, and/or sales. Figure 4.5 shows the distributional impact of the pandemic and the type of supply- and demand-side contractions that occurred in Southeast Asia.

The pandemic's impact during April–November 2020 was significantly more pronounced in manufacturing and mining compared with the services sector. While the banking and trade and logistics sectors were the least negatively impacted during that period, several firms in the healthcare and electronics sector are also experiencing some positive impacts (AMCHAM and ERIA, 2020). A detailed survey conducted by the Asian Development Bank (ADB, 2021) confirmed this trend. Nearly half of the manufacturing and agriculture firms that continued to operate during the lockdown also witnessed a drop in domestic demand, with supply disruptions and contract cancellations. However, SMEs in electronics and food services reported a better business environment after the outbreak due to higher demand for goods and services during lockdowns. SMEs along global value chains reported a sharp drop in both domestic and foreign demand, delayed product/service delivery, supply chain disruptions, and contract cancellations. Microenterprises were less severely affected, as they only serve domestic markets. This reflects the downside risks associated with the region's increased integration via supply chains and the imperative for making them more resilient to future shocks.

While relatively few manufacturing industries laid off workers, many reduced working hours and wages. Unemployment rose in several economies that have dominant manufacturing industries, such as Indonesia, Thailand, and Viet Nam, which are linked to East Asian economies: China, Japan, and Korea. Table 4.6 shows the manufacturing and trade linkages of Indonesia, Malaysia, the Philippines, and Thailand with Japan. When disaster strikes and impacts spread throughout supply chains, the shock is felt not only in the affected region, but also by those outside it and sometimes far away from it.

**Figure 4.5 Nature and Distributional Impacts of COVID-19 on Productivity Across Sectors**




COVID-19 = coronavirus disease.

Source: AMCHAM and ERIA (2020).

The biggest impact of job losses has occurred in tourism-related sectors such as hotels, travel, retail, and real estate. The countries most affected by the reduction in tourist flows are Indonesia, Malaysia, Singapore, Thailand, and Viet Nam (ILO, 2021). As a result, average wages fell by 10%–12% during the emergency and recovery period in those countries (IMF, 2021). The immediate impact of lockdowns had a marginally negative effect on household income during the emergency phase, and firms recovered quickly during the second phase mainly due to expansionary and supportive government policies.

**Table 4.6 Manufacturing Industry and Trade Trends of Major Southeast Asian Economies with Japan, 2016**

| Country/Industry | | Exports | | Imports | |
|---|---|---|---|---|---|
| | | Rank | Proportion (%) | Rank | Proportion (%) |
| **Indonesia** | Machinery | 2 | 12.1 | 2 | 18.6 |
| | Electronics | 3 | 11.2 | 3 | 11.4 |
| | Automobile | 3 | 14.6 | 1 | 40.1 |
| **Malaysia** | Machinery | 6 | 5.1 | 3 | 11.4 |
| | Electronics | 5 | 7.5 | 3 | 13.4 |
| | Automobile | 7 | 5.6 | 1 | 41.7 |
| **Philippines** | Machinery | 2 | 18.1 | 1 | 30.0 |
| | Electronics | 3 | 12.3 | 2 | 11.7 |
| | Automobile | 3 | 14.5 | 2 | 26.1 |
| **Thailand** | Machinery | 3 | 8.8 | 1 | 25.9 |
| | Electronics | 1 | 14.5 | 1 | 23.3 |
| | Automobile | 6 | 3.8 | 1 | 60.5 |

Source: AJC (2017).

## 2.2 Driving Industrial Recovery Through Stimulus Policy Measures

Many countries began economic stimulus measures to support the healthcare system, and expanded them to fiscal and macro-financial policies to ease industry disruptions. Table 4.7 characterises the type of policy instruments most widely used across countries to support industries in general and SMEs in particular. During the emergency and recovery phases, immediate policy support included tax relief, employment support, and support for retaining business. Most countries in Southeast Asia accepted loan repayment deferrals and loan restructuring for small businesses. Malaysia granted a 6-month moratorium on loan repayments while the Philippines granted a 30-day grace period. In parallel, emergency concessional loan schemes, special funds, and refinancing facilities were established. Some countries, such as India and Malaysia, established a special pandemic relief fund and injected working capital in support of SME recovery. Thailand and Viet Nam launched low interest rate soft loan packages for small industries. Indonesia created a special fund to finance affected tourism industries, with a concessional interest rate. Japan provided effectively zero interest rate loans and full credit guarantees for SMEs that experienced sharp decreases in sales and exports. China, India, and Korea also offered special credit guarantees to affected small businesses through non-banking financial institutions.

## Table 4.7 Types of Industry Targeted by Economic Recovery and Stimulus Policy Measures

| Country | Deferred loan payments | Concessional lending | New credit | Capital injections | Targeted expenditure | Tax reductions | Payroll and social security | Wage and employment subsidies | Import restrictions | Digital economy drive | Utility payments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Australia** | Temporary changes to insolvency laws to provide a safety net<br><br>Extensions for loan repayments | Interest rate reduced | Special loans for SMEs under the SME Guarantee Scheme | US$1 billion COVID-19 Relief and Recovery fund for industries<br><br>Injection of US$40 billion of lending for SMEs | Loans can be unsecured and for 5-year terms | Tax credits<br><br>Relief for certain tax obligations, including deferring tax payments up to 4 months | Temporary cash flow payments up to US$100,000<br><br>'Job maker' hiring credit | 'Job keeper' payment<br><br>Promoting apprentices and trainees by offering 50% wage subsidies | International freight assistance to imports of medical supplies | Digital solutions programme to help SMEs gain access to low-cost and effective digital transformation | Payments can be extended over a longer period<br><br>Various assistance programmes by state governments |
| **Brunei** | Deferred principal payments | | | | | | | | | | |
| **Cambodia** | Debt restructuring | | New public bank for SMEs | Capital injections, with reduced base rates | Capital injections for tourism promotion | | Tax holidays<br><br>Social security contributions reduced | 60% minimum wage paid in garment sector | Customs procedures eased | | |
| **China** | Deferred principal and interest | | | Liquidity support | | Loss carryover and extended timeline for taxes | VAT reduced<br><br>Social security contribution exempted for food sector | | Simplified import procedures for medical supplies | Digital transformation of SMEs promoted | Electricity fee reduced by 5%, deferred payments for SMEs |
| **India** | Deferred principal payments | Interest rate reduced for small businesses | Special loans for the agriculture sector | Capital injections to NBFIs | Capital injections for pharmaceutical industry | Deferral of income tax for 6 months | Cash transfers for low-income households | Cash transfers for migrant workers | | Digital payments promoted | Tax exemption for new company registration |
| **Indonesia** | Debt restructuring | Interest rate reduced by 25% | Special loans for SMEs | Capital buffer on banks | Tourism promotion<br><br>Social media infrastructure | Gradual tax reduction in manufacturing industries | Tax suspended for hotels and restaurants<br><br>VAT reduction<br><br>Tax loss compensation for local governments | | Regulations relaxed on imports<br><br>Customs duty payments deferred | | Low rental fee |

| Country | Deferred loan payments | Concessional lending | New credit | Capital injections | Targeted expenditure | Tax reductions | Payroll and social security | Wage and employment subsidies | Import restrictions | Digital economy drive | Utility payments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Japan** | | | Emergency loan for SMEs with zero interest rate | | | | 1-year mortarium on social security payments for SMEs | Leave allowance for SME employees | | Support for teleworking, online education, and reshoring | |
| **Korea, Rep. of** | Deferred payments | | Emergency loan for SMEs | Base rates reduced | 70% tax cut for eco-car purchase and 10% refund for eco-home | | Tax breaks for SMEs and self-employed | Wage subsidies for affected firms | Import duty reduction<br><br>Custom procedures expediated | Support for SMEs' switch to e-commerce | Low rental fees |
| **Lao PDR** | Debt restructuring | | | | | | | | | | Reduced electricity tariffs |
| **Malaysia** | 6-month moratorium | Interest rate reduced by 50% | | COVID-19 Fund for SMEs | Tax relief for tourism spending | Deferral of income tax for 3 months | Service tax exempted in hotels<br><br>Employment provident fund payments deferred | Enhanced wage support for SMEs | | Support to e-commerce in agribusiness sector | Discount on electricity bills |
| **Myanmar** | | | | COVID-19 fund for small business | | Deferral of income tax payments | | | | | |
| **New Zealand** | Business debt hibernation | Low interest cash flow loans | Business finance guarantees | | Health, tourism, and aviation support | Tax loss carryback note<br><br>Late payment relief | | Wage subsidies to retain employees | | R&D tax credits | |
| **Philippines** | 30-day grace period | Interest rate reduced by 25% | | Capital required relaxed | Stimulus spending on domestic tourism | | | Cash transfers to affected workers | | | |
| **Singapore** | Deferred principal payments | | Small enterprise financing scheme | | | Deferral of income tax payments and tax rebates | Rebates on property tax and GST at 7% | Job support programme covering 25% of wages | Rental fees waived | Special digital support programme for small businesses | |

| Country | Deferred loan payments | Concessional lending | New credit | Capital injections | Targeted expenditure | Tax reductions | Payroll and social security | Wage and employment subsidies | Import restrictions | Digital economy drive | Utility payments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Thailand** | Debt restructuring | Interest rate reduced by 25% | Soft loans for SMEs | | Stimulus spending on low-income SMEs | | Social security contribution reduced | | Import tax exempted for medical supplies | | Reduced water and electricity fee |
| **Viet Nam** | Deferred principal payment | Interest rate and transaction fees reduced | Soft loan package | | | Deferred tax payments | VAT refund<br>Social insurance contributions suspended | Cash handouts for workers | | | Reduced electricity fees |

COVID-19 = coronavirus disease, GST = goods and services tax, R&D = research and development, NBFI = Non-Banking Financial Institution SMEs = small and medium-sized enterprises, VAT = value-added tax.

Source: ERIA Study Team.

Tax relief was a key component of industrial support during the recovery phase in several countries, where corporate tax reductions or exemptions and deferred payments helped the manufacturing and tourism industries. Social security contributions were exempted for badly affected industries in many AMS. VAT was also reduced or exempted in many countries. Various tax breaks were provided for small businesses and self-employed people affected in specific sectors. Employment support included various subsidy schemes and cash transfer arrangements for displaced workers. Some countries promoted new working environments for employees by revising their terms of employment – including work-from-home options, using unpaid leave options, and promoting digitalised business transactions. Other countries provided special support for small businesses to go digital by creating e-commerce platforms, and established designated help desks for accelerating digitalisation. To help businesses continue operations, several countries discounted utility payments, waived electricity bill payments, and subsidised rental/leasing fees, which have implications on carbon emissions.

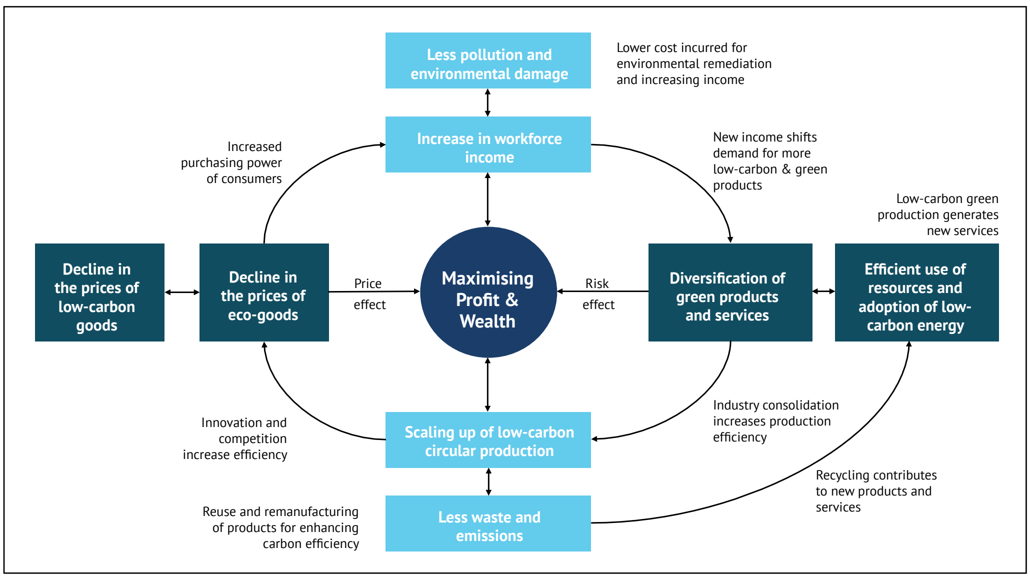
## 2.3 Reconciling the Economic Recovery with Green Industrialisation

Inclusive, resilient, and low-carbon green growth is essential in the post-COVID-19 era, as it could unleash dynamic and competitive economic forces that generate employment, enable the efficient use of energy and raw materials, facilitate international trade, and become a driver of shared prosperity (ADB and ADBI, 2013; ERIA, 2015; UNIDO, 2009; UNIDO, 2011).

Since the 1980s, industries in Asia have witnessed steady and strong growth in the consumption of energy and other natural resources. Carbon emissions and the use of materials in manufacturing increased threefold from 2010 to 2019 in ASEAN and East Asia, largely because of the scale effect of consumption and the switch to a carbon-intensive sector. There is no guarantee that the region's natural resources-based economic growth will continue forever. Climate change and biodiversity loss are placing heavy pressure on the region's economies, with a projected fall in total factor productivity of 3%–12% from 2020 to 2050 (Moore and Diaz, 2015). Accelerated industrialisation, and unsustainable production and consumption, generate pollution, waste, and carbon emissions. The intensity effect – technological changes in some subsectors such as energy supply, buildings, and transport – has also resulted in increased resource efficiency and changes in carbon intensity, etc. Scaling up such actions and the operationalisation of a low-carbon circular business model would help industrial firms to replace fossil fuel inputs with renewable energy sources and increase their resource efficiency in the post-COVID-19 era. Figure 4.6 presents the drivers of a low-carbon industry transformation model.

The virtuous circle of low-carbon transformation involves recursive process innovation, product diversification, new workforce income generation, price discovery, and sustainable consumption, which basically drives the future of industrialisation towards eco-innovation, manufacturing efficiency,

**Figure 4.6 Factors Affecting the Low-Carbon Economy Transformation at the Firm Level**




Source: ERIA Study Team.

and productivity gains for increased competitiveness.

The contents of the economic recovery and stimulus packages targeting industries also reflect significant differences in the industrial structure and productive capacities of the economies. Reconciling future industrialisation with low-carbon and inclusive growth requires significant learning and experimentation to find practical ways to reconcile the conflicting goals of maximising profits and minimising environmental impacts. Changes in the current demand and supply for low-carbon products and services could enhance opportunities for accelerating green industrialisation in the post-COVID-19 era. The extent to which the supply- and demand-side policies drive new industries and market demand depend on factors such as the strength of domestic technological and manufacturing capabilities, the green components of the stimulus packages, and the extent of international collaboration for technology transfer along global value chains.

A long-term perspective and the use of mixed supply- and demand-driven policy instruments in the new normal phase 3 are key for the green industrial transition. Such interventions were found to be effective in countries such as Korea, Japan, and Germany, which are ranked amongst the world's top five green industrial manufacturing sites. Table 4.8 identifies four phases in the development of green industries in Korea, characterised by phased approaches and targeted policy measures.

**Table 4.8 Phases of Green Industrial Development and Supporting Policies in the Republic of Korea**

| Policy Instrument | Infant imitation (1960–1970) | Internationalisation (1970s–1980s) | Innovations (1990s–2000s) | Green growth (2010s– |
|---|---|---|---|---|
| **Supply-driven** | | | | |
| Export subsidies | x | | | |
| Restricted FDI | x | | | |
| Technology licencin | x | | | |
| Industrial R&D | x | x | x | x |
| Joint ventures | | x | | |
| Advanced Tech Development Fund | | | | x |
| **Demand-driven** | | | | |
| Tax incentives for industries | | x | x | x |
| Consumer subsides | | | | x |
| **Both supply- and demand-driven** | | | | |
| Local content requirement | x | x | x | |
| Restriction of imports | x | | | |
| Tariff and non-tariff barriers | x | x | x | |
| Competitiveness policies | | | x | x |
| Market-based Instruments | | | | x |

FDI = foreign direct investment, R&D = research and development

Source: ERIA Study Team.

The Government of Korea acted as a strong regulator during the infant imitation phase, as it limited the type of industries to be supported through subsidised loans and selective attraction of foreign investment. It also built industrial research organisations and promoted technological learning through licencing. The internationalisation phase saw a sharp expansion in manufacturing industries in parallel with trade liberalisation and export promotion. Diversification and expansion of the consumer base was made possible by the integration of new SMEs in regional/global supply chains. When Korean industries in certain sectors (e.g. car, electronics, and steel) reached maturity and competitiveness, government policies targeted engendering valued-added technological and business innovations for greening of the industries. As part of the response to the global financial crisis, the Korean government formulated a green industry strategy in 2009 and introduced market-based policy instruments such as emission trading systems to spur eco-innovation, develop low-carbon green innovation technologies, and change the consumption pattern of green products and services. Public procurement and consumer subsidies provided a stable base for domestic industries to go green. Despite these efforts, per capita carbon emissions increased by over 18% from 2009 to 2017 – more than China, which saw a 12% increase during the same period. On the other hand, countries such as the UK saw a fall of 26%. This indicates that more structural changes on demand-side carbon management and innovation are needed in Korea.

Korea's COVID-19 pandemic recovery and stimulus package, the Korean Green New Deal, is considered one of the more positive green interventions in the region. Table 4.9 provides the details of the large financial support laid out by the government for a variety of new green initiatives. The deal aims to harness the power of digital technologies and artificial intelligence in stimulating low-carbon green growth, with a focus on job creation as well as carbon emission reduction in the next 5 years (2020–2025).

**Table 4.9 Investment and Job Creation of Korean Green New Deal**

| Projects | | Total investment (fiscal investment, W trillion) | | New jobs created ('000) |
|---|---|---|---|---|
| | | 2020–2022 | 2020–2025 | 2020–2025 |
| Digital new deal | Data dam | 8.5 (7.1) | 18.1 (15.1) | 389 |
| | AI government | 2.5 (2.5) | 9.7 (9.7) | 91 |
| | Smart healthcare | 0.1 (0.1) | 0.2 (0.1) | 2 |
| Digital-green industrial convergence | Green and smart schools | 5.3 (1.1) | 15.3 (3.4) | 124 |
| | Digital twins | 0.5 (0.5) | 1.8 (1.5) | 16 |
| | Make SOC digital | 8.2 (5.5) | 14.8 (10.0) | 143 |
| | Smart and green industrial complex | 2.1 (1.6) | 4.0 (3.2) | 3 |
| Green New Deal | Green remodelling | 3.1 (1.8) | 5.4 (3.0) | 124 |
| | Green energy production | 4.5 (3.7) | 11.3 (9.2) | 38 |
| | Eco-friendly vehicles | 8.6 (5.6) | 20.3 (13.1) | 151 |

AI = artificial intelligence, SOC = social overhead capital.

Source: Ministry of Economy and Finance, Republic of Korea (2020).

## 2.4 Turning Digital Technology Innovations into Actions for Low-Carbon Green Growth

Multiple climate change mitigation and low-carbon green growth scenarios envisage technological innovation and digital transformation as key drivers throughout this century (ADB, 2020b; Fidalgo-Blanco, Sein-Echaluce, and García-Peñalvo, 2014; IEA, 2020;). During the emergency lockdown and recovery phases, the use of digital applications has increased in all social and economic sectors.

Although comprehensive data are not available to capture the full spectrum of digital technology penetration, Table 4.10 shows how quickly consumers and industries switched to information and communication technology (ICT) for trade and financial payments, even in low-income economies. Broadband subscriptions, smart mobile phone use, and e-commerce activities accelerated during the first two phases of the pandemic. Cisco (2020) estimated that nearly 650 million additional mobile devices and connections were added during 2020.

**Table 4.10 Increase in Internet Use During the Lockdown Period (March–August 2020) for Online Shopping (%)**

| Country | Connectivity | | | Payments | | |
|---|---|---|---|---|---|---|
| | Mobile broadband subscribers (% of population) | Mobile broadband prices (500 MB/ month) as a % of GNI per capita | Fixed broadband subscribers (% of population) | Mode of received digital payments in the past year | Paid online for internet purchases | % of online firms using digital payments |
| Cambodia | 67 | 1.10 | 1.50 | 16 | – | – |
| Lao PDR | 51 | – | 1.00 | 12 | – | – |
| Malaysia | 116 | 0.90 | 8.00 | 76 | 52 | 57 |
| Indonesia | 100 | 1.40 | 3.10 | 34 | 49 | 51 |
| Philippines | 40 | 1.50 | 3.00 | 23 | – | 52 |
| Thailand | 170 | 1.20 | 11.00 | 62 | – | – |
| Viet Nam | 82 | 1.40 | 12.00 | 22 | 10 | 51 |

ASEAN = Association of Southeast Asian Nations, GNI = gross national income, MB = megabyte.

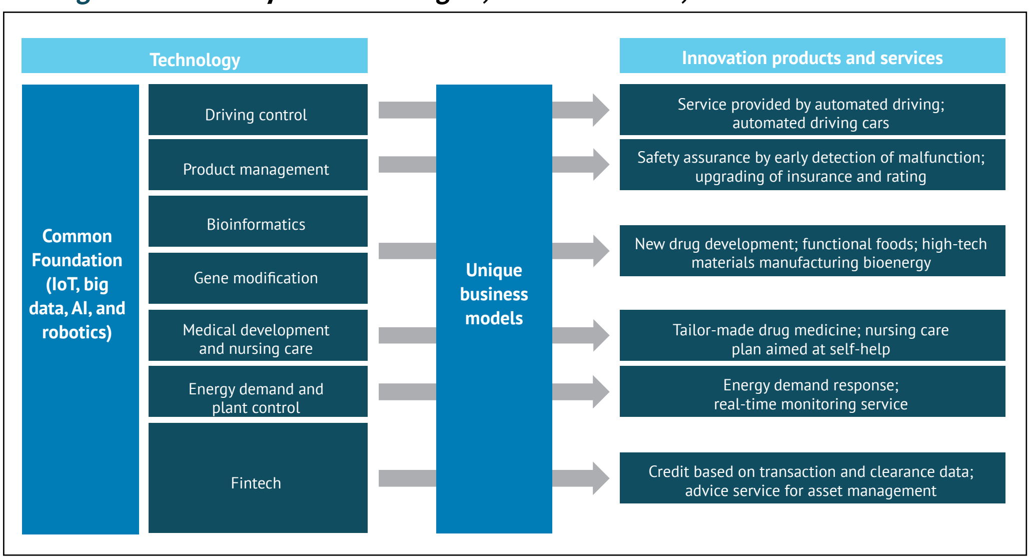
Source: Estimated by the ERIA Study Team based on ASEAN statistical database.

As industries increase their understanding of the full potential of digitalisation, their benefits will grow. A 2015 analysis found that digital technologies could help reduce greenhouse gas (GHG) emissions by up to 20% by 2030 (GeSI and Accenture Strategy, 2015). However, appropriate incentives must be in place as part of the sector decarbonisation strategies. The adoption of sector-specific automation, widespread integrated and near-instantaneous digital interconnectivity, internet of things, and artificial intelligence are already increasing productivity and reducing emissions. This will substitute energy and physical capital for the input of human energy and capital. In aviation and ocean freight, for example, big data analytics optimise route planning and reduce fuel use.

By 2035, McKinsey estimates that transportation innovations – such as electric and autonomous vehicles and ride-sharing, smart technologies for home and commercial energy efficiency management, and renewable energy technologies – could generate US$600 billion–US$1.2 trillion in savings, depending on how widely they are adopted (McKinsey Global Institute, 2018). New plant-based alternatives to animal products could reduce demand for land for livestock production, cutting carbon emissions by up to 8 gigatons of carbon dioxide ($CO_2$) equivalent per year (IPCC, 2015). In forestry and agriculture, geographic information systems, remote sensing, and big data analysis facilitate sustainable land management and carbon sequestration (Wong et al., 2014). Some research (Mörner and Bergmark, 2019; De Marchi, Di Maria, and Micelli, 2013) has shown that the integration of currently available frontier digital technologies into industrial production processes and lifestyle choices has the potential to enable up to one-third of the halving of global GHG emissions by 2030. New solutions for pollution and emission reductions during the post-COVID-19 era include the use of digital technologies and software that facilitate work from home; the use of remote environmental sensors and controls in farm, forestry, and fishery activities; transport optimisation; travel substitution; efficiency improvement in power generation and distribution; and the use of e-commerce, e-governance, etc. The way in which global and local industries respond to the evolution of these digital technologies is highly likely to affect their productivity, competitiveness, and carbon emissions in the next 5–10 years.

ICT, when integrated with big data analytics, provides opportunities to change how industries produce and consume raw materials, meet energy demand, and facilitate various new business models. These technologies, shown in Figure 4.7, constitute the core of the Fourth Industrial Revolution, and are the foundation for the next generation of industries to emerge and prosper in the post-COVID-19 era.

**Figure 4.7 Industry 4.0 Technologies, Business Model, and Innovative Services**




AI: artifical intelligence, IOT: Internet Of Things

Source: Nishimura (2021).

On the other hand, digital technologies are also highly energy- and resource-intensive. It is estimated that 1 ton of single-use laptop computers with a lifespan of 3 years could emit up to 10 tons of $CO_2$ (Lind et al., 2018). Digital networks and data centres are increasing rapidly during the pandemic, with the large number being installed in India, China, and ASEAN impacting sectoral energy use and national carbon footprints. Hence, digitalisation may deliver carbon efficiency downstream but it also has the potential to increase cumulative emissions. It is crucial to improve energy efficiency and decarbonise the digital industrial system to make the most of these technologies without increasing resource and energy use during their manufacturing and utilisation. Sectoral guidelines, regional standards, and carbon intensity targets – as well as an appropriate carbon pricing mechanism – are needed.

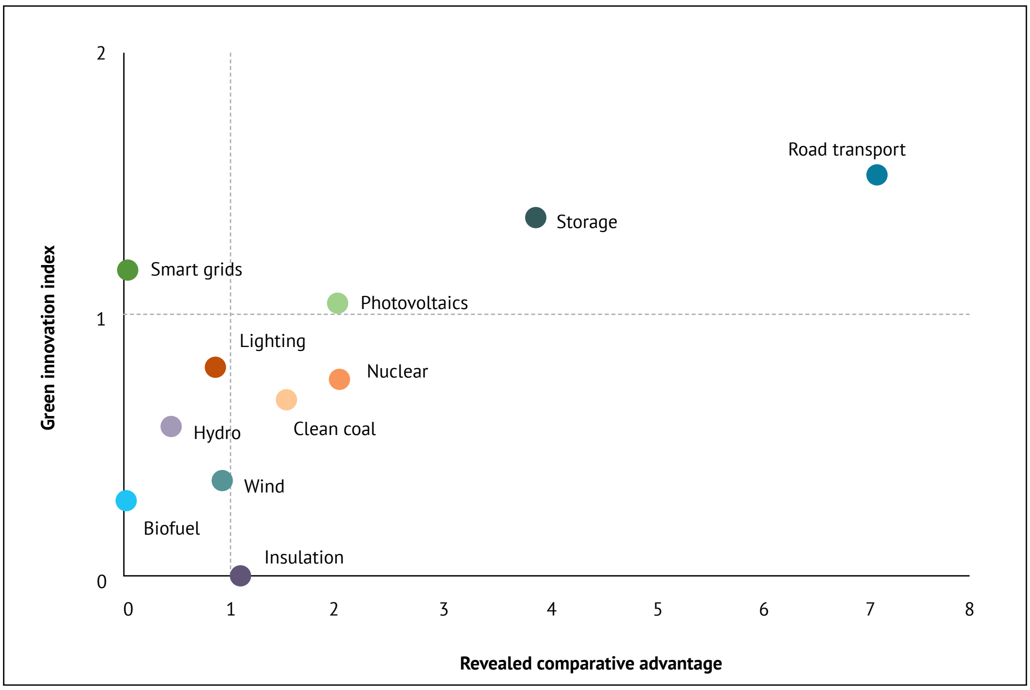
### 2.5 Unleashing the Transformative Power of Low-Carbon Green Innovations

To deliver green industrial transformation and meet the commitments of the Paris Agreement, governments must accelerate the deployment of existing technologies, business models, and services, while innovating newly improved ones. Globally, several patented inventions related to low-carbon green industries – such as building, transport, and energy generation – tripled from 2000 to 2015. However, inventive activity started slowing across these technology domains in 2015 in both absolute terms and as a share of total inventions, and was markedly lower during the pandemic outbreak in 2020. Some early research findings in Japan, China, and Korea have shown that the pandemic caused financial constraints to foster research and innovation at the firm level in some sectors (e.g. energy efficiency and air quality improvement), while the crisis led to a concentration of public spending in research activities such as electric vehicles, hydrogen fuel, and wind and nature-based solutions (Guderian et al., 2020).

Despite pockets of progress in areas such as energy storage, fuel cells, hydrogen, and photovoltaic energy, the current levels of low-carbon innovations fall short of what is needed to reach a net zero economy, as visualised by major East Asian economies such as China, Japan, and Korea during the pandemic as part of the economic recovery phase or separate climate neutrality ambitions. Most green technologies – such as for data centres and digital networks, carbon capture and utilisation, and geothermal and wave power – require more progress to reach a carbon efficient threshold at an affordable cost. Previous studies (ADB and ADBI, 2013; Yoshida and Mori, 2015) have shown that East Asia is competitive in terms of economies of scale in the production, export, and patenting of more than 15 low-carbon technologies and associated services.

Countries like Japan, Korea, and China have a high innovation index and comparative advantage in selected green technologies because of their long-term R&D policies. As shown in Figure 4.8, Japan's higher green innovation index in smart grids, energy storage, and fuel-efficient cars means that a greater innovation path is achieved in these sectors, as expressed by their proportional representation in the patent mix. The comparative advantage revealed indicates the potential of producing and exporting a full range of low-carbon products in a given year, as Japan has a higher position in technologies such as road transport, battery storage, and nuclear energy. However, stark disparities exist regionally. On average, Japan accounted for one-quarter of the world's high-value low-carbon green patents, China comprised one-fifth, and Korea made up one-tenth from 2015 to 2019. R&D expenditure related to green technology innovations in Korea has expanded since 2008, as it was one of the first countries in the world to announce a green growth plan (2009–2050). Since then, the country's resource productivity, including carbon productivity, has improved in select sectors of transport, electronic manufacturing, and cars (Kim, 2019). By contrast, some AMS exhibit significantly lower levels of patenting and export activity, but have huge potential for developing new types of production networks and supply chains in green industries such as waste to energy, energy efficiency, and blue hydrogen. These middle- and low-income economies can take steps to build innovation capacity strategically by capitalising on existing strengths and can learn from East Asian neighbours and international institutions to build scale.

**Figure 4.8 Green Innovation Index and Relative Comparative Advantage of Japan in Low-Carbon Technologies**




Source: ERIA Study Team, based on WIPO GREEN (n.d.), Database of Innovative Technologies and Needs. https://wipogreen.wipo.int/wipogreen-database/database (accessed 31 August 2021); and UNCTAD (2020).

However, countries in the region must overcome some common barriers to innovation. First, markets undersupply innovation because firms do not fully capture all the benefits of innovation while generating and diffusing technologies (Ambashi, 2018). Second, when industries and households do not have to pay for externalities such as pollution and emissions, the demand for low-carbon green innovations is limited and the incentives for companies to invest in internal R&D are lower (Anbumozhi and Kawai, 2015). Third, financing of more radical types of potential innovations is constrained by information asymmetries and by uncertainty concerning future regulations (ADB, 2021). Fourth, the regional diffusion of low-carbon technologies is undermined by trade barriers and lack of country capacity to adopt, adapt, and deploy new technologies (Anbumozhi and Kalirajan, 2017).

An industrial firm's propensity to innovate and deploy low-carbon technologies in the future depends on removing such barriers. Several factors require an enabling policy environment for technology transfer that is determined not only by markets but also by the absorptive capacity of the recipient countries. Table 4.11 characterises such an ecosystem for the countries in the region. As can be seen from the high-ranked countries (Japan, Korea, China, Singapore, and Malaysia), a sophisticated level of vocational education, a low regulatory burden, access to finance, investment protection, free trade, and tax transparency are directly related to the extent and effectiveness of innovation and technology diffusion.

**Table 4.11 World Bank Ease of Doing Business Index, 2019**

| Economy | Starting a business | Dealing with construction permits | Getting electricity | Registering property | Getting credit | Protecting minority investors | Paying taxes | Trading across borders |
|---|---|---|---|---|---|---|---|---|
| Brunei Darussalam | 16 | 54 | 31 | 144 | 1 | 128 | 90 | 149 |
| Cambodia | 187 | 178 | 146 | 129 | 25 | 128 | 138 | 118 |
| Indonesia | 140 | 110 | 33 | 106 | 48 | 37 | 81 | 116 |
| Lao PDR | 181 | 99 | 144 | 88 | 80 | 179 | 157 | 78 |
| Malaysia | 126 | 2 | 4 | 33 | 37 | 2 | 80 | 49 |
| Myanmar | 70 | 46 | 148 | 125 | 181 | 176 | 129 | 168 |
| Philippines | 171 | 85 | 32 | 120 | 132 | 72 | 95 | 113 |
| Singapore | 4 | 5 | 19 | 21 | 37 | 3 | 7 | 47 |
| Thailand | 47 | 34 | 6 | 67 | 48 | 3 | 68 | 62 |
| Viet Nam | 115 | 25 | 27 | 64 | 25 | 97 | 109 | 104 |
| Australia | 7 | 11 | 62 | 42 | 4 | 57 | 28 | 106 |
| China | 27 | 33 | 12 | 28 | 80 | 28 | 105 | 56 |
| India | 136 | 27 | 22 | 154 | 25 | 13 | 115 | 68 |
| Japan | 106 | 18 | 14 | 43 | 94 | 57 | 51 | 57 |
| Korea, Rep. of | 33 | 12 | 2 | 40 | 67 | 25 | 21 | 36 |
| New Zealand | 1 | 7 | 48 | 2 | 1 | 3 | 9 | 63 |

Source: World Bank (n.d.), Ease of Doing Business Index. https://data.worldbank.org/indicator/IC.BUS.EASE.XQ (accessed 31 August 2021).

Overcoming financial barriers to start-up innovation and early-stage commercialisation niche digital technologies that have sustainability benefits requires a specific type of support. Gaddy, Sivaram, and O'Sullivan (2016) pointed out the limitations of the traditional venture capital model for funding such technological innovations in developing countries, as they focus on a narrow range of mature technologies. This is partly due to the time constraints of venture capital investors and the relatively high risks for returns on investment in R&D. Strong public–private partnership is fundamental for low-carbon technology innovations to diversify and for aligning very different stakeholders at different stages of technology development. Governments can support the growth of low-carbon technology incubator programmes and digital technology accelerators with seed capital. They can help to form new partnerships to ensure continued investment along the innovation chain, from basic research to the development and deployment of low-carbon technology and business models (Anbumozhi, Kimura, and Kalirajan, 2018). Japan's Green Technology Funding mechanism could be a model, as it brings together risk-tolerant private investors, global technology networks, and financial entities with the investment necessary to finance new low-carbon technology innovations. The Japanese funding plan is to achieve 2050 carbon neutrality targets shared by the public and private sectors and the government through support from the New Energy and Industrial Technology Development Organization (NEDO) on issues ranging from R&D of niche technologies and demonstration of new low-carbon project subsidies, to the implementation of costly projects such as carbon capture, utilisation, and storage.

### 2.6 Strategies to Foster Green SMEs for Inclusive Growth

SMEs are the backbone of national economies in terms of the social fabric and local employment, but are sensitive and fragile to external shocks and play a critical role in the transition to a low-carbon economy. During the emergency and recovery phases, they were more seriously affected than large enterprises. In ASEAN, about 89%–99% of industries are categorised as micro, small, and medium-sized enterprises, contributing 58%–91% of employment. Table 4.12 shows the importance of SMEs, including informal microenterprises, as core engines of inclusive economic growth, job creation, and social cohesion, as they account for more than 60% of employment and 50% of GDP. They are also important stakeholders in building a better, green, and inclusive recovery.

The role of SMEs in environmental sustainability is also important (Koirala, 2018; OECD, 2018). Most of the employment losses incurred during the emergency and economic recovery phases have been in SMEs and informal businesses. ASEAN has a significant number of informal SMEs, with fragmented institutional settings, which limit their ability to adopt technologies and access affordable finance. Hence, they are less productive and less innovative, but contribute more to global trade and emissions.

**Table 4.12 Economic Distribution of SMEs and its Social Impacts in ASEAN**

| Country | Registered SMEs | Employment (million) | Number of informal small businesses | Employment (million) | Share of employment (%) |
|---|---|---|---|---|---|
| Brunei | 5,342 | - | - | - | 32.0 |
| Cambodia | 17,981 | 1.4 | 495,777 | 2.2 | 74.9 |
| Indonesia | 5,930,000 | 37.7 | 53,370,000 | 80 | 58.4 |
| Lao PDR | 100,000 | - | 78,500 | - | 80 |
| Malaysia | 907,065 | 6.9 | - | 1.36 | 10.6 |
| Myanmar | 59,300 | - | 620,0000 | - | 73 |
| Philippines | 941,174 | 4.3 | 900,000 | 3.5 | 38 |
| Singapore | 506782 | 3.6 | - | | |
| Thailand | 639630 | 6.73 | 2,368,049 | 5.0 | 55.3 |
| Viet Nam | 1,130,000 | 8.57 | 5,100,000 | 8.7 | 57.2 |

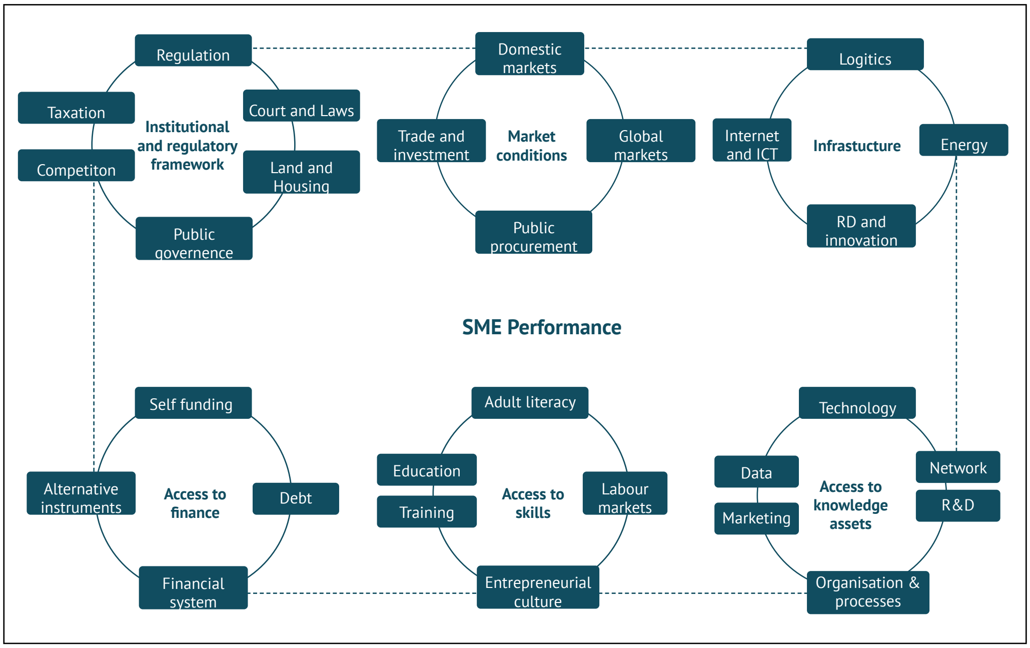
ASEAN = Association of Southeast Asian Nations, SMEs = small and medium-sized enterprises.
Source: ERIA (2015).

SMEs have a high aggregate environmental footprint, including cumulative carbon emissions. SMEs in the manufacturing sector – which accounts for a large share of global resource consumption, pollution, and waste generation – are critical for green industry transformation and meeting climate goals. SMEs also have the potential to make substantial environmental improvements in local and emerging market contexts that may be unappealing or unfeasible for large corporations. Studies show that SMEs represent more than 90%, 80%, and 70% of clean tech enterprises in Europe, Canada, and the United States respectively (Bak et al., 2016). Figure 4.9 shows the regulatory, market, social, and technical factors that could enhance SMEs' eco-performance.

To harness SME potential for low-carbon and inclusive growth, governments and policymakers need to take a more comprehensive approach. This was recognised in the ACRF, which aims to unlock SMEs' potential through open innovation on access to finance, technology development, and human resources development, amongst others – to enhance their sustainability, resilience, and competitiveness. Coordinated and targeted large-scale commitments are required to set ambitious targets for implementing the ACRF action plan. Designing appropriate capacity building and skills training that specifically target innovative, low-carbon SMEs, while addressing existing challenges of SMEs operating in clusters and leveraging existing institutions, would contribute significantly to fostering innovative capacity. Governments need to strengthen policy signals in support of SME-focused low-carbon innovation, provide a de-risking strategy for private investors, and safeguard investments in climate mitigation and resilience activities undertaken by industrial clusters of emerging start-up SMEs, global supply chains, and informal microenterprises.

Several innovative financial instruments, such as dedicated funds, direct loans, and warehousing,

**Figure 4.9 Conditions Necessary for Improved Economic Performance of SMEs**




ICT = information and communication technology, R&D = research and development, SMEs = small and medium-sized enterprises.

Source: Koirala (2018).

are often used as risk mitigants. Such innovative instruments have effectively removed green investment barriers. During the COVID-19 crisis, Malaysia's Green Technology Financing Scheme extended loan assurances to small-scale renewable energy and energy efficiency. Qualified low-carbon projects under this scheme can seek a loan from authorised commercial banks, which in return can receive a loan guarantee of about 60%. On-bill finance is an innovative programme implemented by Australia's Clean Energy Financing Corporation, where the utility company collects payment fees from an SME borrower and remits them to the investor. It is attractive to private lenders due to the low history of default. Property assessed clean energy (PACE) is a form of renewable energy financing through property, where a debtor repays a loan through property taxes attached to the project asset, such as a building. Such innovative financial programmes need to replicated and upscaled during the new normal phase.

## 3 Smart City Solutions and Inclusive and Low-Carbon Green Growth

Cities are home to most of the world's population and are where global problems and solutions meet. They are centres of economic growth and innovation. However, the high concentration of people and economic activities in cities make them most vulnerable to various disasters, epidemics, and pandemics. The COVID-19 pandemic emerged from cities and spread to rural areas via urban transport corridors. Regionally, around 70% of all reported infections are in urban areas. Further, since they are host to more than 50% of industries, cities and towns consume much of the national electricity and account for nearly 60% of global carbon emissions. National efforts to limit global warming hinge on cities. A report by the Coalition for Urban Transitions (2021) found that implementing a bundle of currently available low-carbon technologies and digital practices across megacities could collectively cut annual emissions from key urban sectors by 80%–90% by 2050, beyond their initial commitments to the Paris Agreement. As a result, the decisions made by city mayors can have a direct and immediate impact on people's health, the planet, and prosperity – perhaps more than national or international policies.

Around the region, smart cities are defined as innovative entities that use ICT and other means to improve the quality of life, efficiency of urban operations and services, and competitiveness. During the pandemic, the phenomenon of migration to rural areas has occurred as city centres are more affected by lockdowns and working from home has increased. Many cities, such as Singapore, Bangkok, and Manila, have demonstrated proactive use of smart technologies in monitoring the pandemic via contract tracing – laying the foundation for long-term resilience and green growth. Nevertheless, the pandemic has created the opportunity for cities worldwide to adopt an agile approach towards digital technologies.

### 3.1 The Pandemic Recovery and the Resilience of Smart Cities During the Pandemic Emergency

While evidence of the sustained impacts of national policies on economic resilience during the pandemic remains elusive, the role of smart cities in the pandemic response has been threefold. First, smart cities have been deploying a host of digital technological solutions and innovative bottom–up approaches to drive greater economic resilience (Table 4.13).

For example, in Singapore, the government has recognised the importance of speeding up national digitalisation. Smart facility management, the internet of things, and surveillance have become the symbols of the Smart Nation Platform, as they create advanced, safe, and liveable urban environments despite the pandemic. These smart city solutions have also doubled as preventive efforts to curb viral contagion. Korea has provided one of the most successful demonstrations of the power of smart city technologies. The country's smart city data hub system allowed health officials to conduct advanced contact tracing using data from cameras and other sensors (Kim and Castro, 2020). As a result, Korea was one of the few countries that rapidly reduced infection rates without a full lockdown.

Second, several cities in Asia have acted as effective implementation channels of nationwide economic relief packages. During the emergency and recovery phases, cities have acted as implementation vehicles for nationwide economic recovery and stimulus measures. From March to November 2020, city and subnational governments were in charge of 60%–72% of stimulus spending in Indonesia, Malaysia, and Thailand. City administrations continue to play a critical role in providing financial assistance to poor households and empowering small businesses during the pandemic. As large-scale social

**Table 4.13 City-Level Digital Actions Accelerated During the Pandemic**

| Country | City | City-level digital actions |
|---|---|---|
| Brunei | Bandar Seri Begawan | Working with Ericsson to pilot-test 5G and IoT, with full deployment expected by 2021 |
| Cambodia | Phnom Penh | Smart cities will make use of ICT to boost service delivery and performance, optimise resource consumption, and connect citizens |
| Indonesia | Jakarta | More transparent and liveable cities; QLUE to receive and process complaints and monitor civil service |
| Lao PDR | Luong Prabang | Introduced connected CCTV system and household electricity meters |
| Malaysia | Kuala Lumpur | Promote IoT through partnership with LoRa Alliance to improve traffic through WAN |
| Myanmar | Yangon | Introduced digital payments and e-cards to ensure better transport services |
| Philippines | New Clark City | Spatial planning and IoT for disaster resilience |
| Singapore | Singapore | National digital identity, e-payments, smart urban mobility, big data operation centre, Smart Nation Platform |
| Thailand | Phuket | Smart transport and surveillance and big data operation centre |
| Viet Nam | Da Nang | Collaborated with IBM to develop IoT infrastructure to address issues such an air control, water management, waste management, energy, and disaster warnings, with full deployment expected by 2025 |

CCTV = closed-circuit television, ICT = information and communication technology, IoT = internet of things, WAN = wide area network.

Source: ERIA Study Team.

assistance programmes take time to design and deliver, cities equipped with better digital infrastructure were found to be relatively efficient in the targeted delivery of relief to the intended beneficiaries. For example, several state governments in India have used a smart city network platform to deliver essential commodities and conduct alert responses, as many city centres are equipped with the digital identity

of citizens, aerial surveillance, and Global Positioning Systems (Fatewar and Vaishali, 2021).

Third, cities' steep digital technology adoption represents a step forward in fortifying urban climate action and will have far-reaching impacts as cities emerge from the COVID-19 pandemic. Jakarta Smart City has deployed a wide array of smart applications in its transport curtailment efforts during the lockdown (Anbumozhi, 2021b). Having developed a system that tracks mobile phone pings to cell towers to monitor crowds during festival celebrations, the city was able to use this innovation to help monitor the movement of polluting vehicles. In parallel, artificial intelligence, coupled with a surveillance and early warning system in Sydney, has built the resilience of the urban population to heavy flooding, even as COVID-19 cases continue to occur (OECD, 2020a).

Navigating the emergency and recovery phases – lockdown, telework, and travel restrictions – during the pandemic has prompted the acceleration of partnerships between city governments and the private sector to co-create innovative solutions powered by digital technologies for inclusive and resilient cities. By rapidly adopting digital platforms, cities like Tokyo, Singapore, and Seoul continue to stay one step ahead of the virus.

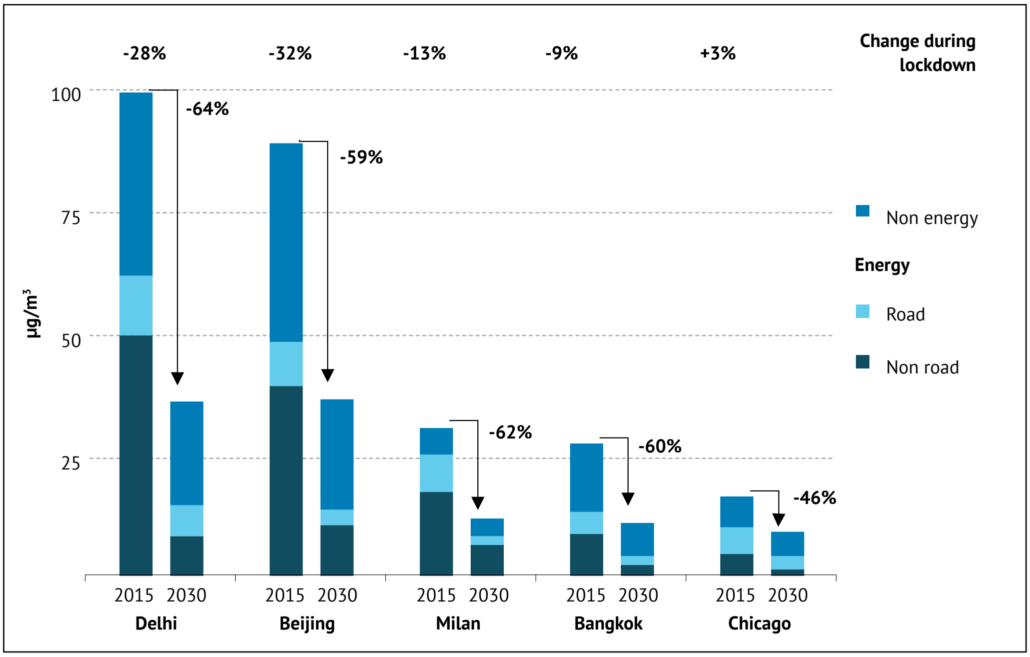
### 3.2 Cities as Transformative Agents for a Low-Carbon Circular Economy

Cities have a fundamental role to play in the low-carbon circular transition. On a regional scale, cities use about 1% of the land area, but house about 55% of the population in Asia (ADB, 2020b). With increasing urbanisation, many cities suffer from the externalities of continued urbanisation such as emissions, waste generation, and air pollution. Cities are also typical functional units where decisions affect the national carbon footprint, and can influence the total level of transport, energy and water consumption, as well as waste generation.

Global $CO_2$ emissions fell by 8% in the first three quarters of 2020, according to IEA (2020), with daily emissions of $CO_2$ having fallen by an average of about 20% around the world in phase one (April–May 2020) primarily due to the downturn in economic activities tied to COVID-19 related lockdowns in cities. Singapore, for instance, has seen a reported 20% reduction in $CO_2$ emissions from the pre-pandemic level (Ju and Hargreaves, 2021). No verifiable reports are available for other cities, but energy use is bouncing back in megacities such as Bangkok, Kuala Lumpur, and Jakarta, which have partially opened their city facilities and transport corridors. In Europe, daily carbon emissions are reported to have declined by 58% during lockdowns, with emissions from cars and motorcycles falling by 88% (Le Quéré, 2020). However, in the long term, an 8% year-on-year reduction may not be particularly significant, considering that economic recoveries from previous global economic crises were followed by a significant increase in GHG emissions which negated short-term emission reductions. In addition, without coordinated and substantive action at the city level, the pandemic has put low-carbon infrastructure investments at risk, mainly due to three major reasons: (i) healthcare priorities and economic uncertainty tend to induce cities to reduce or postpone public spending on planned low-carbon investment, (ii) low fossil fuel energy prices provide weaker incentives for energy-efficient technology deployment, and (iii) the reduced energy demand in the transport sector disincentivises short-term plans for fuel efficiency investments.

Reduced private transport during the lockdown has had a positive impact on the air quality of many cities in Asia. Cities with lockdowns reported a decrease of about 50%–75% in road transport activity and a reduction of up to 95% in rush-hour traffic congestion in the major cities of Jakarta, Bangkok, and Manila. In New Delhi, a 95% reduction in rush-hour traffic congestion during the first phase of the lockdown coincided with a 66% drop in nitrogen dioxide and a 28% fall in particulate matter (PM10) (IEA, 2020). Beijing and Bangkok also recorded reductions in sulphur oxide concentrations as industrial activities were curtailed. However, as cities have lifted their lockdowns in many cities, particulate matter concentrations are returning to 'old normal' levels. PM15 pollution levels, which are higher in almost all the cities, are known to cause lung and heart damage. Nitrogen dioxide – another pollutant produced from power plants, vehicles, and other industrial facilities – can have significant impacts on respiratory problems. Residents with pre-existing respiratory conditions, such as asthma or chronic bronchitis, are more vulnerable to the COVID-19 virus (WHO, 2020).

**Figure 4.10 Changes in the Air Quality of Major Cities During the Pandemic Lockdown**




µg/m³ = microgram per cubic metre

Source: IEA (2020).

During the COVID-19 crisis, the volume of solid waste generated by cities has risen, including medical waste (e.g. disposable masks and gloves) and electronic waste (e-waste). Such waste has ended up in oceans and waterbodies, due to improper disposal, waste management, and recycling facilities. Infectious medical waste increased by 600% from 40 tons per day to 240 tons per day in Hubei Province (China) during the COVID-19 outbreak. Medical waste generated during the initial lockdown period is presented in Table 4.14.

Before the COVID-19 outbreak, residential waste volumes increased by about 20%–30% year on year in megacities. In Jakarta, household waste quantities increased by 60% during the lockdown months of May–August 2020. During this period, cities in ASEAN saw an average increase in municipal solid waste and recycling collection of 20%. Other cities, such as Bangalore, experienced an estimated increase of up to 50%. The waste agency of Bandung in Indonesia detected a 350% increase from mid-March to May 2020 (Sangkham, 2020).

It is imperative for cities to adopt a circular economy model that reuses and recycles waste to convert it into new energy and material streams – increasing the value of all assets and minimising resource consumption. The transition to a circular economy by cities will not only conserve natural resources, but also reduce environmental and climate impacts. Table 4.15 lists the key steps to be considered in establishing circular cities, broadly categorised under planning, action, and monitoring domains. These steps foster innovation at the city level, increasing their competitiveness to attract new investments.

**Table 4.14 Medical Waste Generated in Five Megacities of Southeast Asia – Initial Lockdown (April–May 2020)**

| City | Population (World Population Review) | Medical waste generated (tons per day before COVID-19) | Additional medical waste (tons per day) | Total possible production over 60 days |
|---|---|---|---|---|
| Manila | 14 million | 47 | 280 | 16,800 |
| Jakarta | 10.6 million | 35 | 212 | 12,720 |
| Bangkok | 10.5 million | 35 | 210 | 12,600 |
| Ha Noi | 8 million | 27 | 160 | 9,600 |
| Kuala Lumpur | 7.7 million | 26 | 154 | 9,240 |
| **Total** | | **170** | **1,016** | **60,960** |

COVID-19 = coronavirus disease.

Source: ERIA Study Team from interviews with City Net members.

**Table 4.15 Key Steps in Circular City Formulation**

| | |
|---|---|
| PLAN | 1. Characterise and analyse local context and resource flows, and identify idle assets<br>2. Conceptualise options and prioritise amongst sectors with circular potential<br>3. Craft a circular vision and strategy with clear circular goals and targets |
| ACT | 4. Close loops by connecting waste/residue/water/heat generators with off-takers<br>5. Consider options for extending use and life of idle assets and products<br>6. Construct and procure circular buildings, energy and mobility systems<br>7. Conduct circular experimentation - address urban problems with circular solutions<br>8. Catalyse circular developments through regulation, incentives and financing<br>9. Create markets and demand for circular products and services - be a launching customer<br>10. Capitalise on new IT tools supporting circular business models |
| MOBILISE/ MONITOR | 11. Coach and educate citizens, businesses, civil society and media<br>12. Confront and challenge linear inertia, stressing linear risks/highlighting circular opportunities<br>13. Connect and facilitate cooperation amongst circular stakeholders<br>14. Contact and lea from circular pioneers and champions<br>15. Communicate on circular progress based on monitoring |

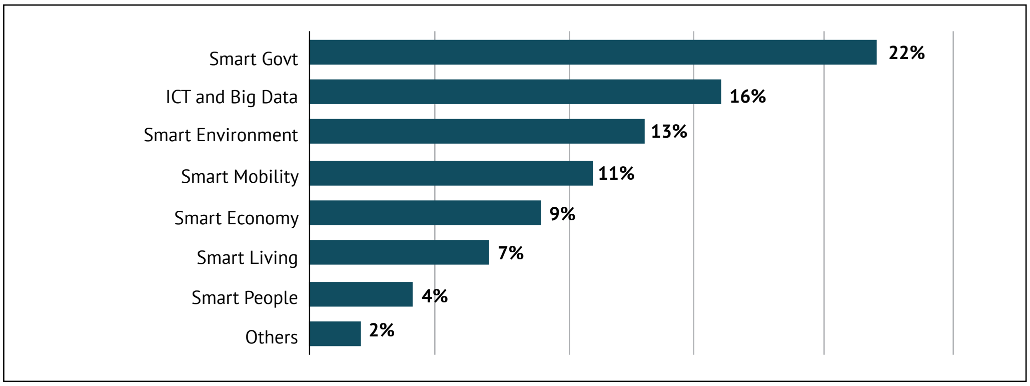
ICT = information and communication technology.

Source: 4th Indonesia Circular Economy Forum (2021).

### 3.3 Innovation, Inclusion, and Efficiency Narratives for Smart Cities in the Post-COVID-19 Era

The pandemic has compounded existing socio-economic vulnerabilities and disproportionately affected vulnerable populations in cities. Low-paid workers in cities, who usually have fewer savings, were severely hit by the lockdown measures and closures in retail, transport, restaurants, and other associated services. Homeless and older persons, estimated to total 3 million in cities and towns across ASEAN and East Asia, have limited means of isolating and protecting themselves from infection. For older persons, many of whom live alone and tend not to have a family member or friend to rely on, COVID-19 places severe restrictions on their daily independence – generating other psychological impacts in addition to the higher risk of complications in the case of infection.

**Figure 4.11 Smart City Application Types in ASEAN**




ASEAN = Association of Southeast Asian Nations, Govt = government, ICT = information and communication technology.

Source: ERIA Study Team.

When cities emerge from the pandemic and the new sustainable development phase begins, city leaders should not simply return to the old normal of unequal and polluted urbanisation. National governments should significantly accelerate inclusive and low-carbon green growth by investing in compact, connected, and smart cities.

A detailed review of the cities participating in the ASEAN Smart Cities Network (ASCN)[1] indicates two main approaches to developing smart cities: (i) a top–down approach, designed through a national urbanisation strategy; and (ii) a bottom–up approach, where smart city innovations emerge and flourish. An Economic Research Institute for ASEAN and East Asia (ERIA) survey of the ASCN (Anbumozhi, 2021a) found different smart city application types in operation (Figure 4.11).

The smart city models are composed of seven elements, from improved governance to smart people, which can be categorised in three building blocks of inclusive and low-carbon green growth:

1. High-level objectives, which define the desired green growth outcome to be achieved, such as quality of life, pollution prevention, emission reduction, and inclusiveness.

2. Enabling factors, which represent cross-cutting entry points for digital transformation, such as technology, policy skills, business, and planning.

3. Action fields, in which smart city solutions can be applied in the energy, transport, water, and waste sectors.

[1] The ASCN is a collaborative platform where cities from the 10 AMS work towards the common goal of smart and sustainable urban development. The 26 ASCN Pilot Cities are Bandar Seri Begawan, Battambang, Phnom Penh, Siem Reap, Makassar, Banyuwangi, DKI Jakarta, Luang Prabang, Vientiane, Johor Bahru, Kuala Lumpur, Kota Kinabalu, Kuching, Nay Pyi Taw, Mandalay, Yangon, Cebu City, Davao City, Manila, Singapore, Bangkok, Chonburi, Phuket, Da Nang, Hanoi, and Ho Chi Minh City.

Based on the building blocks, four domains of innovative programmes can be identified: (i) business-related categories, (ii) citizen-related categories, (iii) environment-related categories, and (iv) government-related categories. Table 4.16 presents the domain taxonomy that can be used to categorise future smart city approaches.

**Table 4.16 Domain Taxonomy of Smart Cities for Inclusive and Low-Carbon Growth**

| Domain | Sub-domain |
|---|---|
| Business-related smart city domains | Entrepreneurship<br>Enterprise management<br>Logistics<br>Transaction |
| Citizen-related smart city domains | Education<br>Healthcare<br>Public transport<br>Smart traffic<br>Tourism |
| Environment-related smart city domains | Renewable energy<br>Smart grid<br>Building and housing<br>Waste management<br>Water management<br>Pollution control<br>Public spaces |
| Government-related smart city domains | Emergency response<br>E-government<br>Public safety<br>Public service<br>Transparency |

Source: ERIA Study Team.

Despite widespread enthusiasm, most city leaders struggle to understand how best to invest in smart digital solutions to deliver long-term inclusive and green growth to their citizens. Emerging experiences from the sustainable urbanisation and smart city movements offer a three-point agenda on smart city innovations.

**First, innovation through collaboration**. Most smart city innovations have their origin in the private sector. For individual smart technologies to create smart cities, innovations must be on a citywide scale. This requires contributions not only from commercial ICT firms, but also from social entrepreneurs and citizens.

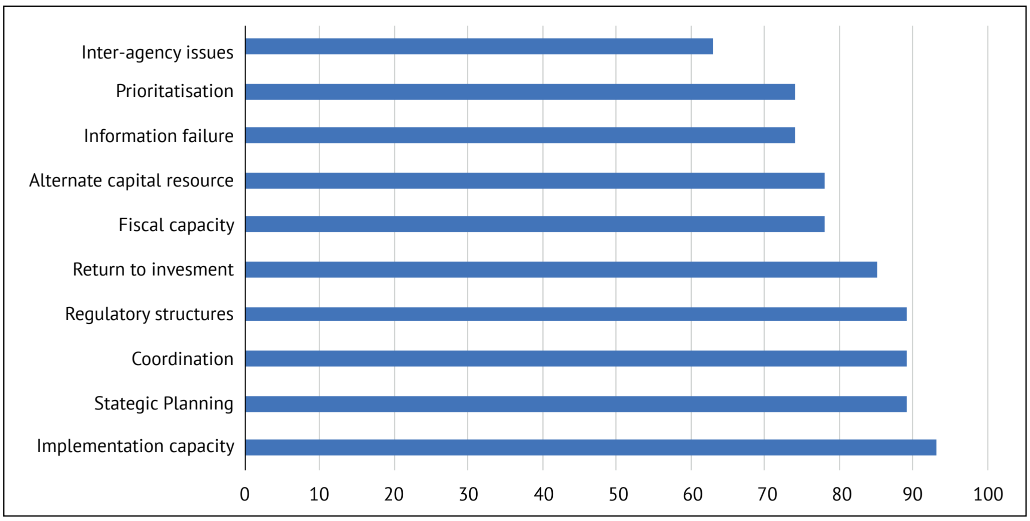
**Second, inclusion.** City leaders should focus smart city efforts on the needs of all residents. Using data to target the most vulnerable citizens, opening up data to promote accountability, and tapping mobile connectivity to expand participatory governance and budgeting will offer systemic access to city services for all citizens.

**Third, efficiency in service delivery.** Through digitalisation and the collection of large amounts of data, followed by the translation of these data into strategic infrastructure investments, cities can support climate-resilient, low-carbon growth. Evidence-based decision-making and continuous monitoring of energy use and emission reduction targets, with the aid of dashboards, signal a genuine revolution in city management.

### 3.4 Removing Financial Barriers to Innovative Low-Carbon Climate-Resilient Cities

Cities' ability to make low-carbon, circular, climate-smart investments – particularly during the pandemic recovery stage in emerging economies of Asia – often relies on the reallocation of existing budgets and the ability to increase revenue sources. Cities do not always have the capability to finance the investments identified for low-carbon development plans from their budgets alone, as they rely on transfers from national governments, tax, and tariff revenues for their funding. In addition, cities often face several competing priorities (e.g. health and education resource constraints), making it challenging to develop investible project plans and accurately quantify project costs, particularly in nascent sectors such as electric mobility and digital infrastructure. The investment barriers faced by ASCN member cities are illustrated in Figure 4.12.

**Figure 4.12 ASEAN City Mayors' Perspective on Barriers to Sustainable Urbanisation and Mobilising Investments**




ASEAN = Association of Southeast Asian Nations.

Source: ERIA Study Team.

More than 50% of the 26 cities identified lack of public funding as a major barrier to low-carbon smart city development, while 50% cited insufficient national support. Where capital is available, there is often a lack of investment-ready, bankable projects. Some cities lack the capacity or knowledge to develop and report climate-smart low-carbon actions that are competitive with non-climate projects in attracting finance. Most such projects also require close cooperation across sectors, and smaller projects, which are more typical at the city level, often need to be implemented by public and private actors. Aligning the interests and goals of different stakeholders, including communities and central governments, is therefore often a limiting factor for increased investment in smart transport projects.

Some pioneering cities like Seoul, Tokyo, and Bangkok are using alternative mechanisms such as initial grants, subsidies, and loans for more costly projects. However, increasing up-front capital investment and operation and maintenance costs, coupled with most city governments' inability to establish creditworthiness and access capital markets, is making it challenging for city mayors to meet these financing needs. There is a growing mismatch between capital requirements and available resources in the pandemic period.

New financial instruments such as green and social bonds, being developed in Singapore, Hong Kong, and Seoul, have great potential to drive low-carbon smart investment by allowing cities to acquire long-term debt at stable prices. They are well suited to larger projects or project portfolios with large up-front costs, where such access to capital is essential. However, lack of fiscal autonomy and the inability to develop effective public–private partnerships increases the difficulty of securing financing for low-carbon infrastructure initiatives.

### 3.5 Overcoming Governmental Fragmentation to Achieve the Goals of Sustainable Cities

National governments have two clear roles to play in enabling cities to be drivers of low-carbon green growth/a net zero future: (i) creating a favourable environment for city-level actions, and (ii) integrating city-level actions in national-level low-carbon circular economy targets and roadmap building to seek complementarity. Whatever the size of cities – mega, medium, or small – a strong national framework is needed to adopt this two-pronged approach.

Greater collaboration between higher levels of government and financers can help overcome this fragmentation challenge. Funding low-carbon, circular, and resilient smart cities has potential for enormous economic returns to national governments as a result of energy and material savings. For instance, in Southeast Asia, urban emissions from 26 designated smart cities could be reduced by 50% by 2030 and 98% by 2050 using proven low-carbon measures in the energy, water, transport, and water sectors (Anbumozhi, 2021a). Decarbonising cities has the potential to create millions of new jobs and could catalyse a net zero transition. Recent analysis by Vivid Economics for the Coalition for Urban Transitions (2021) estimated that about 31 million new jobs could be created in China, India, Indonesia, Brazil, Mexico, and South Africa by adopting low-carbon resilient measures. Smart city measures such as retrofitting buildings could create an estimated

8–21 jobs per US$1 million spent on energy efficiency measures, in comparison to three jobs in the fossil fuel sector. Governments need to support cities so that informal workers and other vulnerable groups impacted by the pandemic receive their share of the benefits of the low-carbon transition in the post-COVID-19 era.

However, the transformation of smart cities into liveable and sustainable cities will not be easy during the initial years of the post-COVID-19 era, as governments are facing severe budget cuts. A smart city's ability to make digital and green investments often relies on the reallocation of budgets and the ability to raise new revenue streams.

National governments have a central role to play in unlocking the vast potential of cities, by paying attention to the following three policy actions in a coordinated way. First, governments should create an enabling environment, including fiscal autonomy, for cities that empowers city leaders and mayors to push through climate action, create a circular economy, and build resilience through collaboration and cooperation. Measuring a smart city's performance is a complex task, but it is critical to advancing decoupling and recoupling agendas. All projects for smart cities should be required to have a robust monitoring protocol, with clear standards and specifications for planning, implementation, and operation. This includes providing a common and reliable set of key performance indicators, as illustrated in Figure 4.13 for low-carbon development in the post-COVID-19 era.

**Figure 4.13 Key Performance Indicators for Circular Low-Carbon Smart Cities**

| Issue | Key performance indicator | City development challenge |
|---|---|---|
| Energy & resource use | Share of renewable energy | Reduction of carbon emissions |
| | Buildings with energy efficiency standards | Optimising energy use |
| Transport | Public transport trips per capita | Car-dependent society |
| | People using alternate forms of mobility | COVID-19 response |
| Urban environment | Available green area per capita | Limited green space |
| | Percentage of works using remote working | COVID-19 response |
| Inclusive community | Women's labour force participation | Gender gap in employment |
| | Citizens' participation rate in local activities | Weak ties in local community |
| Safety & security | Area covered by disaster warning system | Disaster management |
| | Buildings adopting remote contact technologies | Response to COVID-19 |
| Local economy | Facilities using advanced ICT technology | Shrinking competitiveness |
| | Annual growth rate of employment | Big data use for business |

COVID-19 = coronavirus disease, ICT = information and communication technology.

Source: Anbumozhi (2021).

Second, strengthening policy coherence for smart city projects is an imperative. Generally, there is policy alignment between the objectives of smart city initiatives and those of climate policy, as well as the SDGs. National governments should provide a stable regulatory framework and policy reforms to attract investment to augment those policy objectives and ensure that next-generation reforms do not disrupt the synergic benefits. Even though the identification of such integrated policy strategies remains the responsibility of national governments, it is essential that city administrations are given a more prominent role in deploying smart solutions. Without their involvement, sustainability and liveability cannot be achieved.

Third, improving access to investment capital is a major issue for smart cities in the pandemic recovery stage. National governments can offer financial backing by establishing structural funds, which could be combined with the national development bank's debt and equity instruments, as well as introducing market-based mechanisms such as emission trading systems and carbon taxes. Guidelines on how to combine the market-based and regulatory instruments to support digitally aided low-carbon circular cities need to be developed by networks such as the ASCN. In this case, as illustrated in Table 4.17, Korea offers an interesting example of how smart policies have changed over time. The key is flexibility and agility in policymaking.

**Table 4.17 Goals and Actors of Smart City Development in the Republic of Korea**

| | **Construction stage** (2003-2013) | **Connecting stage** (2014-2016) | **Enhancement stage** (2017-) |
|---|---|---|---|
| Goal | To create new growth engine by combining ICT with construction industry | To provide high quality service by integrating existing infrastructure and service | To solve urban problems and create innovative jobs |
| Information | Vertical information integration | Horizontal information integration | Cloud based information integration |
| Platform | Closed platform | Public platform (open to relevant organisations) | Open platform (open to private sectors) |
| Legal framework | Law of Ubiquitous City Construction | Law of Ubiquitous City Construction | Law for Smart City Creation and Promotion of Industries |
| Main agents | Ministry of Land, Infrastructure, and Transport | Ministry of Land, Infrastructure, and Transport; Ministry of Science and ICT; Ministry of Trade, Industry and Energy | Smart city governance |
| Target | New towns | New towns, existing cities | New towns, existing cities, declining cities |
| Projects | Integrated Operation Control Centre (IOCC), physical infrastructure | Smart city platform, service integration | National smart city pilot projects, Smart city platform, smart city R&D, smart city challenge (for existing cities), smart urban regeneration (for declining cities) |
| Resource | Profits from Residential district development projects | Government budget | Government budget, resource from private sectors |

ICT = information and communication technology, R&D = research and development.

Source: Choi et al. (2020).

## 4. Building Sustainable Financial Systems for a Green Recovery

During the pandemic crisis, not all forms of macroeconomic policy frameworks or stimulus measures are created under equal conditions with same objectives. The health crisis has been accompanied by an unprecedented economic downturn, amidst existing climate risks. Supply and demand for goods and services fell rapidly, with millions of jobs lost during the emergency and recovery phases. Financial systems, including central banks, national development banks, commercial banks, and insurance companies' capital and bond markets – which are critical players – need to be reshaped to finance low-carbon inclusive growth. These early experiences could be scaled up and systemised nationally and regionally to effect major deployment of capital to finance the net zero economy. The key questions are: Should incentives provide equal treatment for all sectors or favour certain sectors? Can this be harmonised with the need to promote financial stability and avoid excess risk in the financial system?

### 4.1 Financing the Economic and Stimulus Packages

Most governments have used a wide range of fiscal, monetary, and other policy interventions to help industries, local governments, and households cope with initial shocks; avoid a deeper recession; and sustain trade in goods and services. They have spent a significant amount of budgetary resources on managing the crisis and promoting a quick recovery. Governments and central banks have engineered an unconventional loosening of macroeconomic policy. This is arguably quite conventional Keynesian deficit financing to maintain private income flows – but on a very large scale, given the size of the pandemic shock. As of May 2021, the aggregate value of the economic recovery packages reached US$28 trillion in Asia and the Pacific (ADB,

**Figure 4.14 Categorisation of Economic Recovery of Stimulus Policies for the Pandemic Recovery in ASEAN and East Asia**


ASEAN = Association of Southeast Asian Nations, FiT = feed-in tariff, R&D = research and development, RPS = renewable portfolio standard.

Source: ERIA Study Team.

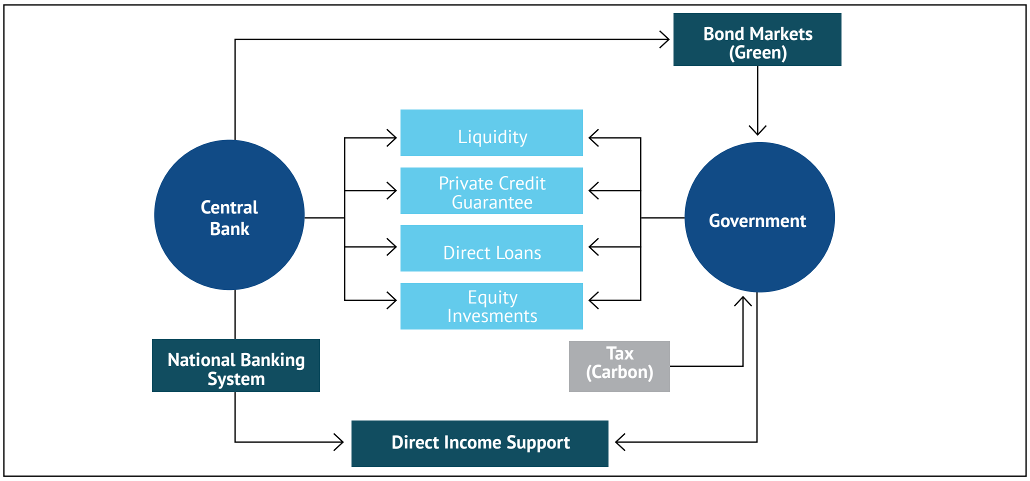
2021). The current policy actions taken by countries are considered to be much more comprehensive than those employed following the 2008 financial crisis, which had a higher financial outlay for low-carbon green stimulus spending.

Stimulus spending refers to policies that require substantial amounts of public funds, with the aim of preserving employment, avoiding bankruptcy, creating new jobs, and helping hard-hit communities to recover in a sustainable way. Figure 4.15 maps these policy instruments employed by ASEAN and East Asian countries, which may be categorised as economic stimulus spending policies, tax reform policies, and cross-cutting policies. Some policies that support low-carbon transformation but do not require large financial injections from the government (e.g. mandates for renewable energy targets, standards for energy efficiency, promoting e-vehicles, and introducing circular smart city practices) remain unchanged during the crisis period and are grouped under cross-cutting policies. These policies may increase private costs, which governments may not wish to impose given the impact on the existing markets of energy providers and manufacturers. Therefore, in some countries, governments may proceed with caution on new regulations for climate change mitigation.

As can be seen with respect to the distribution of policy instruments, there are no optimal choices for policymakers as spillovers occur across the categories of social safety, economic revitalisation, and low-carbon growth. This does not imply that optimal co-benefit policies are not possible, but they are difficult to determine and dependent on the immediate priorities amongst competing objectives. The choice between policy instruments is having consequential direct and indirect impacts on inclusive and green growth as well as some trade-offs. The most direct long-term policy effect of continued public spending on green infrastructure and R&D, as in Korea, is that they can mobilise private investment and the shift in post-pandemic growth towards a low-carbon lock-in. This lock-in could be reinforced by aligning financial systems with green recovery objectives.

The funding relationship between governments and central banks during the COVID-19 crisis period is captured in Figure 4.15. Most government funding during the emergency and recovery phases was allocated via existing and supplementary budget outlays. In fiscal terms, central banks initiated several liquidity support measures for banks to facilitate lending to industries devastated by the pandemic and the associated lockdown measures. These included large-scale capital injections to commercial and national development banks (in Cambodia, India, Indonesia, and China); a reduced base rate for lending (in Cambodia, the Philippines, Korea, and Viet Nam); relaxed capital requirements for banks (in the Philippines); and related regulatory forbearance to encourage SME financing. To provide liquidity, central banks expanded borrowers' liabilities via standing facilities and the purchase of financial assets. Countries like Indonesia, India, and Malaysia also relaxed regulatory requirements, such as lowering the minimum liquidity ratio by adjusting the liquidity and capital requirement ratios.

**Figure 4.15 Financing Channels for the Pandemic Recovery in ASEAN and East Asia**



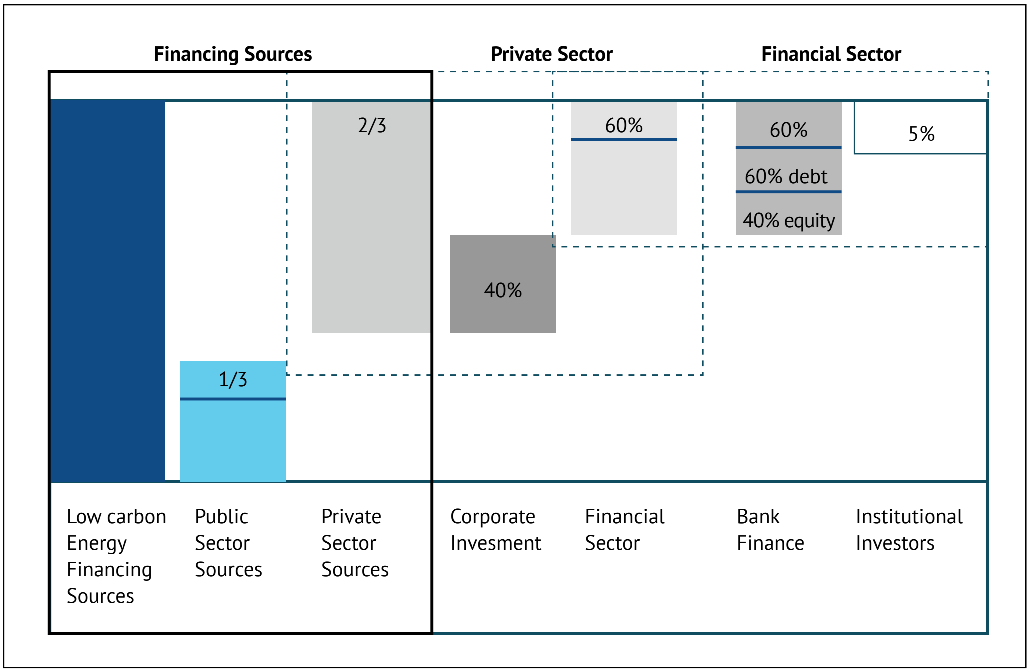

ASEAN = Association of Southeast Asian Nations.
Source: ERIA Study Team.

Several countries (including Thailand, Malaysia, and Singapore) have expanded the range of acceptable collateral for commercial banks and non-financial institutions for secured loans from their central banks. Meanwhile, channels of liquidity, private credit guarantees, direct loans, and equity investments are the prerogative of central banks. Direct income-support measures, such as a reduction in income tax, VAT cuts, and payment deferrals, are commonly mandated by government fiscal policy and thus affect annual budget outlays. Green bonds are specially earmarked for climate and other environmental protection projects. They are typically backed by the issuing corporate or special project entity's balance sheet and usually carry a higher credit rating in emerging Asian bond markets. Carbon pricing mechanisms, which are recognised as an essential element of revenue and public budgeting in Europe's Green New Deal, have not yet been seriously considered in Asia during the pandemic crisis.

## 4.2 The Dynamics of Financing a Low-Carbon Resilient Future

Developing and emerging economies of Asia will account for most of the global low-carbon financing needs through 2050. In developed countries such as Australia, Japan, New Zealand, and Korea, private financing accounts for about two-thirds of capital mobilisation through debt and equity channels that are partially supported by central banks through risk sharing and by governments through subsides. Public finance from national governments, state-owned investment agencies, and national development banks provide the remainder. Figure 4.16 illustrates the prevailing financing landscape. Private sector financing of low-carbon energy infrastructure projects can be broadly divided between the financial sector (60%) and corporate sources (40%). Bank financing (60% debt and 40% equity) accounts for about 95% of the financial sector contributions – mostly long-term low-carbon investments. Bank investments in equity markets are an alternative source of funding. Non-bank entities, including institutional investors, provide the remaining 5% of capital requirements.

**Figure 4.16 An Illustrative Landscape of Low-Carbon Financing in Asia**




Source: Anbumozhi, Kimura, and Kalirajan (2018).

The magnitude of this portfolio varies across countries. Public and quasi-public financial institutions such as national development banks, state-owned commercial banks, and autonomous government guarantee programmes account for two-thirds of corporate financing in developing and emerging economies of Asia. Governments could accelerate this trend by targeting more of their funds to leverage private finance. A country with a higher leverage ratio means lowered public financing expenditure. In general, international financial investors play a central role in upscaling the investment flows into lower- and middle-income countries in the region.

There are multiple reasons for scaling up private finance in support of inclusive and low-carbon growth. First, developed countries are yet to agree on concrete plans for meeting their commitment to provide US$100 billion annually to developing countries for achieving their nationally determined contributions (NDCs), which are under revision in 2021. Second, as several assessments indicate, more than US$100 billion per year is needed to meet energy transition objectives (IPCC, 2015; Bowen, Campiglio, and Tavoni, 2014). Third, government budgets globally are constrained by shocks brought on by the COVID-19 pandemic, with little clarity on how public funding will be scaled up to meet the climate targets. Mobilising private capital is critical to jump-start, leverage, and guide large-scale deployment of low-carbon technologies and infrastructure investments in the post-COVID-19 era.

Capital market investors in the region are increasingly aware of the need to shift capital flows away from activities that may result in stranded assets and high lock-ins, but need more incentives to direct the investments towards low-carbon sectors. Amongst the 1,500 global signatories to the Principles for Responsible Investment, asset owners and investment managers in Asia account for less than 12%. Of the 52 partner exchanges that have signed the Sustainable Stock Exchanges Initiative, 17% are from East Asia. These figures reflect the failure to take the transition to net zero seriously. Table 4.18 presents the environmental, social, and governance (ESG) related assets in stock markets. ESG assets in ASEAN and East Asia were estimated to be worth US$44.9 billion in 2018, an average increase of 22% per year since 2011 (ASrIA, 2019). Australia, Hong Kong, Malaysia, Korea, and Singapore account for nearly 90% of all reported ESG asset management. While the sustainable energy market segment is growing fast, it started from a low base and still constitutes a small fraction of total asset management. The reasons for this could be the lack of sufficient carbon disclosure requirements and other systemic risks associated with ESG investments (Hongo and Anbumozhi, 2015).

**Table 4.18 ESG and Low-Carbon Asset Management in Selected Asian Stock Markets**

| Country | Number of companies listed on stock exchange | Market capitalisation (US$ million) | Requires ESG reporting as listing rule | Has written guidance on carbon reporting | Offers low-carbon energy investment-related training | Has sustainability-related indices |
|---|---|---|---|---|---|---|
| Australia | 2,275 | 1,507,050 | Yes | No | Yes | No |
| China | 3,500 | 9,299,503 | No | Yes | Yes | Yes |
| Hong Kong | 2,186 | 4,443,082 | Yes | Yes | Yes | Yes |
| India | 7,497 | 4,753,385 | Yes | Yes | Yes | Yes |
| Indonesia | 566 | 520,687 | Yes | No | No | Yes |
| Japan | 3,604 | 6,222,825 | No | No | Yes | Yes |
| Korea, Rep. of | 2,138 | 1,869,629 | No | No | No | Yes |
| Malaysia | 904 | 4,55,773 | Yes | Yes | Yes | Yes |
| New Zealand | 176 | 98,685 | No | Yes | No | No |
| Philippines | 267 | 290,339 | No | No | Yes | No |
| Singapore | 749 | 1,100,000 | Yes | Yes | Yes | Yes |
| Thailand | 688 | 595,573 | Yes | Yes | Yes | Yes |
| Viet Nam | 728 | 126,502 | Yes | Yes | Yes | Yes |

ESG = environmental, social, and governance.

Source: Author based on Sustainable Stock Exchanges Initiative (2021).

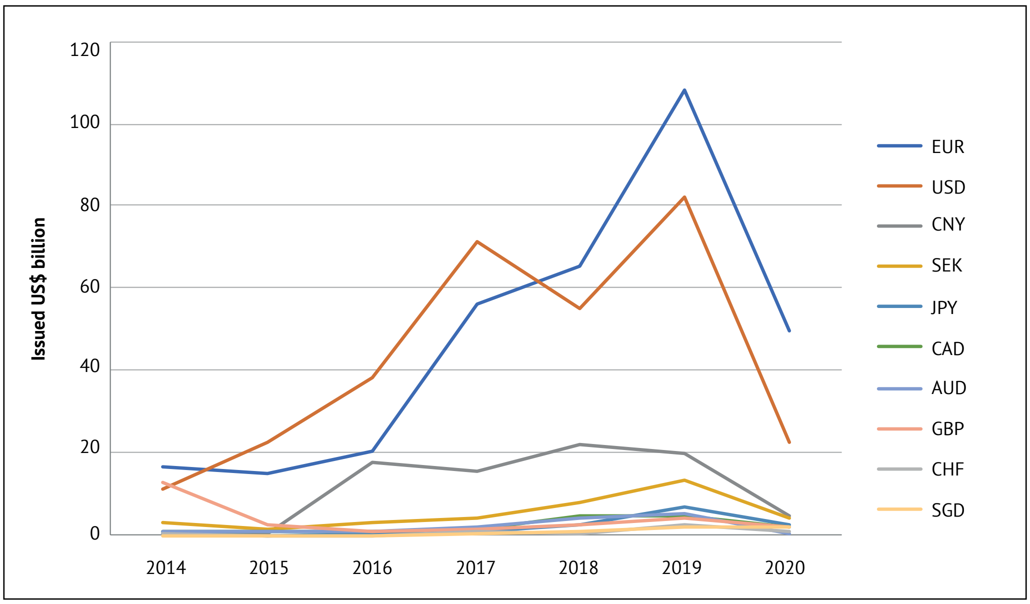
While ESG or low-carbon circular assets have no single definition, the use of a taxonomy featuring the following eight categories could be considered 'green': energy, buildings, water, waste, transport, land use, industry, and ICT investments. Subcategories could be developed to include many low-carbon services such as universities, finance, and business consulting.

### 4.3 Trends of Regional Green Bond Markets

The growth of green bond markets, in terms of issuance and volume, has been rapid since 2014. In general, bond markets may be categorised as either corporate or project, most of which are issued in dominant foreign currencies (United States dollar and euro). Figure 4.17 depicts the growth patterns of green bonds in ASEAN, which mirror global trends. Volume and loan issuance in ASEAN jumped from US$47 billion in 2014 to US$259 billion in 2019 (Climate Bonds Initiative, 2020a). This represented 3% of the global total and 12% of the ASEAN and East Asia total (Climate Bonds Initiative, 2020b). Taxonomy, regulatory, and corporate governance issues could be the reasons for the relatively underdeveloped local currency green bond markets in the developing countries of ASEAN.

Bond issuance during the pandemic witnessed renavigations in the second quarter of 2020. The Korean government issued its first green bond for US$996 million, the proceeds of which will be used to finance the mass rail transit project. Korea's Kookmin Bank issued a COVID-19 Response Sustainability Bond for US$500 million in September 2020, the first corporate initiative to refinance new and existing ESG-related projects in accordance with the bank's sustainable financing framework. In May 2020, the Government of Hong Kong, along with the Hong Kong Monetary Authority and Securities and Futures Commission, established the Green and Sustainable Finance Cross-Agency Steering Group, which is tasked with coordinating the supervision of climate risks to the financial sector.

**Figure 4.17 Changes in Global Green Bond Issuance**




Source: Study team based on Climate Bonds Initiative (2020), Interactive Data Platform. https://www.climatebonds.net/market/data/ (accessed 31 August 2021).

The Sustainable and Green Exchange was also established to serve as an information hub for low-carbon finance investments. Hong Kong's Mass Transit Railway issued a US$1.2 billion green bond to alleviate the financial damage faced by the company due to the pandemic. The Hong Kong branch of Industrial Bank also issued US$450 million of blue bonds on ocean infrastructure and US$0.38 billion of COVID-19 resilience bonds. In Japan, Mitsubishi UFJ Financial Group issued a €500 million sustainability bond, the first corporate bond issued in Japan to be linked to COVID-19.

The pandemic also put a stress test on bond markets issued in weak currencies. There are differences between categories of green bond issuance. In 2020, public sector issuers, such as national development banks, experienced a smaller decline compared with corporate sector issuers. Creating a stable and predictable policy environment for both local and foreign currency bond markets through institutional coordination and standard setting is critical. The growth of green sukuk bond markets in Malaysia (Box 4.1) offers a valuable lesson for the coordinated role of stock exchanges, institutional investors, and central banks.

### Box 4.1 Growth of the Green Sukuk Bond Market in Malaysia

Malaysia has the third-largest bond market relative to gross domestic product in ASEAN and East Asia, and it is a global leader in sukuk issuance. A sukuk is an interest-free bond that makes returns to investors without breaching the principles of Islamic sharia law. The roots of Malaysia's success in sukuk bond market growth have origins in the 1990s, when the country chose to develop bond markets as a tool to mobilise private capital in support of national infrastructure projects. The first sovereign 5-year sukuk worth US$600 million was launched in 2002. Since then, the Malaysian sukuk bond market has witnessed exponential growth with the support of the Securities Commission and the Central Bank.

The launch of the world's first green sukuk in 2017 demonstrates the country's leadership in the global sukuk market. Green sukuk are sharia-compliant investments in clean energy and other environmental assets, as characterised by the Climate Bonds Standard and Certification Scheme.

The Securities Commission Malaysia and the Central Bank of Malaysia are the two key institutions that played core roles in acquiring authenticity in the advancement of sukuk markets by issuing comprehensive regulations and best practice guidelines. The progress of the sukuk market is also supported by a wide-ranging reporting and settlement system, which has resulted in an active primary sukuk market. Further, the public pension fund also channelled a significant share of its savings into the sukuk bond markets, which in turn inspired buyer's confidence in securities and secondary markets. Sukuk issuance in 2019 reached nearly US$100 billion. Considering the impact of COVID-19, the government continues to power its well-established sukuk bond market with the issuance of a US$150 million 'care sukuk' to pay for economic relief packages and a green recovery plan. The proceeds from the sukuk will be used to finance microenterprises, female entrepreneurs, and support grants for research into infectious diseases; and to improve digital connectivity for rural schools.

ASEAN = Association of Southeast Asian Nations.

Source: ERIA study team

While many developing economies of Asia are set for an extended period of very low interest rates, there could be increased opportunities for green bond markets if downside risks are addressed and sectoral imbalances corrected through improved disclosure strategies. Some public sector issued bonds may require temporary debt relief from bond holders to respond to the adverse impact of the pandemic on borrowings.

While green bonds issued by government-backed financial entities in ASEAN focus more on building energy efficiency, corporate climate bonds have a diverse portfolio. To help drive down costs, reduce greenwashing, and have an impact on investments, the ASEAN Capital Markets Forum released a set of voluntary ASEAN green bonds guidelines in 2017. These guidelines, based on the International Capital Market Association's Green Bond Principles, seek to boost the fundamentals of bond markets, such as the consistency, transparency, and uniformity of bond issuance, across the region. The key elements of the ASEAN standards include the geographical and economic connection to the region, exclusion of fossil energy projects, and inclusion of external reviewers for the management of proceeds. Discussions are in progress to align these regional standards with the global standards of the International Capital Market Association. Implementing and reinforcing similarities between the regional and international standards imply increased requirements for disclosure, more clarity on reporting requirements, and further flexibility for issuers on the allocation of proceeds. While bond markets have become a catalyst for mobilising private investments, the banking sector continues to play a dominant role in allocating capital to low-carbon green growth before and during COVID-19.

### 4.4 The Role of Central Banks in Upscaling Sustainable Financing

Ensuring financial stability is a key mandate of central banks and regulators, therefore they have a direct role to play in mitigating climate risks and promoting low-carbon green growth. Financial institutions that have insured or lent to corporations affected by climate risks will see higher levels of claims and losses in those portfolios. Credit ratings and share prices for fossil fuel investments have already fallen dramatically, and a similar situation could occur in the oil, gas, and automobile sectors if they do not adapt in time. This would affect the network of banks that support such industries, leading to wide-ranging impacts throughout the interconnected financial system. Again, institutions that lend to and insure the affected organisations could see higher levels of claims as well as increased non-performing loans and losses arising from such portfolios. They will need to update their lending policies and systems to account for these risks and will suffer financial losses and reputational risks if they are unable to adapt in time. It is therefore clear that, in addition to impacting financial stability more broadly, climate change is a prudential risk that needs to be considered by central banks and other financial institutions, and hence also needs to be incorporated in the supervisory processes undertaken by the central banks and regulators that oversee them. Sustainable insurance developed quite significantly during March–December 2020, e.g. the Monetary Authority of Singapore (MAS) published the Guidelines on Environmental Risk Management for Insurers (MAS, 2020), which set out the regulator's expectations of environmental risk management for all insurers. The guidelines cover governance and strategy, risk management, underwriting, investment, and disclosure of environmental risk information. MAS has stated that environmental risk has potential financial and reputational implications for insurers, and deems it crucial for insurers to build resilience against the impact of environmental risk as part of their business and risk management strategies.

A similar theme was reflected in a survey by the South East Asian Central Banks Research and Training Centre on the views of central banks and monetary authorities on policies related to low-carbon energy finance (Durrani, Volz, and Rosmin, 2020), which showed that climate change is increasingly relevant and important to the operations of central banks. Many Southeast Asian countries are particularly impacted by climate change and are preparing to develop innovative financing solutions. Nearly 90% of the 18 responding central banks agreed that climate finance had become an important area of focus, particularly after the ratification of the Paris Agreement. A third of central bank governors in the region had already issued policy statements on improved framework conditions for sustainable finance solutions. Three central banks have published guidelines on climate actions. Almost all the central banks think that they should play a critical role in helping the finance industry to develop appropriate tools and policy instruments to stimulate markets for equity investments and the issuance of green bonds.

The Report on the Roles of ASEAN Central Banks in Managing Climate and Environment-Related Risks made this focus very clear (Anwar et al., 2020). It recommended developing the capacity of supervisors to monitor climate risk and integrate it into prudential supervisory frameworks. It also highlighted the need for central banks to embed ESG standards into their operations and strategies and to take the lead in working with other domestic government agencies to grow the supply of low-carbon related financial products. However, before financial institutions can begin financing broader green ventures, the supporting risk and regulatory framework has to allow climate risks to be calculated and priced more effectively.

A key starting point is therefore the establishment of a green taxonomy, accompanied by rules and guidelines to allow a more accurate understanding of climate risks and alternative assets that support low-carbon green growth. The ASEAN report recognised this as a third priority and set out the aim to adopt a principles-based ASEAN-wide taxonomy for green and transitional activities, as well as to develop ASEAN green lending principles and guidelines. The Malaysian Central Bank (Bank Negara Malaysia) has already consulted on the establishment of a green taxonomy in Malaysia and is working on finalising its climate change and principles-based taxonomy. Similarly, MAS has released its draft taxonomy for consultation.

There is a need for open disclosures of climate risk related exposures, and strategies for mitigating them. Regulators also want to ensure that consumers are provided with clear information as to the ESG components of particular investments, so that they can make their investment decisions in an informed manner. Public disclosure of these data and strategic plans of how firms will mitigate and reduce climate risks will allow the financial markets and consumers to allocate capital towards more sustainable firms and technologies. To support this, supervisors will need to undertake an additional layer of climate risk based supervisory review and oversight, to prevent 'greenwashing,' which exaggerates the environmental friendliness of investments.

In addition, we recommend that central banks and regulators establish a formal climate risk stress testing framework in the region. MAS announced that it would incorporate climate-related scenarios in their annual stress tests for the financial industry in 2022; and the Hong Kong Monetary Authority (HKMA), in December 2020, invited banks to stress test for climate change risks, allowing a high degree of flexibility in terms of methodology and granularity of information. In July 2021, the HKMA also published guidelines for banks on climate risk management, including expectations on governance, strategy, risk management, stress testing, and disclosure (HKMA, 2021). The guidance states that banks should build capability to measure climate-related risks using climate-focused scenario analysis and stress testing. Furthermore, in July 2021, The Network for Greening the Financial System – a global network of regulators collaborating on climate change – published updated climate risk scenarios that regulators and financial institutions can deploy as part of their stress-testing programmes (Network for Greening the Financial System, 2021). Such stress tests are now seen as the clearest way to signal to the financial markets that they need to take climate risk mitigation and low-carbon green growth seriously.

Another challenge for central banks and regulators is that the current risk management framework used to calculate capital requirements (the latest iteration of which is Basel III/IV), typically considers short time horizons and relies on historic loss data to estimate the severity and frequency of risks and losses. Given the lack of climate risk related historical data, current models are not able to assess climate risks and so cannot quantify them appropriately. The Basel framework is also inherently biased towards high-carbon industries since it does not consider the cost of externalities. A suggestion to overcome this weakness is therefore the potential for a requirement to add in forward-looking climate-based factors, when making lending, investing, or insurance decisions. Such factors would then increase or decrease the risk rating (and pricing) for that transaction. Similarly, there is significant consideration around whether green-supporting and brown-penalising factors should be implemented in banks' capital calculations. These would automatically boost green lending, reducing the cost of borrowing for those sectors relative to high-carbon related loans. Such a framework is already being applied by the People's Bank of China, which was one of the founding members of the Network for Greening the Financial Systems. This is in conjunction with several additional measures the People's Bank of China has taken in establishing a national taxonomy and framework for climate risk disclosures as well as expanding the domestic low-carbon green finance market.

The development of such domestic and international green finance markets, once a certifiable global standard is in place for green bonds, will be key to helping finance green projects and industries. Again, this is mentioned as an important priority in the ASEAN report discussed above and is another key consideration that should be adopted by countries in Asia. We suggest that an additional way to boost both the demand and supply of such green finance products is to require firms to hold a certain amount of green bonds within their capital structure. This is being considered and may be incorporated during the next few years in the capital requirements that banks have to set aside.

### 4.5 Using Green Investment Banks to Scale Up Private Capital

Central banks need to scale up investments in support of low-carbon green growth. During the pandemic, to develop more sustainable financial products and markets, MAS launched the Green and Sustainability-Linked Loan Grant Scheme, worth S$91.75 million, which defrays expenses incurred from engaging with independent advisers to validate green and sustainability-linked loans, and encourages banks to develop more accessible framework conditions for green and sustainability-linked loans. The Government of Japan launched a ¥2 trillion (US$18.2 billion)[2] innovation fund to support zero emission projects for the next 10 years (2020–2030). The fund will create large-scale and low-cost hydrogen production equipment. In July 2020, China's Ministry of Finance and Ministry of Ecology and Environment, along with Shanghai City Government, launched the National Green Development Fund, which seeks to assist the low-carbon transformation of the Chinese economy and reinforce the market's role in combating pollution. In its first phase, the fund raised CNY88 billion (US$13.6 billion),[3] which will be used to invest in green projects. These public injections are expected to scale up private investment.

Fostering green investment banks to scale up private financing would be an effective strategy. Some countries have made progress in creating them as channels to boost green investment. The Japan Green Fund and Malaysia's Green Technology Financing Scheme represent innovative lending frameworks that support the low-carbon energy transition (Berensmann, Dafe, and Lindenberg, 2015). The UK Green Investment Bank was established as a tool to expand financial markets and meet the UK's legally binding NDC targets cost-effectively, but it has since been privatised. Australia's Clean Energy Finance Corporation was also initiated with the same purpose. New York Green Bank was established by the state government to attract more private investment for its low-carbon energy transition.

However, the rationale and motivations for creating green investment banks vary across countries, as illustrated in Table 4.19.

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[2] Exchange rate: US$1 = ¥109.967 (3 September 2021).

[3] Exchange rate: US$1 = CNY6.45443 (3 September 2021).

**Table 4.19 Rationale for Creating Green Investment Banks**

| Country and entity | Capital market efficiency | Climate change mitigation | Energy price rationa-lisation | Increase grid reliability | Green job creation | Part of national green growth policy | Increase sustaina-bility |
|---|---|---|---|---|---|---|---|
| Australia: Clean Energy Finance Corporation | x | x | | x | | x | |
| Japan: Green Fund | | x | | | x | x | |
| Malaysia: Green technology Corporation | | x | | | x | x | x |
| UK: Green Investment Bank | x | x | | | x | x | x |
| US: New York Green Bank | x | x | | x | | | |
| US: Connecticut Green Bank | x | x | x | x | x | | |

UK = United Kingdom; US = United States.

Source: ERIA Study Team.

In addition to climate change mitigation, the mission statements of green investment banks have cited factors such as resilient infrastructure, local development, global competitiveness, energy security, and green job creation. However, all green investment banks share the underlying goal of addressing investment barriers and catalytic private investment that drive low-carbon green growth. Green investment banks – as in Japan, Malaysia, and the UK – are typically established as special purpose entities that are granted independent authority to meet their mandates and mobilise private capital using least-cost solutions to reduce public expenses. In the United States and Australia, these green bank entities seek to provide additional capital to facilitate transactions that would not occur without them.

During the pandemic, Thailand outlined new financial mechanisms to establish the country as an electric vehicle hub in the next 5 years (2021–2025). Malaysia's Sustainable Energy Development Authority announced plans to build 4.3 gigawatts of solar cell module manufacturing capacity, making it the third-largest producer in the region. Korea's W66 million Green New Deal plans to invest in green infrastructure. Establishing specialised green investment banks will help these initiatives to spur investment from the capital markets.

## 4.6 Barriers to Mobilising Private Capital for Low-Carbon Green Growth

Financing low-carbon initiatives is significantly different from conventional investments. In the direct finance model, lenders scrutinise the entire asset portfolio to estimate cash flow to service their loans. For a low-carbon project, assets are examined and the assets are financed as stand-alone entities rather than as part of a broader corporate balance sheet. This means that a low-carbon project must be able to generate sufficient cash flow to cover all operating costs and debt service, while providing an acceptable rate of return on the equity invested. This is a challenge, given that low-carbon investment must mitigate undue financial risks and adhere to NDC goals. The types of risk identified for mobilising private finance could be classified into policy, institutional, and market barriers (Table 4.20).

**Table 4.20 Investor Views on the Challenges of Mobilising Private Finance**

| What do you perceive as barriers to receiving private finance and bank loans? (Respondents could choose multiple answers) | | | | |
|---|---|---|---|---|
| **Category** | **Obstacles** | **ASEAN** | **ASEAN+3** | **ASEAN+6 plus Mongolia and Hong Kong** |
| **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-favourable interest rates | 28% | 23% | 25% |
| | Rising interest rates | 28% | 23% | 21% |
| | Technology advancement risks | 22% | 18% | 17% |
| | Unstable consumer market | 11% | 9% | 13% |

ASEAN = Association of Southeast Asian Nations; ASEAN+3 = 10 ASEAN Member States plus China, Japan, and the Republic of Korea; ASEAN+6 = ASEAN+3 plus Australia, India, and New Zealand.

Note: Colours are on a green–red spectrum: green indicates more support for a response, while red indicates less support.

Source: Anbumozhi et al. (2020).

Some 31% of 200 respondents surveyed by the ERIA (Anbumozhi et al., 2020a) before the pandemic considered the Paris Agreement somewhat important to their investment decisions and 55% said it was very important. More than 50% of respondents reported that high investment amounts, up-front capital, and longer recovery periods are major institutional barriers to driving their low-carbon investment decisions. Inconsistent support policies for renewable energy development and complex procedures in power purchase agreements were also highlighted as policy obstacles. Market barriers faced by commercial banks included lack of capacity to value risks in monetary terms associated with small-scale energy projects. Further, they lacked incentives given the relatively high cost of evaluating non-standardised small-scale low-carbon energy projects and relatively high credit risks.

The banking sector could provide leadership in financing the low-carbon economy by increasing the availability of risk-adjusted lending matched to investor requirements. Instances where attractive risk-return profiles already exist offer greater opportunities for commercial banks to upscale and retroflex proven lending models. In situations where low-carbon investments offer larger profit revenue, but are coupled with uncertain risk returns, commercial banks can work jointly with central banks and green investment banks using their blended finance, risk sharing, and project development tools.

The survey also revealed that, for many types of bank-financed activities, there is a lack of benchmarks to determine whether a bank's overall funding is in line with the NDC targets set by the government. Roadmaps that show economy-wide financing needs by country, type of bank transaction, or asset type are needed to fill the gap and allow the finance sector to benchmark their portfolios to enhance their banking sector role in transitioning to a low-carbon energy future. However, in most of the commercial banks in developing countries of ASEAN and East Asia, the concept of low-carbon financing, other than for conventional renewable energy projects, is relatively new, and most bank officials have little experience or training in due diligence of complex low-carbon technology projects that have multiple co-benefits as well as risks. However, the main challenge is that many of the co-benefits are difficult to monetise to generate a revenue stream for investors. Therefore, governments should do more to offer a revenue stream, or impose regulation, especially on carbon pricing. Overall lending for the low-carbon economy in most of the developing and least developed countries constitutes only a minor share of total profitable lending and is often done at a premium risk guarantee compared with conventional finance, in part because of additional policy uncertainty in many places.

Developing countries have several strategic sectors whose transformation is central to stimulate green recovery. However, the key challenge for institutional investors in many countries is careful selection of the type of low-carbon technological and infrastructure investment that can bring both jobs in the short run and economic benefits in the medium term. Pricing carbon and removing fossil fuels subsidies can accelerate the low-carbon transition and raise revenues for the public financing of low-carbon energy infrastructure that would have leveraging effects in attracting private capital. Nevertheless, green stimulus appears to be most effective in countries that have commercial and investment banking systems which already possess the capacity required for implementing those measures (Chen et al., 2020; Engström et al., 2020).

## 5. Powering the Economic Recovery Towards Low-Carbon Green Growth

The COVID-19 pandemic has exposed the fragility of interconnected economic systems. The lockdowns needed to handle the health crisis have resulted in a sharp contraction of aggregate demand, supply disruptions, and loss of revenue in all sectors of the economy in ASEAN and East Asia. The unprecedented crisis has raised uncertainties for already vulnerable communities, industries, and financial institutions.

The comprehensive responses of governments in the region fall into three phases: emergency rescue, economic recovery, and transformation to a new form of sustainable growth. These three phases overlap and interweave, but essentially involve three kinds of policy instruments – health and social security, economic stimulus, and green growth – which are cross-cutting.

Well-designed stimulus packages, such as the ACRF, can boost aggregate demand and employment in the short term; lift productivity and competitiveness in the medium term; and bring about the transformation needed for inclusive, sustainable, and resilient growth. Both the content and scale of economic stimulus packages matter. Many examples of sustainable benefit investments and activities can be launched quickly, but must be anchored with the target to meet the Paris Agreement and the SDGs by 2030 and a net zero economy by 2050. Further, stimulus packages can be built to exploit transformative opportunities brought forth by digital technologies and the innovation potential of industries, as articulated in the ACRF. The pandemic recovery must be driven by appropriate policy interventions that fully capitalise on market potential, but must be part of coordinated actions by governments, industries, cities, and financial institutions.

Aligning the long-term objective of low-carbon green growth during the economic recovery phase has become critical for governments to avoid further high-carbon lock-in. Priority actions for governments shall include the following:

- Develop new policy configurations to make appropriate investments that are labour-intensive in the short run and have high multiplier and co-benefits in the longer run. Investments with these characteristics include low-carbon infrastructure such as renewable energy assets, grid modernisation, energy efficiency improvement in the building sector, R&D in clean and fuel-efficient technologies, supporting climate-smart resilient agriculture, restoration of degraded forests, etc. It can take time to plan and execute such investments. More efficient operations and coordination are imperative in many countries.

- Design supporting policies to maximise the benefits of free trade and exploit comparative advantages in global supply chains and green investments, including carbon prices, supportive regulations, and bailout conditions – learning from sector leaders, wherever they are located. Falling fossil fuel prices provide an opportunity for carbon pricing and the removal of inefficient subsidy reforms, and can be part of wider tax policy reforms to restore fiscal sustainability.

- Combine investments in physical infrastructure with the provision of soft infrastructure such as skills training and other innovation related assets to maximise the impact of long-term productivity growth.

To deliver low-carbon resilience, industries must accelerate the deployment of existing technologies, innovative new business models, and swiftly harness the opportunities available with digital transformation. To scale up actions, green industries should work with governments to:

- Deploy targeted green industrial investments that accelerate innovations and create the next generation of low carbon in areas such as electrical vehicles, hydrogen fuel, and carbon capture and storage, which will facilitate industrial restructuring;

- Formulate well-designed supplier technical assistance programmes for the digitalisation of supply chains that can ensure fruitful interactions across stakeholders and improve resilience against external shocks; and

- Help SMEs to overcome technology, financial, and innovation barriers through better allocation of resources and risk-sharing mechanisms towards improved resource efficiency.

Empowering city and local governments to plan and implement low-carbon, climate-resilient and circular action plans are an essential part of the green transformation – revitalising local economies and building social cohesion. City governments must work with national governments to:

- Redesign existing infrastructure configurations such as energy, water, waste, and transport to seize the opportunities available through smart technologies for enhanced service delivery and improved economic competitiveness of the cities;

- Promote an agile and flexible model of city governance through key performance indicators for smart collaborative tools – adopting the circular economy model to keep the value of goods and products at their highest, prevent waste generation, and reuse waste as a city asset; and

- Facilitate the uptake of innovative financial mechanisms, including green bonds, social bonds, and transition bonds, to finance low-carbon resilient infrastructure, neighbourhood transport development, and affordable smart housing.

The power and influence of financial systems, if channelled towards a net zero future, could accelerate the trajectory of low-carbon green growth. To make meaningful and sustainable financial architecture, the following should be done:

- Leverage central banks and their supervisory control to direct capital to discourage emission-intensive investments and to increase commercial banks' lending towards low-carbon infrastructure.

- Create and reinforce the mandate of green investment banks to leverage private financing that could deliver transformative investments.

- Establish a standard taxonomy for climate bonds and other green assets, and align the regional criteria for carbon disclosure and transparency with global standards for evaluating the risks and opportunities associated with private capital mobilisation.

Now is the time to recommit governments, industries, cities, and financial systems to play a leadership role in driving the transition to a low-carbon economy and a net zero future. Early implementation of these measures, as part of the economic recovery phase, will boost stakeholder confidence, counteract the trade-off pressure, and create much-needed co-benefits and spillover effects within the economy. While countries and key economic actors have accumulated experience, deep knowledge, and the means to emerge from this crisis stronger and in a sustainable way, there is a significant risk that the economic recovery could go the other way. Going back to the carbon-intensive and polluting old normal would be the most dangerous path. Postponing the necessary interventions, new innovations, and essential investments could increase the cost of tackling climate change and would lead to great deterioration of the social discipline that we all need to manage future risks.

# Chapter 5

## Catalysing Regional Cooperation for Seizing the Opportunities

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Asia's economic performance through its open regionalism policies is remarkable. The Association of Southeast Asian Nations (ASEAN) Member States (AMS), China, and India – along with the advanced economies of Japan, the Republic of Korea (henceforth, Korea), Australia, and New Zealand – are in the midst of historic transformation into a low-carbon economic system that has the potential to dramatically improve the resilience and living standards of the region's 3 billion people.

Addressing global issues such as climate change requires urgent policy actions at the national level. Many countries are implementing core policies that support low-carbon green growth: regulatory interventions, market-based instruments (e.g. carbon pricing and targeted support to low-carbon technology), diffusion innovation, and sustainable consumption. Several obstacles stand in the way of effective implementation of such policies. One of the most important is the continued prioritisation of carbon-intensive activities by existing policy frameworks due to economic interests. Inadvertently or not, this creates misalignment between existing regional policy frameworks such as the ASEAN Economic Community (AEC), the Regional Comprehensive Economic Partnership (RCEP), and the ASEAN Comprehensive Recovery Framework (ACRF), hindering the progress towards global targets such as the Paris Agreement and the Sustainable Development Goals (SDGs).

There is consensus on the need to achieve a net zero economy as quickly as possible. However, it is equally clear that transformational integrated policy changes and structural changes in key economic sectors are not happening at the required speed. The coronavirus disease (COVID-19) pandemic has its own impact on the economy, but has also created new once-in-a-generation opportunities for implementing hard policy reforms through economic recovery and stimulus packages. The need to accelerate the low-carbon transition as part of the pandemic recovery is unquestionable, but the question is how to do it in a cost-effective way.

This chapter presents a broad diagnosis of new regional cooperation opportunities in areas essential to complete the transition to a low-carbon economy by 2030 and a net zero economy by 2050. It highlights where regional cooperation and coordination can have the greatest impact, by bringing together frontier knowledge of how regional cooperation has succeeded in the past. It points to a number of policy areas – trade, finance, taxation, carbon markets, innovation, and capacity building – where regional cooperation reduces the cost of implementing national actions and complements global pacts.

## 1. Emerging Regional Cooperation Architecture in Support of Low-Carbon Green Growth

Figure 5.1 provides an overview of selected regional cooperation initiatives that have been introduced in Asia during the past 20 years, which have an economic, environmental, and low-carbon development component.

Of these, two are singled out here for additional discussion given their strong relevance to post-COVID-19 recovery strategies in the region at large but especially in Southeast Asia. The first is the ASEAN Smart Cities Network (ASCN), a collaborative platform established in 2018 to support smart and sustainable development.

**Figure 5.1 Regional Cooperation Initiatives in Asia**


Source: ERIA Study Team.

At a high level, its approach seeks to encourage inclusive development strategies that are respectful of human rights and fundamental freedoms, as inscribed in the ASEAN Charter. Moreover, its networking aspects – connecting leaders and specialists from different countries – are designed to enhance mutual understanding across cultures. Currently, the ASCN has 26 pilot cities as members and has established partnerships with 33 external partners, including from Japan, Korea, and the United States (US).

The second is the ACRF, a cooperative framework designed to support countries from across Southeast Asia to respond to and recover from the COVID-19 pandemic collectively. It is designed as a consolidated framework – one that brings together all new and existing sector and thematic initiatives that fall under the umbrella of ASEAN. Its focus covers both specific near-term recovery needs and an overall crisis exit strategy. A key consideration for the development of the consolidated framework is to promote consistent and coordinated measures and ensure long-term sustainability and social inclusion. As this framework was developed at the 36th ASEAN Summit in June 2020, it remains to be seen how effectively countries will be in aligning their national recovery strategies with the ACRF priorities.

As both initiatives suggest, ASEAN has sought to characterise some of the benefits of regional cooperation in terms of greater sharing of ideas, resources, experiences, and perspectives. Beyond this, though, both efforts also hint at an important leadership role for a diverse range of subnational actors in driving economic and social transformation, and the importance of their inclusion at the table. To that end, while national and central governments design and formulate broad strategic plans, it is cities and subnational authorities that will adapt and implement such plans at the local level, with people's participation. Further, if well executed, these measures could help to propel these communities to greater economic competitiveness as Asia's economies increasingly find themselves on a global stage.

## 2. Role of Capacity Building – Knowledge Sharing and Policy Networks

### 2.1 Reconciling Global and National Priorities

Many countries with a net zero target (NZT)[1] have started to incorporate it directly into their near-term nationally determined contributions (NDCs). Achieving a global transition to NZT by 2050 without effective regional and international cooperation will be a major challenge. Strong regional cooperation is of immense importance for innovating and disseminating cost-effective technologies to achieve the NZT. More regionally coordinated actions are essential amidst the COVID-19 pandemic to seize opportunities across borders that lead to reducing the cost of implementing the stimulus agenda and maintaining competitiveness. Recent literature (e.g. Li and Zhang, 2018; Mo, Zhai, and Lu, 2017) has argued strongly that regional economic cooperation – through liberalised trade and investment, carbon markets integration, and increasing investment in innovation on low-carbon products and services – could contribute not only to lowering emissions, but also to raising long-term economic growth prospects.

Figure 5.2 illustrates the evolution of formalised institutions in support of economic cooperation and integration, which started in 1967 with the formation of ASEAN. Accelerated liberalisation of trade, investment, infrastructure connectivity, and technology transfer in the 1980s and 1990s was made possible through this institution, which served as a platform for networked economies. Individual countries continued to benefit from public and private investment in innovations, financing, and institutional reform, such as eliminating domestic content rules, which made the transition to a low-carbon economy less expensive. Regional cooperation, drawing on the experience and comparative advantage of Asian economies, will further amplify more locally focused programmes.

[1] Net zero refers to the balance between the amount of greenhouse gases produced and the amount removed from the atmosphere. Net zero is achieved if the amount added is no more than the amount taken away.

**Figure 5.2 Evolution of Institutions Supporting Regional**

**Regional integration organisations in Asia**

- Association of Southeast Asian Nations (ASEAN) 1967
- Economic Cooperation Organization (ECO) 1985
- South Asian Association for Regional Cooperation (SAARC) 1935
- Asia-Pacific Economic Cooperation (APEC) 1939
- Greater Mekong Subregion Economic Cooperation Program (MS) 1992
- Central Asia Regional Economic Cooperation Program (CAREC) 1997
- South Asia Subregional Economic Cooperation (SASEC) 2001

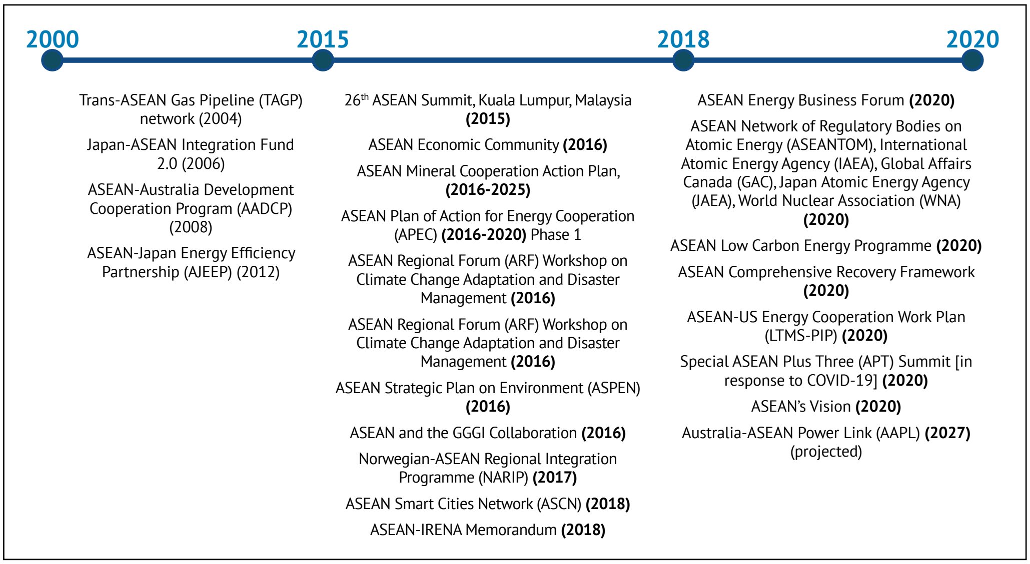
Source: ERIA Study Team.

The foundations for regional cooperation are based on the endowment mix of individual economies – notably, their respective endowments of natural, manufactured, human, and social capital. Opportunities for collaboration emerge from the heterogeneity across economies. These are the foundations for the five pillars on which regional cooperation can be built by strengthening (i) regional innovation systems; (ii) collective learning and capacity building; (iii) free trade in all goods and services, including low-carbon goods and services; (iv) integration of carbon markets; and (v) pooling of regional public and private financial resources (Anbumozhi and Yao, 2016). Drawing on Anbumozhi and Yao (2016), this chapter discusses the following issues on climate change: ways to seize non-market opportunities, such as joint research and policy networking; capacity building through regional cooperation; ways to seize market-based opportunities, such as knowledge, and trade in low-carbon goods and services; and boosting investment flows in low-carbon goods and services. Following an evidence-based approach to transforming Asia into a low-carbon green Asia with net zero emissions, this chapter will highlight a few good examples of policy initiatives taken across the region for other countries to emulate.

## 2.2 ASEAN's Regional Framework on Climate Change

Climate change has long been addressed by the ASEAN Ministerial Meeting on Environment (AMME), with the ASEAN Senior Officials' Meeting on Environment reporting to the ministerial body. The ASEAN Socio Cultural Community (ASCC) Blueprint 2025 discussed environmental and climate change issues in four key areas – biodiversity and natural resources, environmentally sustainable cities, sustainable climate, and sustainable consumption and production – which were articulated into seven strategic priorities. The ASEAN Working Group on Climate Change (AWGCC), formed in 2009, has three mandates: (i) enhance regional cooperation in climate change via its action plan; (ii) promote collaboration amongst ASEAN sectoral bodies; and (iii) articulate ASEAN's concerns and priorities at international fora. The AWGCC held the first ASEAN Climate Change Partnership Conference in 2018 in Manila to introduce and build awareness of the need for coordination in addressing climate change issues. The second conference, held in Singapore in 2019, provided a platform to share experiences and identify potential cooperation in addressing climate change. Although the AWGCC has delivered a number of collaborative projects involving ASEAN Dialogue Partners in recent years, it is clear that the AWGCC lacks a clear mandate to coordinate beyond the AMME working groups. Unfortunately, with the passing of time, dialogues on climate change have appeared beyond the domain of the AMME and ASCC blueprint.

**Figure 5.3 Key ASEAN Cooperation Initiatives on the Economy, Energy, Environment, and Climate Change**




ASEAN = Association of Southeast Asian Nations, COVID-19 = coronavirus disease, GGGI = Global Green Growth Institute, IRENA = International Renewable Energy Agency, LTMS-PIP = Lao PDR–Thailand–Malaysia–Singapore Power Integration Project.

Source: ERIA Study Team.

For example, the ASEAN Plan of Action for Energy Cooperation (APAEC), which is the blueprint for energy cooperation in the region, plays a vital role in setting a sustainable future for the ASEAN energy landscape. The APAEC sets the work plan for the ASEAN Ministers on Energy Meeting (AMEM), which has consistently promoted renewable energy transition not only to fuel the region's energy security, but also to control carbon emissions. The ASEAN Ministerial Meeting on Agriculture and Forestry has increasingly promoted collaboration in protecting agriculture, forestry, and food security amid the climate crisis. The ASEAN Health Ministerial Meeting has acknowledged the challenge posed by climate change on public health. As the region is prone to natural disasters and is increasingly experiencing the impacts of climate change, ASEAN could see increasing cases of climate-triggered diseases such as dengue, malaria, and respiratory diseases. Prakash (2018: 22) cautioned that 'Long coastlines and heavily populated low-lying areas make the region of more than 640 million people one of the world's most vulnerable to weather extremes and rising sea levels associated with global warming'. There is an urgent need for effective regional cooperation to assist with building both physical and human capital to mitigate this challenge.

The future planned under the APAEC phase II – regional cooperation projects – is listed in Figure 5.4, including institutional propositions to achieve carbon neutrality in 2059.

**Figure 5.4 Proposed Regional Cooperation Projects in Energy and Environment**

2000

**United Nations Decade of Landscape Restoration 2021-2030**

**Endorsement of APAC Phase I1: 2021-2025**
- ASEAN Paver Grid (APG) - (HAPUA) (LTMS-PIP)
- Trans- ASEAN Gas Pipeline (TAGP)
- Coal and Clean Coal Technologies
- Energy Efficiency and Conservation
- Renewable Enerey
- Regional Energy Polity and Planning
- Civilian Nuclear Energy

ASEAN-EA: Rolling Work Programme 2019-2021, including support for the development of the APAC Phase II

Carbon Neutral Strategy 2050

ASEAN = Association of Southeast Asian Nations, HAPUA = Heads of ASEAN Power Utilities/Authorities, IEA = International Energy Agency, LTMS-PIP = LTMS-PIP = Lao PDR–Thailand–Malaysia–Singapore Power Integration Project.

Source: ERIA Study Team.

Several weaknesses in the regional governance structure limit the region's ability to tackle cross-cutting issues such as climate change. Most importantly, information sharing is limited amongst the different ASEAN sectoral bodies, ASEAN entities, and the ASEAN Secretariat. Ironically, the ASEAN Joint Statement on Climate Change to the 25$^{th}$ session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCC COP 25) in November 2019 reaffirmed 'the principle of common but differentiated responsibilities and respective capabilities (CBDR-RC)' in light of climate challenges and differences in national circumstances (ASEAN, 2019b).

As a regional organisation invested in meeting transboundary challenges together, ASEAN is an institution that has the convening power to convince Dialogue Partners to prioritise climate action, channel public financing, and provide capacity building.

The time frame for meeting the objective of a temperature rise well below 2°C has been shortened significantly with the COVID-19 pandemic. A business-as-usual scenario for the global economy will not bring any changes or benefits to countries trying to meet their international obligations. COVID-19 may be the crisis of a generation, but it is also a critical opportunity for governments, regional groupings, and businesses to make changes to the conduct of business that addresses the new challenges head on. Recognising the urgent need for coordinated actions for the COVID-19 pandemic exit strategy for the region, the 37th ASEAN Summit promulgated the ACRF. The five strategic areas of the ACRF are intended to address both the region's immediate needs during the reopening stage for a successful transition to the new normal as well as medium- and long-term needs through the stages of COVID-19 recovery and for longer-term sustainability with net zero emissions. The framework rests on commitments to create jobs, accelerate economic growth, and achieve environmental sustainability.

### 2.3 Regional Collaboration: Learning from Country Experiences

It is well documented that Japan, Korea, and China have been at the forefront of controlling carbon emissions by instituting appropriate policy measures at the sectoral and national levels (Kharecha and Sato, 2019; Winchester and Reilly, 2019; and Duan et al., 2018). Drawing on the experiences of Japan and China, Asia's big emerging economies, such as India, Viet Nam, and Indonesia, have begun taking actions in the form of voluntary targets and policy commitments to improve carbon efficiency. Nevertheless, the realisation of these commitments in Asian emerging economies has varied and is constrained by barriers including a lack of technological innovation and dissemination, and financial deficiencies for promoting innovation (Durmusoglu et al., 2018). Thus, regional/international funding and technology innovation and transfer are imperative for effective functioning of low-carbon energy systems to achieve the NZT by 2050 in Asia. The region should enhance its capacity to make better use of existing institutions, human capital, and funding sources. An interesting question is what the developed and emerging economies of Asia can demonstrate to other Asian economies in terms of instituting policy frameworks for transforming Asia into a net zero economy.

The similarities amongst some Asian countries, such as urbanisation (measured by the annual percentage change in the urban population) and air pollution in cities, enhance the opportunity to learn from each other. Hence, discussion in this subsection is focused on what developing Asian countries can learn from developed and emerging Asian economies in sectors that have common characteristics. Creditable efforts by China have included energy-saving laws and regulations; carrying out annual assessment evaluations; increased public budgets to encourage energy savings; and respective adjustments in tax, price, and financial policies. Research on improving the carbon sink capacity of forests has been encouraged through financial support. These emission reduction methods seem to be cost-effective: 'What once seemed unattainable targets to Chinese economic authorities are now viewed with confidence. Officials have been pleasantly surprised at the rate of decrease in costs and are now talking confidently of reaching the high point of the emissions intensity reduction' (Garnaut, 2011: 56).

China's afforestation programme could be a good source of learning for Indonesia, which has serious deforestation problems. Land use, land use change, and forestry are central to climate change discussions in Indonesia. Changes in these sectors are strongly correlated with the country's emission trajectory. Better forest management will be critical for reaping the highest social and environmental benefits from the Reducing Emissions from Deforestation and forest Degradation plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks (REDD+) programme. The potential for achieving such benefits is very high if the management of forests is placed in the hands of those who push for sustainable practices, which is exemplified in India. In this context, it may be useful to observe India's forest management initiatives, which aim to strengthen community participation in the sustainable use of forests. To achieve the active participation of communities, capacity building programmes to increase local communities' awareness of forest conservation have been implemented at the subnational level, which can also be applied in Indonesia. The development of community-based forest management in Indonesia has gained momentum since 2014. The Indonesian government committed to allocate 12.7 million hectares of forestland to local communities through various schemes of the Social Forestry Programme. By early 2019, the total forest area managed by the local community through the Social Forestry Programme was only 2.7 million hectares, involving more than 0.5 million households (Suharjito and Wulandari, 2019). Thus, local communities administered only about 21% of the committed forestland 5 years since its announcement, which indicates that government regulations to constrain deforestation are still relatively ineffective. Hence, the Indonesian government's target of making its forests a major carbon sink by 2030 may be difficult to achieve as long as there are economic gains from carrying out unsustainable forestry practices, mainly due to the prevailing poverty in the local community.

Strict regulation is in place in East Asian countries for new vehicles to comply with airborne emission standards. Further, countries such as China and India have significantly promoted the use of mixed-fuel motor vehicles and have popularised the use of liquefied petroleum gas in auto-rickshaws and taxis in cities. China has increased resources for coal liquefaction projects and encouraged research into alternative fuels.[2] In developed countries, such as Japan, electric vehicle (EV) market shares have remained at a low level. By 2017, China accounted for more than half of all EV sales globally (IEA, 2018) (Box 5.1).

India has concentrated its efforts on improving and promoting public transportation, with long-term plans to ensure the availability of efficient and convenient public transport. Like China, India is supporting research and development (R&D) programmes on the cellulosic extraction of ethanol and butanol from agricultural waste and crop residues. As in the case of China, India has introduced compressed natural gas operated public transport, including three-wheelers in big cities, which has significantly reduced

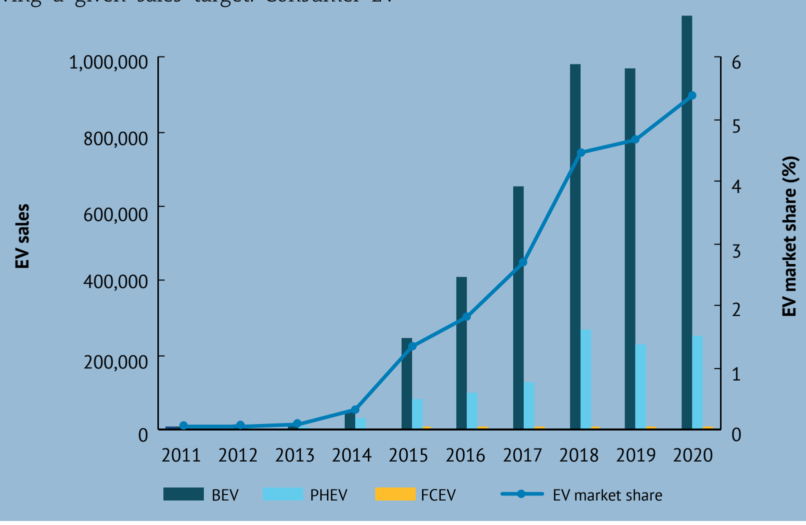
[2] Coal to liquids 'results in a fuel with appreciably less (5-12%) life cycle GHG emissions than the average US petroleum-derived diesel...Coal and Biomass to Liquids can produce fuels, which are economically competitive when crude prices are equal to or above USUS$93/bbl and which have 20% lower life cycle GHG emissions than petroleum-derived diesel' (National Energy Technology Laboratory, 2009: vi).

### Box 5.1 China's Electric Vehicle Market – The Success Story

The Chinese government introduced a package of electric vehicle (EV) promotion policies at the launch of the 'Ten Cities, Thousands of EVs' project in January 2009. The project was initially implemented in 13 pilot cities and focused on subsidies for purchasing EVs for public transport, taxis, public affairs, sanitation, and postal services (Ministry of Finance, China, 2009). In May 2010, purchase subsidies were extended to cover private purchases of EVs in six cities – Beijing, Shenzhen, Shanghai, Hangzhou, Hefei, and Changchun (Ministry of Finance, China, 2010). The number of cities in which purchase subsidies for private EVs were given gradually increased to 88 in 2013 and was extended nationwide in 2016 (Ministry of Finance, China, 2015).

Incentives for EV manufacturers in China have been in the form of model development awards, manufacturing awards, and monetary rewards for achieving a given sales target. Consumer EV incentives have been in the form of monetary and non-monetary incentives, including purchase subsidies, purchase tax exemptions, and exemptions from purchase restrictions. EV drivers have also been exempted from driving restrictions, vehicle and vessel tax, parking fees, bridge and road tolls, insurance fees, and public charging fees; and have had preferential access to bus lanes (Wang et al., 2019). To promote the transformation of the EV industry from a subsidy-driven model towards market-oriented development, China has begun to phase out its subsidies for purchasing EVs in a step-by-step way.

Sales of battery EVs have seen particularly strong growth, at least partly because of policies favouring battery EVs (Hao et al., 2020). Fuel cell EV technology is still relatively underdeveloped and there is a shortage of hydrogen refuelling stations (Matsumoto, 2019).




BEV = battery electric vehicle, EV = electric vehicle, FCEV = fuel cell electric vehicle, PHEV = plug-in hybrid electric vehicle.

Note: EV market share is as a share (%) of total car sales.

Source: CAAM (2021), ERIA Study Team.

air pollution.[3] With the objective of promoting eco-friendly vehicles, the Government of India launched the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) scheme in 2015. Many carmakers in India have been working on EVs, and the penetration of battery EVs has increased significantly in the last 5 years. Several start-ups have emerged, and their respective products and technologies are competing with conventional car manufacturers. Nevertheless, there is still a long way to go for the industry to reach

[3] The California Energy Commission found that compressed natural gas reduces emissions by 30% in cars and 23% in buses compared with gasoline and diesel (Wang and Huang, 2000).

a parity point with conventional internal combustion engines vehicles. Passenger vehicle demand has been very low, so only a few original equipment manufacturers have brought their products to market. However, the two-wheeler and three-wheeler EV segments have increased significantly in India (Morder Intelligence, 2020). Each state government across India has announced its own EV policies. As in the case of China, some of them incentivise the supply side, while others promote the demand side. Some EV policies promote both the supply and demand sides through incentives, discounts, and other benefits (Transport Policy.net, n.d.). These policies are driving the growth of EVs in India in a slow but steady manner (National Automotive Board, India, 2021).

Amongst the six major ASEAN economies, Indonesia, Malaysia, and Thailand have shown a keen interest in promoting EV production and consumption by instituting appropriate macroeconomic policies. For example, in March 2017, the Thai government launched EV promotions for cars and other vehicles, covering three types: hybrid EVs, plug-in hybrid EVs, and battery EVs. Thailand's Board of Investment has offered promotional privileges, such as tax holidays of 5–8 years and import duty exemptions for cars and machinery. The promotions include passenger cars, pickups, and buses with different rates of privileges based on production technology (Maikaew, 2017). Eight more important EV parts have been added to the corporate income tax exemption for 8 years by the Thai government, including batteries, traction motors, battery management services, DC/DC converters, inverters, portable electric vehicle chargers, electrical circuit breakers, and EV smart charging systems. Four Japanese carmakers – Toyota, Nissan, Honda, and Mazda – have been granted privileges for hybrid EVs, while Mercedes-Benz, BMW, and SAIC Motor-CP all acquired privileges to build plug-in hybrid EVs. Thus, the EV policies are tailored to support assembly and component production, which will exert an impact on technological upgrading of the EV supply chain. Under the 2014 National Automotive Policy, the Malaysian government introduced reforms to boost the production of energy-efficient vehicles in the country's automotive industry (Zulkifli et al., 2016). In November 2020, Thailand's Board of Investment introduced a new EV package to focus on battery electric vehicles (BEVs), local production of critical parts, and the inclusion of commercial vehicles of all sizes as well as ships (Thailand Board of Investment, n.d.).

Viet Nam and the Philippines appear to have the same objective as Indonesia, Malaysia, and Thailand of joining in the EV supply chain through component production and assembly lines. However, government policies are not yet well articulated to attract private sector involvement in the EV supply chain. Singapore does not seem to be promoting EVs enthusiastically, as the public transport system in Singapore has been well developed to limit the number of private vehicles on the road (Schröder, Iwasaki, and Kobayashi, 2021a).

People living in major cities in ASEAN emerging economies like Thailand, Viet Nam, Indonesia, the Philippines, and Malaysia suffer from poor access to, and availability of, timely socio-economic services. The concept of a smart city has been used in other parts of the world to eliminate such constraints to promote good living conditions with efficient resource allocation.[4] Rapid urbanisation within ASEAN has led to the formation of the ASCN, with the selection of 26 pilot cities in 2018. The ASCN's aim is to help AMS harness technological and digital solutions and thus improve the lives of people across the urban–rural continuum. Those technologies are expected to bring sustainability benefits to cities and subregions. Although regional cooperation amongst cities exists in different forms, their potential is often overlooked. The ASEAN Sustainable Urbanisation Strategy and the ACRF offer these cities a framework for working together. In this context, reduced costs and net benefits are worth mentioning. In March 2018, Australia announced an AU$30 million fund to support smart city development in ASEAN (Straits Times, 2018). In July 2018, five agreements were signed during the opening ceremony of the Inaugural ASCN Meeting. Amongst them, the most notable was an agreement between the United Nations Development Programme (UNDP) and the Japan External Trade Organization (JETRO), which expressed support for the ASCN in the context of promoting sustainable development in the Asia-Pacific (JETRO, 2018). An agreement was also signed in 2018 between Thailand's Amata Smart City Corporation in the province of Chonburi and the Yokohama Urban Solutions Alliance to set up a Smart Grid Project and build a new waste-to-energy power plant, amongst other measures (Tang, 2018).

### 2.4 Market-Based Instruments

Market-based instruments (MBIs) have the potential to become a major mechanism for managing a wide range of environmental concerns (Whitten, van Bueren, and Collins, 2003). In some countries, a variety of MBIs is being tested and applied to environmental problems. As MBIs aim to achieve emission reductions where marginal reductions are cheapest, they have greater potential to achieve efficiency gains compared with command-and-control (CAC) regulatory instruments. Many countries in the region have started introducing a carbon trading market and carbon pricing schemes to boost a low-carbon economy. Congestion charging and tradable renewable energy certificates are other examples. MBIs are more difficult to use when the impact of the relevant externality is difficult to assess or varies significantly (e.g. weather or time of day).

There has been a noticeable shift in favour of tradable permit programmes in the Asia-Pacific region in recent years. For example, the Korea emission trading scheme (K-ETS) was launched on 1 January 2015, becoming East Asia's first nationwide mandatory emission trading scheme and, at the time, the second-largest carbon market after the EU ETS. The K-ETS covers 685 of the country's largest emitters, accounting for about 73.5% of national greenhouse gas (GHG) emissions. It covers direct

[4] A smart city is a city area that uses different types of electronic methods and sensors to collect data. Insights gained from the data are used to manage assets, resources, and services efficiently; in return, the data are used to improve operations across the city. This includes data collected from citizens, devices, buildings, and assets, which are processed and analysed to monitor and manage traffic and transportation systems, power plants, utilities, water supply networks, waste, crime detection, information systems, schools, libraries, hospitals, and other community services (McLaren and Agyeman, 2015).

emissions of six GHGs, as well as indirect emissions from electricity consumption. The K-ETS is meant to play an essential role in meeting South Korea's 2030 updated NDC target of a 24.4% reduction from 2017 emissions (ICAP, 2021d: 1).

In 2011, China approved a pilot emission trading scheme (ETS) in seven provincial regions – Beijing, Tianjin, Shanghai, Chongqing, Shenzhen, Hubei, and Guangdong – with a view to a national scheme in 2017. These have been operative, and progress has been made. The results have differed across regions, with the scheme performing quite well in the Hubei and Guangdong regions while Tianjin did not record a significant reduction in carbon emissions. In February 2021, after 3 years of preparation, China launched its national ETS – the world's largest – estimated to cover about 40% of national carbon emissions (ICAP, 2021a). The impacts of the nationwide scheme were recently studied by Mo et al. (2021). It is important to examine how the carbon pricing policy can fulfil the objective of phasing out China's coal power. Using a full-sample data set of China's 4,540 operating coal plant units, with the assumption that all plants are covered by the ETS, Mo et al. (2021) assessed the financial sustainability of the plants' operations. Their empirical results revealed that with a carbon price of US$7.70 per ton of carbon dioxide ($CO_2$) growing at 4% annually, the average residual lifetime of all the plants will be reduced by 5.43 years. Hence, the cumulative $CO_2$ emissions from 2020 to 2050 will be reduced by 22.73 billion tons. Due to different demand and supply conditions across regions, the impact of carbon pricing varies significantly by geography in China. The analysis indicated that the western regions are more vulnerable to the carbon pricing risk than the eastern regions (Mo et al., 2021).

Tokyo Metropolitan Government started the Mandatory $CO_2$ Reduction and Emissions Trading Programme in April 2010. The programme required the mandatory reduction of absolute $CO_2$ emissions and implemented a cap-and-trade programme under the amended Tokyo Metropolitan Environmental Security Ordinance. Under the Tokyo ETS, large offices and factories were required to reduce emissions by 8% (businesses) and 6% (industries) in the first period (FY2010– FY2014), which increased to 17% (businesses) and 15% (industries) in the second period (FY2015–FY2019) (Tokyo Metropolitan Government, n.d.). The introduction of high-efficiency heat sources and light fittings were key activities in generating emission reductions. Emission reductions have continued alongside increases to gross floor space, indicating a decrease in the emission intensity of Tokyo's building sector (OECD, 2019). The programme differs from that of the European Union (EU) ETS since it also includes large-scale office buildings within its scope (ICAP, 2021c). One year after Tokyo, Saitama Prefecture launched the Target-Setting Emissions Trading Program, in which the prefecture set reduction targets for covered facilities and allowed them to trade allowances, in accordance with the Saitama Prefecture Global Warming Strategy Promoting Ordinance of April 2011 (ICAP, 2021b). In April 2021, Prime Minister Yoshihide Suga announced a 46% carbon reduction target from 2013 levels by 2030. However, this target has been critiqued by some commercial entities and environmental experts for being 'unrealistic' (Harding, 2021).

New Zealand now operates a capped ETS covering all sectors except for agriculture, since there are no technological options, other than reducing livestock numbers, to reduce biogenic methane emissions. The first tranche of the New Zealand emission permits was auctioned in March 2021. A Fixed Price Option of NZ$25 per ton, which acted as a form of price ceiling, was introduced in 2009 and was later raised to NZ$35 per ton for emissions produced in 2020. In June 2020, the government passed the Climate Change Response (Emissions Trading Reform) Amendment Act, 2020, which strengthened New Zealand's ETS and aligned it with the goals of the Paris Agreement and the new 2050 NZT. The government also introduced regulatory settings for 2021–2025 within the legislative framework, establishing a cap on emissions for the first time under New Zealand's ETS. The price containment measures, which include Cost Containment Reserve (CCR) and auction floor price, were introduced via auctioning. Under the CCR, a specified number of allowances from the CCR will be released for auction if a predetermined trigger price is reached, currently set at NZ $50 per ton in 2021 and rising by 2% per year in line with projected inflation. Moreover, the government set a floor price of NZ$20 per ton for 2020–2025, which will operate through a reserve price and below which New Zealand Units will not be sold at auction (ICAP, 2021e).

In 2011, as a market-based emission reduction policy measure, India launched the Renewable Energy Certification (REC) scheme and in 2012 implemented the Perform, Achieve, and Trade (PAT) scheme to improve energy efficiency. In the former scheme, which concerns promoting renewable power generation through renewable purchase obligations on the energy distributor, the renewable energy certificates can be sold and purchased through the energy exchanges. In the latter scheme, the Bureau of Energy Efficiency in India sets energy efficiency benchmarks for India's largest energy users with trade occurring between participants that exceed their allowable targets and those that fail to meet them (Bureau of Energy Efficiency (n.d.). PAT has increased awareness around energy efficiency, and has provided a platform that could help generate exchange of knowledge leading to the adoption of technologies in the future.

A carbon tax, levied on fossil fuels, has been advocated as a cost-effective instrument to boost energy security, stimulate economic growth, and tackle climate change (Howes and Wyrwoll, 2012). Carbon taxes may generate indirect benefits, as the revenues can be used to reduce income or corporate taxes, or can be used to support environmental programmes and provide finance for compensation measures to lower-income households affected by the tax. Asian countries have addressed these issues in their carbon tax strategies, and some have planned to recycle carbon tax fiscal revenue to support environmental and pro-poor projects. India became the first Asian country to confirm the introduction of a carbon tax on coal in 2010, as part of its green growth strategy. However, none of the AMS has implemented a carbon tax – except Singapore, which implemented a carbon tax in January 2019. Nevertheless, an ETS has been under consideration in Indonesia, the Philippines, Thailand, and Viet Nam.

Carbon capture and storage (CCS) and carbon capture and utilisation (CCU) technologies have been acknowledged as important technical supports for coal power plants to maintain the existing production structure while achieving near-zero carbon emissions. Of these, CCU – unlike CCS – does not store the $CO_2$ permanently underground, but utilises it as a raw material to produce other goods and services. Thus, CCU can add additional income streams to the reduction in $CO_2$ emissions (Baena-Moreno et al., 2019). Hence, CCU technologies can act as substitutes for fossil resources. Experts recommend that Southeast Asia harness CCS capabilities, which are estimated to allow countries to keep pace with economic growth and facilitate the transition towards hydrogen carbon economies. This could happen as blending of hydrogen with natural gas could provide a smooth transition from the current hydrocarbon-based economy to a hydrogen carbon economy. The main issues are that growth and innovation in the sector are highly uneven and regulatory frameworks are lacking in some contexts. The Asian Development Bank (ADB) has been incentivising and promoting the growth of carbon capture, utilisation, and storage (CCUS) activities in ASEAN (Nepal, Han, and Khatri, 2021).

Investment in CCUS technologies has been particularly promoted by Japan and Australia (Cuéllar-Franca and Azapagic, 2015). Japan highlights the importance of decarbonisation of the fossil fuel industry through the adoption of CCUS, carbon recycling, and the green transition fund on the pattern of the EU as important tools to meet low-carbon transition goals.

### 2.5 CAC Instruments

CAC instruments are the most common form of environmental policy used in both developed and developing countries. The CAC approach consists of a 'command', which sets a standard, and a 'control', which monitors and enforces the compliance with the regulation. Those who do not meet the standard are penalised. Emission standards can be either performance-based (specifying the acceptable emission limit) or technology-based (specifying emission limits and the technology that must be used). The advantages of CAC approaches are that they are more widely understood, and effective in emission reductions, provided that they are enforced. However, it is not always possible to set 'optimum' standards, especially with non-marketable goods (e.g. water and air); regulated agencies have no incentives to reduce pollution beyond the set standards; penalties for violating standards tend to be generally too low; and enforcement also tends to be weak. For CAC approaches to be effective, standards need to be reviewed and revised frequently, but in practice these measures are not keeping up with changing market environments (Howes and Wyrwoll, 2012). For example, UK climate agreements with firms in lieu of paying the Climate Change Levy seem not to have stimulated extra emission reductions. In contrast, carbon taxes are easily understood and more economically efficient.

Viet Nam, Cambodia, Malaysia, Thailand, and the Philippines all have stipulated standards on sulphur concentration in diesel. For Viet Nam, the standard reduced from 10,000 in 1996 to 500 in 2005, while it decreased tenfold for the Philippines during the same period. Some AMS, such as Indonesia, Malaysia, Singapore, and the Philippines, also impose exhaust emission regulations on certain types of vehicles. Other popular types of environmental CAC regulations in the region include fuel quality regulations and specifications like those for unleaded gasoline in Malaysia, the Philippines, and Thailand; and blending requirements for fuels with ethanol and biodiesel (Timilsina and Dulal, 2009). Some other policy examples include the 'reduced cut' policy by Brunei to protect forests, Singapore's requirement that plans for new buildings and existing buildings which undergo major retrofitting should be cleared by the Ministry of Environment, Malaysia's mandated catalytic converters for cars brought after 1993, and Indonesia's 'liquid organic fertilizer rich in biological sources' (PORKASHI) programme. A few experts (e.g. Catelo, Francisco and Darvin, 2016) have argued that implementing MBIs in Southeast Asian countries would produce more impactful environmental policy than using CAC regulations. As discussed previously, MBIs are already used in certain national sectors, e.g. Viet Nam charges taxes in the transport sector and provides subsidies in the domestic cooking and heating sector, while Indonesia, Malaysia, and Thailand use information provision and voluntary agreement-based MBI strategies in the energy production and industrial pollution sector (Coria, Köhlin, and Xu, 2019).

As discussed in previous chapters, countries in the region are also learning from each other in bringing a green growth element to their green stimulus programmes and other fiscal measures.

### 2.6 Environmental Information Disclosure

Environmental information disclosure in capital markets is important for promoting investment in green businesses and technologies. Capital markets may, in specific circumstances, provide appropriate financial incentives for investment. Information about the pollution efficiency of a firm, and its environmental performance, may act as a signal of its expected long-term profitability (Horvathova, 2012). A firm's performance information, if provided on a regular basis, is valuable for the market to evaluate its worth. Therefore, governments can harness the forces of capital markets by introducing structured programmes requiring the regular release of information about environmental performance. The information will help reduce the risk of investments, protect the interests of investors, promote environmental transparency, encourage environmentally responsible investments, and enhance pollution control. Another example of a public disclosure mechanism is the Global Reporting Initiative (GRI and SASB, n.d.). The initiative facilitates voluntary participation from stakeholders, e.g. private sector agencies and non-governmental organisations, to undertake independent evaluation of the environmental performance of a firm. Environmental performance ratings appear to have a positive impact on regulatory compliance in several Asian countries. This positive impact is demonstrated by increases in compliance rates of 24% in Indonesia; 50% in the Philippines; 14% in Viet Nam; 10% in Zhenjiang, China; and 39% in Hohhot, China (Hongo, 2012). Environmental information disclosure has been associated with positive performance outcomes for Malaysian firms (Abdullah et al., 2020).

Although countries can learn from each other in identifying appropriate institutions and policies to promote green growth, the pace of adoption depends on each country's resources, including human capital, and political will. Developing countries have specific problems with infrastructure development, initiatives for poverty reduction and sustainable development, training, and capacity development. Given the diversity of countries in the Asian region, regional cooperation can be a powerful instrument by which the leading countries can lift the lagging countries towards greater technological innovation and diffusion, which depends on the supply of sufficient human and physical capital. Official development assistance (ODA) can be another important mechanism for international cooperation, especially where there is a shortage of private investment. Traditionally, ODA has been used by countries for socio-economic development, but in recent times environmental protection has been included. For example, in February 2021, ADB and Japan's Ministry of Economy, Trade and Industry signed a memorandum of cooperation to enhance their joint efforts to promote clean energy in Southeast Asia under the Cleaner Energy Future Initiative for ASEAN (CEFIA).[5] The cooperation will focus on the areas of renewable energy, energy conservation and efficiency, and other technologies that will facilitate the transition to low-carbon energy (ADB, 2021a). Care needs to be taken that ODA funds being used for socio-economic development are not shared with the funds going into environmental protection. ODA needs to be increased from its present level to accommodate developing countries' environmental protection strategies. Further, the large foreign reserves in Asia could be leveraged for green research and investment through regional cooperation (Kalirajan, Venkatachalam, and Singh, 2010).

## 2.7 Seizing Market- and Non-Market-Based Opportunities Across Borders

### 2.7.1 Market-Based Opportunities

Besides the market-based opportunities that arise from improved trade and investment through ASEAN FTAs, regional cooperation can bring other win-win opportunities. For example, regional energy collaboration, which provides great opportunities, is important for energy security. Nevertheless, the success of collaboration depends on having strong carbon policies in place, particularly carbon pricing. Several studies have suggested how energy connectivity and cooperation can take place in East Asia. Kimura and Shi (2011) and Thukral, Wijayatunga, and Yoneoka (2017) identified areas of cooperation related to the energy sector that Southeast and Northeast Asian countries can focus on, such as multilateral cooperation, to attain energy security. The only current

[5] CEFIA, established in 2019, facilitates the collaboration of the public and private sectors in accelerating the deployment of sustainable energy and low-carbon technology in the region. The memorandum of cooperation was signed at the 2nd CEFIA Forum held online in February 2021 and hosted by the Ministry of Energy of the Government of Thailand, in cooperation with the Ministry of Economy, Trade and Industry and supported by the ASEAN Centre for Energy (ADB, 2021a).

example of multilateral power trading in the ASEAN region is the Lao People's Democratic Republic (Lao PDR)–Thailand–Malaysia–Singapore Power Integration Project (LTMS-PIP) (IEA, 2019). The LTMS-PIP is part of a broader strategy to develop a multilateral power market across ASEAN. Wu, Shi, and Kimura (2011) and Anbumozhi et al. (2016) in Investing in Low-Carbon Energy Systems: Implications for Regional Economic Cooperation suggested developing interconnected gas pipeline and electricity grids and creating regional energy markets. For example, underwater cables have connected the electricity grids of Singapore and Peninsular Malaysia since the mid-1980s. Their purpose is not commercial, but rather to help each country manage grid stability and supply security. Anbumozhi et al. (2016) and Kutani and Anbumozhi (2015) argued for adopting common efficiency standards as potential solutions for sustainable energy development in the region.

Concerning South Asia, India does not have the capacity to meet its burgeoning energy demand from domestic sources. However, it could solve its energy shortage by collaborating with Nepal on hydroelectricity, with Bangladesh and Myanmar on natural gas-generated electricity, and with Iran and Turkmenistan (through Pakistan) on gas. Experts project a significant increase in liquefied natural gas (LNG)-to-power asset class investments in Indonesia in the coming years (Mallo, 2020). Thailand and Myanmar have been cooperating on natural gas exports. There are other opportunities for the region in trading natural gas, as Asia is the centre of the global LNG trade. Overall, the natural gas market in Asia is projected to grow by 2.5 times in 10 years (Kobayashi and Li, 2018). Although LNG is not climate-friendly in the long run, its exports from the US to Asia increased by a record 67%, with China, Japan, and Korea being the primary recipients during 2019–2020 (US EIA, 2021).

A few energy collaboration programmes in Asia have already been working reasonably well. For example, Japan has established energy collaborative projects such as the Energy Silk Road project involving China, Turkmenistan, and the Cross-Country Pipeline network (Len, Tomohiko, and Tetsuya, 2008). The Trans-ASEAN Gas Pipeline and the ASEAN Power Grid projects have been set up to ensure regional access to gas reserves and greater stability and security of energy supply. That could also reduce emissions within ASEAN if coal is substituted by gas. Developing a network connecting all AMS with high-voltage transmission lines could not only resolve energy shortages, but also bring revenues from cross-border sales of electricity. For example, the Lao PDR has the potential to increase its renewable energy capacity and export the excess power to its neighbours, Thailand and Cambodia. Viet Nam's hydropower potential, which is huge, could also be sold to neighbouring countries (Thavasi and Ramakrishna, 2009). Although power grid interconnection in ASEAN is technically possible, it is challenging. Nevertheless, such projects have the potential to integrate the energy markets of East Asia–ASEAN–South Asia.

Malaysia and Japan have contributed US$308 million on a biofuel joint venture, with a target of producing about 0.2 million tons per year. Within ASEAN, some countries have further potential to increase energy exports. For example, the Lao PDR and Thailand have already implemented several cross-border hydropower trade projects. Amongst them, the most notable is the US$1.2 billion Nam Theun 2, the biggest hydropower plant project in the Lao PDR. The Nam Theun 2 is the result of a private–public and multilateral organisation partnership. It started full generation in early 2010, exporting electricity to Thailand. From 2010 to 2017, the Nam Theun 2 recorded US$170 million in revenue and exported 1,000 megawatts (MW) of power to Thailand. Since 2017, the Nam Theun 2 has broadened its focus and acknowledged that its objectives are generational; therefore, it has started working closely with regional administrations, development agencies, and village partners (World Bank, 2019). In addition, Xekaman 3, commissioned in 2010 with 250 MW capacity, is supplying electricity to the Lao PDR and exporting 90% of the electricity generated to Viet Nam. The Theun-Hinboun Power Company operates the Theun-Hinboun hydropower plant in Bolikhamxay and Khammouane provinces of the Lao PDR. An extension to the original power project was completed in 2012 and was inaugurated in January 2013. The Theun-Hinboun expansion project, with an installed capacity of 60 MW, after some technical upgrades in 2016, now generates 520 MW. The Nam Ngum 2, which began operations in 2010, generates 2,220 gigawatt-hours of energy annually. The project has also helped Thailand gain access to a long-term source of renewable energy (Pöyry, n.d.). Coal is the primary export good in Indonesia, but faces challenges from the country's own growing domestic demand. In 2018, the region's fossil fuel trade balance deficit was US$57 billion, and this is projected to worsen over the next decade. Southeast Asian annual import bills are projected to exceed US$300 billion by 2040. In terms of renewables, trading tends to be mostly confined to bilateral agreements (IEA, 2019).

Sun Cable, a Singaporean consortium, has proposed the US$26 billion Australia–ASEAN Power Link (AAPL). The project is expected to supply power to the Darwin region of Australia and to Singapore via a 4,500-kilometre high-voltage direct current transmission network, including a 750-kilometre overhead transmission line from the solar farm to Darwin and a 3,800-kilometre submarine cable from Darwin to Singapore through Indonesia. The project is expected to generate enough renewable electricity to power more than 3 million homes a year, with commercial operations to commence in 2027.

As global carbon markets grew to more than US$20 trillion by 2020 (World Bank, 2021), Asian countries can benefit from such growth. There are variations across countries concerning the effective functioning of carbon markets, as there is no universally acceptable formula for carbon pricing.[6] As of 2019, carbon taxes have been implemented or scheduled for implementation in 25 countries, while 46 countries have put some form of price on carbon, either through carbon taxes or some form of ETS (World Bank, 2019). The Carbon Pricing Leadership Report 2020/21 (World Bank, 2021) strongly encouraged governments,

6 Lu, Zhu, and Cui (2012) compared carbon tax, emission trading, and CAC regulation at the industry level, concluding that market-based mechanisms would perform better than emission standards in achieving emission targets without affecting industrial production.

business leaders, and other relevant stakeholders from around the world to use carbon pricing as a tool for effective climate action in support of sustainable development.

Although carbon credits have been in use for many years, the voluntary market for carbon credits has gained growth momentum in recent years. Blaufelder et al. (2021) estimated that buyers discharged carbon credits for some 95 million tons of $CO_2$ equivalent in 2020 – more than twice as much as in 2017. The need for scaling voluntary carbon markets to meet the NZT cannot be overemphasised here. Although Asian countries have addressed emission issues with different carbon tax strategies, it is imperative for countries to work together in a regional cooperation framework to make carbon market integration a reality rather than a myth in Asia.

Japan and Korea are keen to promote hydrogen technology as an important power source. Korea has intensified its efforts to move to green hydrogen, and the private sector is taking a lead role in transitioning to a green hydrogen future. The move comes as Korea is pushing to boost the supply of power from clean and renewable energy sources. Korean companies have also made commitments to invest in building a wide range of hydrogen infrastructure, such as the production and storage of hydrogen, by 2030 – which is a step in the right direction for achieving a green hydrogen economy. In 2019, hydrogen accounted for about 4% of final energy demand globally, of which more than 95% is generated from fossil fuels. So, hydrogen is not fully green yet (IRENA, 2019). The Global Green Growth Institute (GGGI) is well positioned to support countries to embrace hydrogen. Green hydrogen can be produced in GGGI member countries such as Indonesia, Viet Nam, and the Lao PDR (GGGI, 2021).

### 2.7.2 Non-Market-Based Opportunities

Many countries in Asia do not have enough resources to spend on R&D; and have a chronic shortage of scientists, engineers, and managers with the necessary skills. The shortage of R&D capacity and skilled workforces capable of low-carbon innovations in developing Asia emphasises the importance of regional cooperation in pooling human capital resources. Japan, China, Korea, and India have a pool of technical expertise, hence knowledge sharing can take place with other regional partners so that the best practice techniques of low-carbon energy systems can be disseminated in other Asian countries. Such a sharing of human capital could be formalised through an institutional framework involving regional institutions such as the South Asian Association for Regional Cooperation (SAARC) Secretariat, ASEAN Secretariat, and Central Asia Regional Economic Cooperation (CAREC) Secretariat. The role of institutions such as ADB, the Asian Development Bank Institute (ADBI), the Climate and Development Knowledge Network, and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) is crucial to bring these institutions together through the proposed virtual university/research institute/secretariat to achieve the common goal of low-carbon energy systems.

For instance, Japan and Korea's national hydrogen strategies are backed by massive investments in the research, development, and commercialisation of clean hydrogen-related technologies. Japan and Korea have also been investing heavily in developing international clean hydrogen supply chains. Japan and Korea have recently emerged as major supporters of Australia's emergent renewable hydrogen industry. Australia's abundant wind and solar resources, technological know-how, R&D, and established record as a trusted energy exporter have made effective collaboration with Japan and Korea a reality. The dissemination of R&D results and technology transfer could be done through a virtual university, research institute, or secretariat for low-carbon research and knowledge sharing, with the help of regional development organisations such as ADB, ADBI, and UNESCAP. The private sector should be looked to for services such as training programmes for technicians and training for government personnel (World Bank, 2008).

Aus4Innovation, an AU$11 million development assistance programme that aims to strengthen Viet Nam's innovation system, is another regional cooperation initiative between Australia and Viet Nam. The Aus4Innovation programme facilitates and embraces opportunities emanating from Industry 4.0, and helps strengthen Viet Nam's innovation agenda in science and technology (S&T). The objective of the Aus4Innovation programme is to work together in exploring new areas of technology and digitalisation – devising new models for public–private partnership to improve Vietnamese capability in digital foresight, scenario planning, commercialisation, and innovation policy (CSIRO, 2021a).

Australia is undertaking an energy transition on a scale and complexity never before witnessed in its history. Record numbers of rooftop solar photovoltaic (PV) units, residential battery storage, and other new energy technologies (collectively referred to as distributed energy resources) are supplying energy to the electricity grid, bringing new challenges and opportunities. The Distributed Energy Resources Laboratory (DER Lab) is a state-of-the-art facility that mirrors the electricity grid. The lab will provide a fail-safe environment in which one can rapidly, efficiently, and securely develop and test technologies and systems before deploying them in the live grid. The DER Lab represents an important national facility for Australia's collaborative development and testing of new capabilities to support the operation of 21st century electricity systems.

### 2.7.3 International Intellectual Property Rights Regime

The intellectual property rights (IPR) regime is crucial in assisting technological innovation by developing countries from the basic R&D done in developed countries. At times, it may be necessary to combine technologies developed in different countries, which may pose problems due to the different IPR regimes in those countries. These problems may inhibit or slow down technological innovation and the adaptation of low-carbon technology by developing countries. A possible solution is regional cooperation in harmonising the IPR regimes across countries. UNESCAP, through its Renewable Energy Cooperation Mechanism for Asia and the Pacific, has been helping developing countries to overcome IPR issues in energy.

Concerning the smooth transfer of technology, an important factor is how closely the national IPR regime is integrated with the global IPR regime. The experiences of two major emerging economies in Asia – China and India – are worth noting. China has striven to conform to the World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and has managed its enforcement issues with administrative and judicial policies to assure foreign investors and a growing number of local IPR holders of the security of their intellectual property. How effectively the central government is in enforcing IPR policy at every level of government is an important benchmark for China's success in integrating its national IPR regime with the global regime. Signing the TRIPS Agreement in 1994 triggered significant changes in the IPR related legal framework in India. Since then, several legislative and institutional adjustments have been made to protect IPR.

Table 5.1 describes the IPR regimes and low-carbon industry policies in selected Asian countries. IPR has often been considered a constraint to international cooperation on low-carbon technology and a barrier to sharing technical know-how. However, success stories suggest that joint ventures between collaborators could provide a solution.[7] Nevertheless, more effort needs to be made to adapt R&D to local circumstances in developing countries. Hence, the importance of promoting more location-specific research cannot be overemphasised. Foreign universities and research institutions may be able to help through regional cooperation concerning capacity building agreements.

## 3. Regional Cooperation in Trade and Technological Innovations in Low-Carbon Energy Systems

### 3.1. Search for Anchors and Common Denominators for Enhanced Regional Cooperation

Consumption and production decisions drive economic systems, assisted by private and public sector investments, to achieve the desired objectives. International trade facilitates the smoothening of these consumption and production decisions. The platform through which this facilitation process predominantly occurs takes many forms/arrangements and is mainly recognised in the form of preferential trade agreements and free trade agreements (FTAs) at the bilateral, regional, and multilateral levels.

Production and consumption decisions to fulfil individual and societal needs are carriers of our perceptions about the environment, resources, level of development, and technological advancement. For example, the US decision in 2017 to cease its participation in the 2015 Paris Agreement on climate change mitigation, and its withdrawal from the agreement on 4 November 2020, and the US pulling out of the Trans-Pacific Partnership in January 2017

[7] Through patent citation analysis, Dechezleprêtre, Martin, and Mohne (2017) argued that the knowledge spillover from clean technologies would be larger than from dirty technologies. They also emphasised that higher R&D subsidies for clean technologies, in addition to implicit support for clean R&D through climate policies such as carbon tax, can lead to higher economic growth in the short and medium term.

## Table 5.1 IPR Regimes and Low-Carbon Industry Policies in Selected Asian Countries

| Type of economy based on carbon-intensiveness | Trade in low-carbon goods and services | FDI | Trade in knowledge (licensing) | IPR | Low-carbon industrial policies |
|---|---|---|---|---|---|
| **Domestic policies** | | | | | |
| Low carbon-intensive: Lao PDR and Cambodia | Liberal access | Non-discriminatory investment promotion | Improve information flows about public domain and mature technologies | Basic protection and minimum standards only | Basic education; improve infrastructure; reduce entry barriers |
| Low–medium carbon-intensive: Indonesia, Thailand, Viet Nam | Liberal access | Non-discriminatory investment promotion | Improve information; limited incentives for licensing | Wider scope of IPR protection; employ flexibilities | R&D support policies; improve infrastructure; reduce entry barriers |
| High carbon-intensive: China and India | Liberal access | Upstream supplier support programmes | Improve information; limited incentives for licensing | Apply full TRIPS | R&D support policies; improve infrastructure; reduce entry barriers |
| **Developed-country policies towards emerging Asia** | | | | | |
| Low-carbon intensive: Lao PDR and Cambodia | Subsidise public good type imports; free trade | Incentives for outward flows exceeding those for FDI | Subsidise transfer of public domain and mature technologies | Forbearance in disputes; differential pricing for exports of IPR products; competition policy assistance | Support for general low-carbon technology policies; public and public–private research facilities |
| Low–medium carbon-intensive: Indonesia, Thailand, Viet Nam | Free trade; no controls | Incentives equal to those granted for own disadvantaged regions | Assistance in establishing joint venture partnerships; matching grants | Differential pricing of public good type IPR protected goods; competition policy assistance | Support for general low- carbon technology policies; fiscal incentives for R&D performed in developed countries |
| High carbon-intensive: China and India | Free trade; no controls | Incentives equal to those granted for own disadvantaged regions | Assistance in establishment of joint venture partnerships; matching | Differential pricing of public-good type IPR protected goods; competition policy assistance | Support for general low- carbon technology policies; fiscal incentives for R&D |

FDI = foreign direct investment, IPR = intellectual property rights, R&D = research and development, TRIPS = Trade-Related Aspects of Intellectual Property Rights.

Source: ADB and ADBI (2013).

and many others are reflective of such perceptions. On the other hand, these perceptions are not singular in character, and it is worth noting that regional groupings such as the EU have taken the lead in positive regional initiatives in the form of the European Green Deal and the promotion of activities such as the concept of a circular economy in an effort to strengthen the global response to the climate change threat (European Commission, 2021).

Multilateralism experienced challenges in 2020 in the spheres of climate mitigation and adaptation actions, international trade, economic growth, health outcomes, and actions required to meet the SDGs. The strains in the frameworks at the multilateral level started long before 2020, and the effects became exacerbated due to the spread of the COVID-19 pandemic. In this context, it is rational to argue that the increased emissions and delayed climate actions, consistent with the

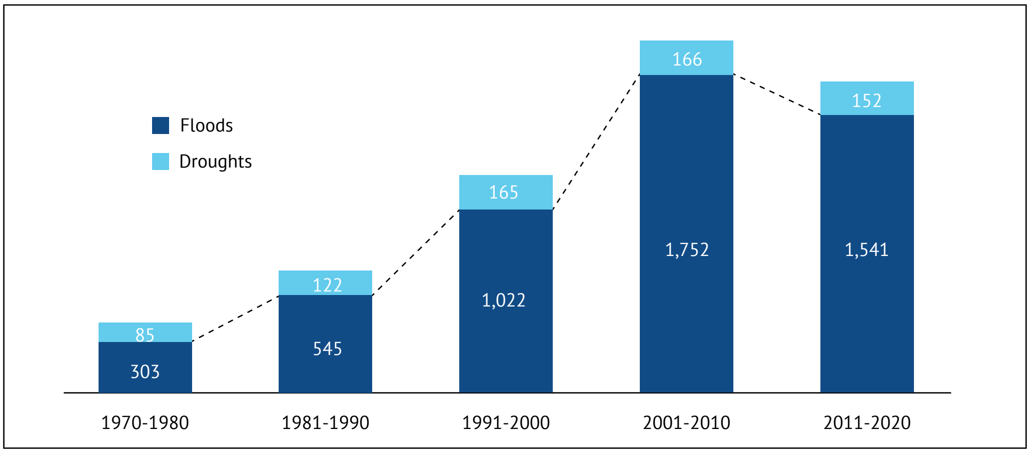
Paris Agreement long-term goal, indicate the need for more platforms to be used to overcome the challenges experienced at the multilateral level and due to considerations of political economy and domestic policy considerations. A regional approach to climate action has the potential to be effective in achieving its objectives because the issues of monitoring and enforcement can be tackled successfully by designing specific targets and programmes to achieve the climate targets due to the manageable geographical area of coverage at the regional level. For example, the EU's experience in collectively adopting a climate action response to the climate mitigation and adaptation measures has yielded results in the form of creating innovative solutions that impact both production and consumption decisions. The EU 27 has made climate mitigation one of the three main priorities in its COVID-19 recovery; and in July 2020, its leaders agreed to spend at least 30% of its multiannual financial framework budget for 2021–2027 and the Next Generation Recovery fund on achieving the EU's NZT by 2050 and meeting its increased 2030 emission reduction goal (Council of the European Union, 2020). In this context, the ASEAN experience within the 'open regionalism' framework deserves a closer look. It is important to identify and document the experience of the past decade, as the lagging countries can learn lessons from the experience of some of the leading countries towards closing the gap between their NDC objectives and achievements. It is argued that regional cooperation (e.g. the RCEP) and subregional cooperation (e.g. the Greater Mekong Subregion (GMS) involving China, Cambodia, the Lao PDR, Myanmar, Thailand, and Viet Nam) would facilitate accomplishing the long-term goals of strengthening low-carbon energy systems and NZT (ADB and ADBI, 2013). Most importantly, the ACRF emphasises that the 'RCEP is expected to be a catalyst for the regional post-COVID-19 economic and social recovery' (ASEAN, 2020a: 33). In addition, ASEAN has identified 19 priority infrastructure projects under the Master Plan on ASEAN Connectivity 2025 to enhance regional connectivity and mobilise investments, of which nine greenfield and six brownfield investments are in the GMS (ASEAN, 2019a). However, the events over the last 3 years (2017–2020), such as intensified and frequent typhoons and floods, have also exposed the fragility of the regional drive towards climate action (Figure 5.5).

'Governments are under pressure to act quickly or risk giving up improvements in living standards achieved through decades of export-driven growth' (Prakash, 2018: 22). Therefore, the political economy has a role to play in the coming years. In light of this, the objective of achieving the goal of NZT by 2050 is also a challenge, if viewed through the sustainability prism.

Acknowledging this reality, the ACRF has been built on recognition of the fact that the business-as-usual scenario will not return to the global economy and a paradigm shift will lead to a 'new normal' situation in the post-COVID-19 world.[8] An inclusive economy, which

[8] The ACRF is structured into five broad strategies: (i) enhancing health systems, (ii) strengthening human security, (iii) maximising the potential of the intra-ASEAN market and broader economic integration, (iv) accelerating inclusive digital transformation, and (v) advancing towards a more sustainable and resilient future. Each of the broad strategies will be implemented by adopting key priorities, which are discussed in chapter 3 of the ACRF (ASEAN, 2020a).

**Figure 5.5 Number of Flood and Drought Events in Asia**




Source: Data from Centre for Research on the Epidemiology of Disasters (CRED), Université catholique de Louvain (n.d.), EM-DAT: The International Disaster Database. www.emdat.be. Cited in Kumse, Sonobe, and Rahut (2021).

provides opportunities to underserved people and communities, is at the core of building a 'new normal' after the COVID-19 crisis. Building an inclusive economy has never been more critical, and the time to embark on the objective is now. In line with the ASEAN Community Vision 2025 and beyond, the ACRF highlights five broad strategies for building an inclusive economy in the post-pandemic era. How to make it happen depends crucially on the will and commitment of ASEAN. The implementation should not lead to widening of gaps and inequalities across ASEAN during these challenging times.

Despite the challenges that have arisen in the global economy over the past 3 years due to the political economy and domestic considerations at the national level, regional cooperation arrangements such as the AEC and the RCEP have been crucial in strengthening the low-carbon energy systems across the region. A number of cooperation frameworks, such as the Agreement on ASEAN Energy Cooperation and ASEAN transport facilitation agreements, could also promote low-carbon energy systems. Apart from the GMS arrangement, the Mekong River Commission, Brunei Darussalam–Indonesia–Malaysia–Philippines–East ASEAN Growth Area (BIMP-EAGA), and Indonesia–Malaysia–Thailand Growth Triangle (IMT-GT) could also contribute to strengthening and enhancing the role of low-carbon energy systems at the national and regional levels (ASEAN, 2016).

There is no doubt that COVID-19 has reduced the financial space to initiate actions at every level. However, despite the reduced budgets, cities, businesses, and others have continued to maintain a stable climate and clean energy rather than making green energy progress in many Asian countries. For example, Australia initiated a clean energy recovery in May 2020 in the form of natural gas-led recovery rather than a green recovery, and is continuously signalling its support for the clean coal industry. At the national level, the government does not intend to update its Paris Agreement target or adopt a net zero emission target by a specified timeframe, such as 2050 like most other countries, and plans to adopt a 'technology neutral' approach which focuses on outcomes rather than technology-based process. An outcomes-focused, technology-neutral approach increases flexibility for business, enabling it to find the most efficient way to comply. It also encourages innovation, since businesses have the scope to experiment with different approaches to reaching the outcome (Maxwell, 2021). However, it should be noted that the Australian government's intended approach is contrary to its focus on natural gas.[9] The federal government published the 'Technology Investment Roadmap Discussion Paper' in May 2020, advocating natural gas and CCS technology, without ruling out support for clean coal and nuclear energy (DISER, 2020). Despite the limited action at the federal government level, all states and territories have committed to both renewable energy as well as carbon reduction targets. Most targets are in line with the Paris Agreement, implying that all states and territories plan to achieve the net zero emission target by 2050 (Table 5.2).

It is interesting to learn that the Australian Capital Territory plans to achieve the net zero emission target much earlier, by 2045 (100% Renewables, 2020). Indonesia, which is the largest economy within ASEAN having vast renewable energy potential, is struggling to create a cleaner energy landscape for its economy and is unable to provide options for sourcing clean energy. For example, unlike the other major AMS – Malaysia, Thailand, and Viet Nam – Indonesia's energy policy has yet to include the direct power purchase agreement scheme, which allows companies to purchase electricity directly from renewable independent power producers instead of buying from state utility companies (Nugraha and Yusgiantoro, 2021). The Indonesian government has backed two recent energy investment decisions, which appear to be neglecting investments in green energy.

The first concerns the political push for promoting coal down-streaming technology. The main argument for the political push is to reduce the burden on Indonesia's trade deficit, created by liquefied petroleum gas imports. The latter can be replaced by its substitute, dimethyl ether, which can be produced through a sequence of processing domestic low-rank coal. However, only very few power producers have ever applied the coal gasification technology because of its poor economic returns. The second concerns promoting biodiesel production. Since the inception of the mandatory biodiesel programme in 2015, Indonesia's biodiesel development has relied heavily on subsidies funded by a levy on palm oil exports, provided through the controversial Oil Palm Plantation Fund Management Agency (BPDPKS). In 2020, additional stimulus of US$192 million was allocated in the state budget to cover the increasing price difference between biodiesel, which is costlier, and regular diesel. Biodiesel production is likely to

[9] The Australian government appointed key fossil fuel and mining stakeholders to its National COVID-19 Commission Advisory Board, including a member of the Saudi Aramco board. The commission has supported a gas-led recovery strategy by recommending the government to underwrite gas pipelines, and increase both domestic gas supply and subsidies for gas-fired power generation. The government has ignored the opportunities for a green recovery in the form of an accelerated transition to renewable energy.

**Table 5.2 Australia's States and Territories' Climate Change Commitments**

| State/territory | Net zero emissions by | Current status of renewable energy | GHG reduction pathway |
|---|---|---|---|
| ACT | 2045 | 100% by 2020 | 40% reduction by 2020<br>50%–60% reduction by 2025<br>65%–75% reduction by 2030<br>90%–95% reduction by 2040 |
| NSW | 2050 | 21% (target to reach 60% renewable energy penetration by 2030) | NSW electricity infrastructure roadmap: 12 GW wind + solar and 2 GW energy storage |
| Queensland | 2050 | 16.6% (50% renewable energy by 2030 target) | 30% reduction from 2005 levels by 2030 |
| Northern Territory | 2050 | 4%* (50% renewable energy by 2030 target) | |
| South Australia | 2050 | 59.7% (target for 100% renewables by 2030) | More than 50% below 2005 levels by 2030 |
| Western Australia | 2050 | 24.2% | Has stated that the Western Australia government supports the federal government reducing emissions by 28%** |
| Tasmania | 2050 | 100% by 2020 (target of 200% renewable energy by 2040) | Reduce GHGs by 60% below 1990 levels by 2050 |
| Victoria | 2050 | 27.7% (50% renewable energy target by 2030) | 28%–33% reductions from 2005 levels by 2025<br>45%–50% by 2030 |

ACT = Australian Capital Territory, GHG = greenhouse gas, GW = gigawatt, NSW = New South Wales.

Source: ERIA Study Team based on various sources.

continue to be a huge financial burden on the Indonesian economy.

Nevertheless, the evidence-based research indicates that despite the challenges to the climate actions at different intensities across different countries within regional cooperation arrangements, subregional and non-state actors in the region have played an important role in the climate mitigation and adaptation measures. Therefore, strategies need to be evolved to make the climate action goal of NZT by 2050 sustainable, inclusive, orthogonal, and achievable through regional cooperation, particularly in the context of slowing down of the multilateral process. Trade, technology (including digitalisation), and R&D are instruments that could provide a flexible and sustainable path to NZT by 2050. Besides removing tariff and non-tariff trade barriers, technology and R&D, which would be environmentally, socially, and economically sustainable, are at the core of the innovative solutions to achieve net zero emissions.

Here, it is important to note from the policy perspective that regional (international) cooperation helps to reduce the cost of national level actions in the post-COVID-19 era. The benefits of simultaneous and concerted policy actions by the countries within the regional cooperation framework would generate economies of scale in climate solutions, and would amplify the gains from learning and quicken the decline in technology costs by increasing the penetration of new technologies through unrestricted and harmonized trade policies. Simultaneous action can also reduce externalities in the form of addressing the concerns of firms whose competitors in countries not facing carbon pricing or regulation would be at an advantage.

### 3.2. Catalysing Regional Cooperation: Seizing the Opportunities in Trade

It is acknowledged that the implementation of NDCs by Asian countries is not only their contribution to fulfilling global commitments, but an opportunity to make decisive, inclusive, and coordinated actions for reshaping the national and regional energy systems to achieve NZT by the middle of the century. NDCs in the context of the COVID-19 recovery can and must change the current paradigms of energy supply and use, which are patently unsustainable, and low-carbon renewable energy technologies will have a crucial role to play. In this context, the LTMS-PIP, which was initiated during the Lao PDR's leadership of the ASEAN energy track, is a milestone in electricity trading beyond borders. At the 38th AMEM held virtually from 19 to 20 November 2020, the Lao PDR, Thailand, Malaysia, and Singapore announced their commitment to initiate cross-border power trade of up to 100 MW under the LTMS-PIP. This is a significant step towards promoting greater infrastructural connectivity in the ASEAN region and is expected to contribute to ASEAN's sustainable energy goals. During the meeting, Singapore's Second Minister for Trade & Industry and Manpower, Dr Tan See Leng, emphasised that 'ASEAN must continue to work closely together to realise our shared energy goals and co-create innovative solutions that will contribute positively to our energy future' (Ministry of Trade and Industry, Singapore, 2020: 1).

Figure 5.6 shows the degree to which $CO_2$ emissions are embedded in the exports and imports of RCEP member countries and India.[10] It is interesting to note that except for Australia, Japan, the Philippines, and New Zealand, the rest of the countries' exports are more $CO_2$ intensive. China is at the top of the list of countries exporting $CO_2$-intensive exports, while Japan has the least $CO_2$ embedded exports. This international trade scenario has led to an initiative, particularly by the EU, to seek approval from the WTO to introduce carbon tariffs on carbon-intensive imports.

Gallagher (2014) argued that although energy-related goods account for more than 10% of international trade, policymakers and the business community perceive several constraints to the diffusion of these renewable technologies at not only the national but also the regional level. Hence, it is important to identify the market and non-market instruments to seize the opportunities for and eliminate the barriers to low-carbon renewable energy technology diffusion at the local, national, and regional levels (Kalirajan, 2012).

One of the important market channels through which to facilitate low-carbon renewable technology transfer is trade in renewable energy goods, and regional cooperation is crucial for maintaining unconstrained trade flows across countries.

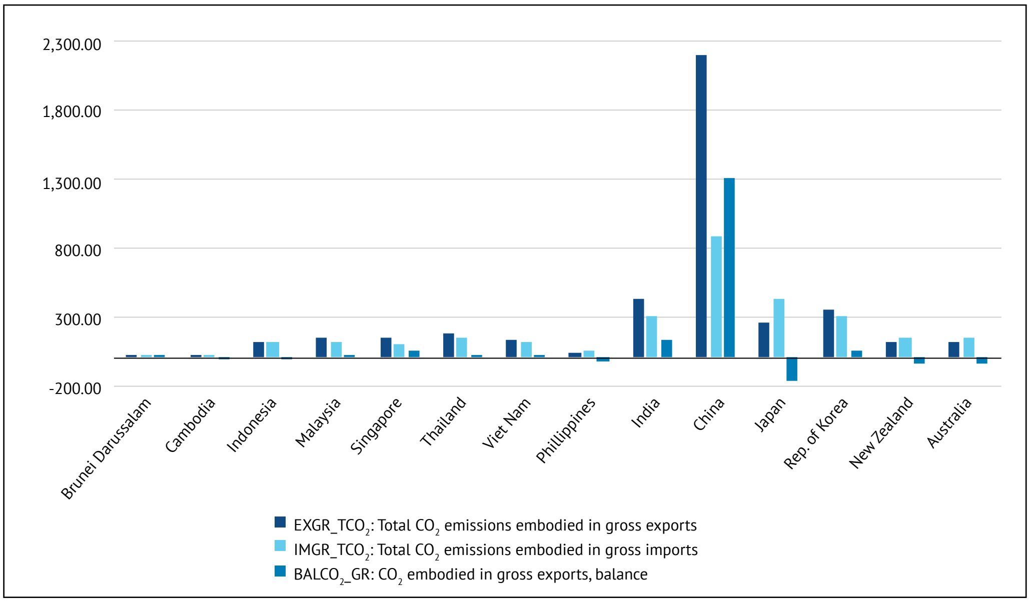
In this context, the RCEP – the regional grouping that includes ASEAN and its five FTA partners – can play an important role in facilitating the

[10] Organisation for Economic Co-operation and Development (OECD) indicators on $CO_2$ emissions embodied in international trade ($TECO_2$) are derived by combining the 2018 editions of the OECD Inter-Country Input–Output (ICIO) Database and the International Energy Agency (IEA) statistics on $CO_2$ emissions from fuel combustion.

RCEP member countries to achieve their NDC targets. As the RCEP is a comprehensive economic partnership arrangement, it is also expected to improve the functioning of non-market channels in transferring renewable energy technologies across countries. Trade flows are generally negatively influenced by 'behind the border' constraints, which are mainly the nontariff barriers that emanate from institutional rigidities; and 'beyond the border' constraints, most importantly tariff rates (Kalirajan and Anbumozhi, 2014). It is imperative to demonstrate the negative impacts of these constraints on the export potential of RCEP member countries to policymakers, so that they can be eliminated. This has implications for fulfilling NDCs across the RCEP region.

Based on the low-carbon renewable energy goods export performance, Kalirajan and Liu (2017) classified the RCEP member countries into two groups for empirical analysis: (i) group A, comprising countries with larger export values of renewable energy goods to RCEP members – China, Japan, Korea, Malaysia, and Singapore; and (ii) group B, including the rest of the RCEP member countries – Australia, Indonesia, New Zealand, Philippines, Thailand, and Viet Nam. Drawing on the meta-frontier approach, Battese, Rao, and O'Donnell (2004) discussed how far the export potential of each member country is from their group's potential and how far each group's potential is from the regional potential frontier.

**Figure 5.6 $CO_2$ Emissions Embedded in the International Trade of RCEP Countries and India, 2015**




Note: $CO_2$ = carbon dioxide, RCEP = Regional Comprehensive Economic Partnership.

Source: OECD (n.d.), Carbon Dioxide Emissions Embodied in International Trade, Embodied $CO_2$ Emissions in Trade: Principal Indicators. https://stats.oecd.org/index.aspx?queryid=92932# (accessed 27 May 2021).

The results shown in Table 5.3 indicate a considerable gap between the realised export potential of the group A and group B countries. The performance of the group A countries, in terms of realised export potential when measured from the regional meta-frontier, is higher than that of the group B countries.

Nevertheless, the results imply a significant gap in the overall renewable energy technology during the sample period in both groups, although group A showed a smaller gap than group B. Thus, there is an urgent need for technology transfer from group A to group B, although group A could improve its export potential by eliminating institutional and infrastructural rigidities to help group B countries in improving their export potential. These results also suggest that group A countries were better able to tackle the non-tariff barriers of their importing counties than the countries in group B, which warrants a detailed analysis for which data are not consistently available for all the selected RCEP members. Within group A and group B, there are wide variations in realising the export potential of renewable energy goods.

Some conjectures can be made drawing on the nexus between the non-market channels and export potential. Although currently there is a huge potential market for renewable energy goods due to NDCs, new entrants and existing players from emerging Asian countries have constraints that need to be addressed.

In this context, the interesting policy questions are whether renewable energy goods exports have been flowing without constraint in the Asian region and whether the RCEP regional cooperation mooted by ASEAN can facilitate minimising those constraints at the regional level. The short answers to those questions are no and yes, respectively. The answer is no, mainly due to the existing institutional rigidities, especially non-tariff measures. The answer is yes, mainly due to the possibility of improving technical cooperation in producing renewable energy goods and consultations in removing non-tariff barriers through the effective functioning of the RCEP.

**Table 5.3 Realised Export Potential with Respect to the Meta-Frontier Countries**

| Country | Realised potential (%) |
|---|---|
| **Group A** | |
| China | 70 |
| Japan | 68 |
| Singapore | 64 |
| Malaysia | 57 |
| Republic of Korea | 55 |
| **Group B** | |
| Indonesia | 56 |
| Philippines | 54 |
| Australia | 54 |
| Thailand | 46 |
| New Zealand | 44 |
| Viet Nam | 43 |

Source: Kalirajan and Liu (2017).

### 3.3. Catalysing Regional Cooperation: Seizing the Opportunities in Technological Innovations

Technology, including digitalisation and R&D, provide common denominators to innovate and thereby facilitate low-carbon production and consumption processes to achieve climate mitigation and adaptation goals in energy, transport, construction, food, and land use. However, there could be incentives down this path to deviate from achieving the climate action goals if technological developments cannot cope with expected and feasible innovations. The product and process inventions must ensure that the production and consumption of low-cost, low-carbon products are manufactured conditionally under economies of scale.

Delaying emission reductions without appropriate technological innovations has cost implications. In addition, countries would be tempted to delay the emission reductions due to the long-term nature of the climate threat and political resistance based on the perceived short-term risk of the economic, distributional, or competitiveness impacts of climate policies. Such delays would increase transaction costs if an abrupt action is required in this regard. For example, if more strict policies were introduced later, they would affect a larger stock of high-carbon infrastructure built in the intervening years, which could lead to higher levels of stranded assets across the economy. In a scenario with delayed action on climate change that hastens only after 2025, GDP losses are estimated to be 2% greater on average across the G20 after 10 years relative to the decisive transition with immediate action on climate change, and would be greater for net fossil fuel exporting countries. The losses could emerge as soon as the delayed transition starts and could be aggravated by financial market instability, as the main uncertainty would be the number of assets that might be stranded (OECD, 2017).

Thus, drawing on the European Green Deal, the RCEP would require investing more in environmentally friendly technologies; supporting agriculture and land use, and industry to innovate; rolling out cleaner, cheaper, and healthier forms of private and public transport; decarbonising the energy sector; ensuring that buildings are more energy-efficient; and working with international partners to improve global environmental standards. The R&D focus areas would be biodiversity (involving measures to protect our fragile ecosystem); the Farm to Fork Strategy (involving ways to ensure more sustainable food systems – European Commission, 2020); sustainable agriculture; clean energy; sustainable industry (entailing ways to ensure more sustainable and environmentally friendly production cycles); building and renovating (considering the need for a cleaner construction sector); sustainable mobility (aiming to promote more sustainable means of transport); and eliminating pollution. Inventions in the above areas would require investment from both the public and private sectors, with public finance providing the leadership role and the private sector facilitating in the form of scale. The circular economy concept envisages new initiatives along the entire life cycle of products to make the economy modern and sustainable. Products would be sustainable as they would last long and would ensure greater participation of citizens in the circular economy.

Regional platforms can be used to promote the climate mitigation and adaptation measures discussed above. The RCEP agreement, signed on 15 November 2020, opens health, education, water, energy, telecommunications, finance, and digital trade to foreign investors. Although the agreement does not mention climate change, the platform could be used to facilitate climate action through the consumption of technology-embedded low-carbon products. Moreover, foreign investors in infrastructure projects (water, energy, telecommunications, and others) could be encouraged on green growth trajectories after taking into consideration the national treatment principles.

Providing a bigger platform through regional rather than bilateral agreements, and subjecting low-carbon products to common standards at a larger geographical level, would help to facilitate new inventions and generate economies of scale, resulting in lower costs for consumers. Therefore, even if a trade agreement does not specifically deal with climate action, it can help in achieving climate goals through consumption-based decisions. A consumption-based approach to target the Paris Agreement goals through regional platforms – by facilitating decisions in the areas of the circular economy, renewables, transport, sustainable agriculture, and industry – would not only affect the fossil fuel-based production decisions, but would also lead to new low-carbon innovative inventions. This would result in investment diversification and has the potential to put the economy on a green growth path. The facilitation of low-carbon innovative products in the form of price-based (tariffs and taxes) and market-based measures has important implications for the market structure, where incumbents are well entrenched. Therefore, consumers guide production decisions, which are facilitated by capital, through investment decisions. Hence, technology and R&D provide the lead in innovating low-carbon products, which if facilitated at a larger level in the form of a regional agreement through trade, would have implications on the market structure of the product and thus on production decisions. In terms of technology transfer, Japan appears to disseminate its approach to carbon neutrality to developing and emerging economies, while Korea's approach seems to be attracting more support from developed countries. For example, Japan's vision highlights the importance of decarbonisation of the fossil fuel industry by adopting CCUS, carbon recycling, and a green transition fund as important tools to meet low-carbon transition goals. At the latest June 2021 ministerial meeting between ASEAN and Japan, the parties agreed to establish CCUS, which is a feasible path to decarbonisation; and to create a knowledge system and a networking platform for relevant CCUS stakeholders such as policymakers, financiers, researchers, and project implementers. CCUS represents a dominant part of the prevailing energy mix in several developing and emerging economies of ASEAN and East Asia. On the other hand, Korea intends to collaborate with Australia in promoting green hydrogen energy.

The 2-year Hydrogen RD&D International Collaboration Program in Australia is a key milestone in the Hydrogen Industry Mission of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), launched in May 2021. The engagement program will support collaboration between Australia's research institutions and leading international research organisations for the benefit of the domestic hydrogen research, development, and demonstration (RD&D) community, as well as enabling RD&D linkages with partner countries. The Hydrogen RD&D International Collaboration Program is funded by the Australian government, and follows partnerships signed with Germany, Singapore, and Japan to accelerate the development of low-emission technologies, including hydrogen, which will drive investment and job creation in Australia. Box 5.2 describes the ascending importance of digital technologies in the region.

With respect to Australia's regional cooperation contribution to boost green growth through technological innovations that include digitalisation of services, Sun Cable has been developing the US$22 billion AAPL, which has been awarded 'major project status' by the Australian government.[11]

The AAPL involves the world's largest battery, with about 22 gigawatt-hours of battery storage, the world's largest solar farm (12,000 hectares of solar arrays), and 4,500 kilometres of high-voltage direct current submarine cable producing 10 gigawatts of dispatchable electricity.[12] The project will provide dispatchable renewable electricity to the Northern Territory and will supply up to 20% of Singapore's electricity demand. Eventually, it will supply Indonesia too. It is expected that the AAPL will export about US$2 billion of solar energy per year to Singapore by the end of 2027, connecting Australia to the ASEAN Power Grid (Straits Times, 2020). Sun Cable could profit from letting other projects export electricity to Asia through shared-cost use of its infrastructure. This would encourage future renewable energy exports, especially to ASEAN, and strengthen Australia's economic relationships with its ASEAN neighbours.

A pre-feasibility project report commissioned by the Pilbara Development Commission and authored by Australian and Indonesian researchers looked into the potential of exporting electricity generated by PV solar in the Pilbara to Asia (Mella, James, and Chalmers, 2017). The study found that it was feasible to deliver energy generated from a Pilbara solar facility and send it via a high-voltage direct current cable under the sea to Indonesia. A pilot project has been planned to involve the development of a 3-gigawatt solar farm and a subsea transmission cable by 2030. The Queensland government announced its support for the construction of Australia's largest solar farm, near Chinchilla.

In terms of regional cooperation on green growth, the hydrogen energy supply chain is provided as an example of Australia and Japan cooperating on a pilot project in 2020–2021. The project will make use of the world's first liquefied hydrogen carrier, the Suiso Frontier. Liquefied hydrogen will be transported from Latrobe Valley in Victoria to Kobe in Japan.

[11] 'Major project status' is the government's recognition of the strategic significance of a project to Australia. It provides projects with support from the Major Projects Facilitation Agency, which acts as a single-entry point for government approvals, project support, and coordination.

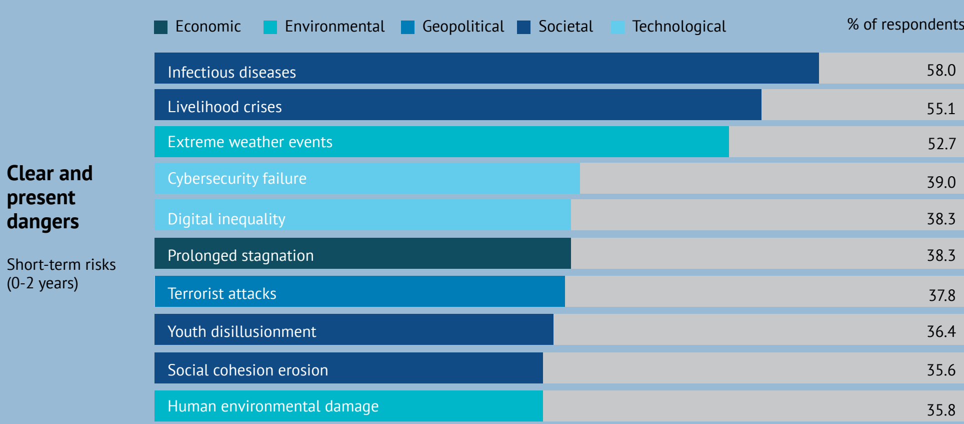
[12] Construction is expected to start in late 2023, with solar energy to reach Darwin in 2026 and Singapore in 2027.

## Box 5.2 Ascending Importance of Digitisation – A Gift from COVID-19

One of the recent technological innovations before COVID-19, which is becoming popular in the post-COVID-19 situation, is the increasing presence of digitisation in socio-economic activities across countries. Currently, for example, just over half of the potential economic value of digital ID could accrue to individuals, making it a powerful key to inclusive growth, while the rest could flow to private sector and government institutions (White et al., 2019). Beyond quantifiable economic benefits, digital ID can offer non-economic value to individuals through social and political inclusion, rights protection, and transparency. Capturing the value of good digital ID is by no means certain or automatic. Careful system design and well-considered government policies are needed to promote uptake, mitigate risks like those associated with large-scale capture of personal data or systematic exclusion, and guard against the challenges of digital ID as a potential dual use technology (White et al., 2019). The World Economic Forum's Global Risks Report 2021 (World Economic Forum, 2021) identified cyberattacks as the top global tech-related danger (Figure). Business, government, and household cybersecurity infrastructure is outstripped or rendered obsolete by increasingly sophisticated and frequent cybercrimes, resulting in economic disruption, financial loss, geopolitical tensions, and/or social instability (Holleyman, 2021). Hence, digitalisation is a double-edged sword and needs to be handled carefully to avoid major disasters to individuals' privacy

### Global Risks Horizon

When do respondents forecast risks will become a critical threat to the world?




COVID-19 = coronavirus disease, ID = identity.

Source: ERIA Study Team. based on World Econoic Forum (2021).

The Suiso Frontier vessel had originally been due to make the journey from Australia to Japan in March 2021, but the project team admits that it might not now happen until March 2022 (Recharge, 2021).

### 3.4. Fostering Policies in Support of New Regionalism for Low-Carbon Green Growth

Drawing on the above empirical results, a series of crucial questions needs to be addressed: How can regional cooperation help break these 'national' constraints? How should countries organise themselves collectively to overcome the skills barriers in any individual country? What will it take to make such a collective effort? How should leader–follower incentives be structured to make this happen?

The following policy implications can be drawn as answers to the above important questions, using the empirical results of this study. First, technology-focused alliances such as the International Solar Alliance (ISA), Global Geothermal Alliance, Mission Innovation, and others will play an important role in enabling countries to harness the full potential of the low-carbon renewable energy resources at their disposal. For example, the ISA, which is an alliance of 121 countries initiated by India, is also seen as an alliance by developing countries to form a united front and to undertake R&D for making solar power equipment in developing countries (Hindu Business Line, 2015). In 2016, the alliance entered into an understanding with the World Bank for accelerating the mobilisation of more than US$1 trillion in investments, which will be needed by 2030, to meet the ISA's goals for the massive deployment of affordable solar energy across the alliance countries (Press Information Bureau, India, 2016).

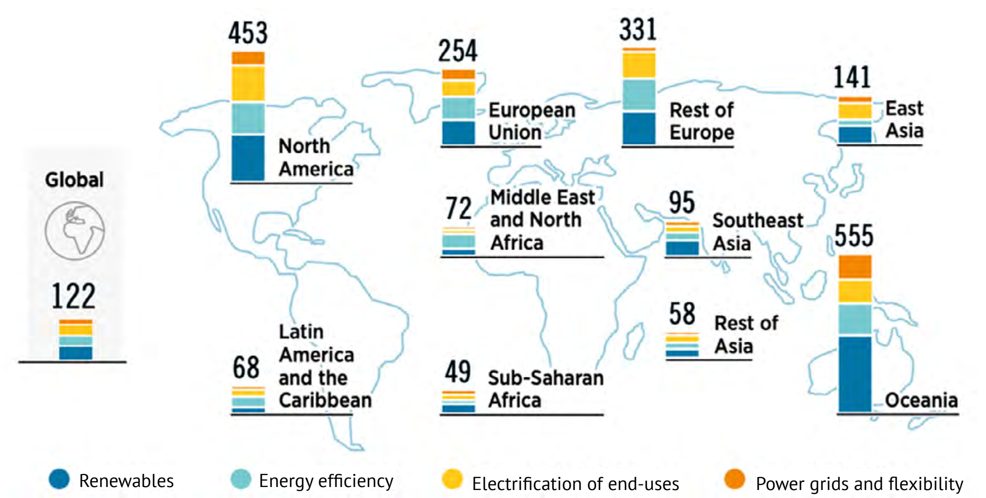
Secondly, cooperation amongst RCEP members has the potential to help new and existing players in the renewable energy sector to invest in quality education, R&D, and training by harmonising education standards across the region. Thirdly, active involvement by governments in the promotion of R&D concerning renewable energy technologies has been more successful in countries such as Japan, China, India, and Singapore than other countries in the region. These developments help make these countries competitive in the export market. The private sector in these countries has contributed to the provision of basic infrastructure services and education. The collaborative role of government and the private sector in the emerging Asian countries can improve their competitiveness in renewable energy goods exports. Fourth, R&D activities and the enforcement of IPR are essential for the players in the renewable energy sector to move into high-end markets. Foreign direct investment (FDI) is an important source for emerging Asian economies to increase their competitiveness and R&D activities, which can be easily facilitated through the RCEP cooperation framework. Fifth, the renewable energy business environment in the emerging Asian countries can be improved by removing unwarranted government interventions, such as providing subsidies to fossil fuels, and inefficient regulations in which the costs exceed the benefits; and improving infrastructure, such as transportation for the renewable energy goods and services export industry. Existing players can expand into high-end and new markets while new entrants may find their place in low-end products on the basis of cost advantage. Finally, with the increasing use of digitalisation in almost all socio-economic activities, maintaining cybersecurity at its best becomes imperative.

## 4. Addressing Green Financing Challenges Through Regional Cooperation

The discussion in section 3 on regional cooperation in trade and technology and its empirical evidence on developing renewable energy capacity and long-term sustainable development show that the role of capital investment and R&D are key to drive the low-carbon development path in the electricity market. Along the way, building labour capabilities via green jobs – focusing on human capital, skills, and talent – is critical as a regional cooperation agenda to accelerate the post-pandemic recovery plans. Removing tariff and non-tariff measures is critical. Taking the empirical evidence further than the renewable electricity market, which is equally important to discuss further, is regional cooperation in financing the green path – especially, financing with regards to infrastructure development, R&D, technology, research mobility, and innovation. Indeed, with the varying degree of clean energy per capita investment across regions, regional cooperation in finance is crucial in ensuring a more balanced clean energy development path (Figure 5.7).

Countries have put forward various amounts of stimulus packages for the road to recovery. While some focus on the immediate health impacts of the pandemic, others have gone beyond the immediate impacts and concentrated on the post-recovery plans. The evidence from the stimulus packages designed and implemented

**Figure 5.7 Clean Energy per Capita Investment Across Regions, 2019–2050** (US$)




**Based on IRENA analysis**

Note: Per capita investment figures were calculated on basis of each region's average population during the period 2019-2050.

Disclaimer: The designations employed and the presentation of material herein do not imply the expression of any opinion on the part of IRENA concerning the legal status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Source: IRENA (2018).

by most of the developing countries, as shown in the earlier chapters, indicate that most countries lack adequate long-term recovery plans and strategies moving towards a greener path. This, in return, poses new challenges and opportunities for the long-term recovery plans to catalyse cross-border activities by firms and other service providers. Nevertheless, fiscal space to do that is limited in many countries, especially in the developing countries that have budget constraints. Indeed, without acknowledging structural deficiencies, it is unlikely that recovery is possible, especially for stimulus packages targeting green initiatives or green industries. For instance, it is estimated that between 2016 and 2030, ASEAN requires US$3 trillion in green investment in areas like infrastructure, renewable energy, energy efficiency and food, agriculture, and land use to realise its green transition (UNEP and DBS, 2017). Table 5.4 shows the amount for global trends in renewable energy investment in 2019. Within the new investment by value chain, asset financing and small distributed capacity financing is dominant. More investment is required in venture capital and private equity. Public and private R&D investments should be intensified.

Moreover, 90% of the infrastructure financing in Asia is almost driven by government financing while the global average of government financing is only around 40% (SIIA, 2020). Thus, major challenges and opportunities for many countries in Asia are tied to the financing needs of such activities and how to attract private financing to strengthen its recovery process. In this regard, the role of regional financial cooperation is critical. Similarly, aligning with the role of domestic capital markets is imperative. This section further discusses the need for regional financial cooperation and how it can play a role in the recovery and post-recovery periods. It also discusses the challenges and opportunities that countries have in the context of green and sustainability related financing as a strategy for recovery.

**Table 5.4 Global Trends in Renewable Energy Investment, 2019**

| Category | Type | Amount ($ billion) |
|---|---|---|
| **Total investment** | New investment | **301.7** |
| | Total transactions | 402.4 |
| **New investment by value chain** | Venture capital | 1.2 |
| | Government R&D | 5.7 |
| | Corporate R&D | 7.7 |
| | Public markets | 6.6 |
| | Private equity expansion capital | 1.8 |
| | Asset finance | 230.1 |
| | Small, distributed capacity | 52.1 |
| **M&A transactions** | Private equity buy-outs | 3.2 |
| | Public markets investor exits (2018) | 0.1 |
| | Corporate M&A | 13.7 |
| | Project acquisition and refinancing | 83.8 |

M&A = mergers and acquisitions, R&D = research and development.

Source: Frankfurt School-UNEP Centre (2020).

### 4.1. Seizing Financing Opportunities Through Regional Cooperation in the Post-COVID-19 Era

Regional cooperation focuses a great deal of effort on trade integration, while financial cooperation shows limited progress and mostly focuses on infrastructure financing. The launch of the Asian Financial Cooperation Association in 2017, a China-led initiative, marks another agenda that focuses specifically on financial cooperation. However, financial cooperation largely occurs in the form of bilateral arrangements. For instance, the Monetary Authority of Singapore announced initiatives with China, as post-recovery strategies, to expand financial cooperation in capital markets, digital finance, and green financing. Nonetheless, similar trends are not observed with other countries.

Charting low-carbon recovery plans must move towards international and regional systems of mutual aid and cooperation in finance. Trade coordination in health-related goods and services is a good example. The need for regional cooperation in finance takes a classical risk-pooling argument. Regional cooperation in finance serves as an opportunity to manage financial resources collectively so that large and unpredictable financial risk becomes more predictable and manageable, and is well distributed amongst the pooling members. It is even more critical in new forms of investment such as green investment.

Further, given the heterogeneity of financial infrastructure across countries, regional cooperation in public and private financing, best practices in financing green projects, and collective government risk sharing and instruments for lowering risk (such as risk insurance for the private sector) would have a complementary role in facilitating and mitigating the financial risk of cross-border financing – especially in new industries where information is lacking for financial institutions to assess such investment portfolios. Likewise, regional cooperation would help to reduce information asymmetry on financial practices and management across countries to facilitate new private investments. Similarly, the role of regional cooperation in helping the functioning of the financial markets to return to their normal state is imperative.

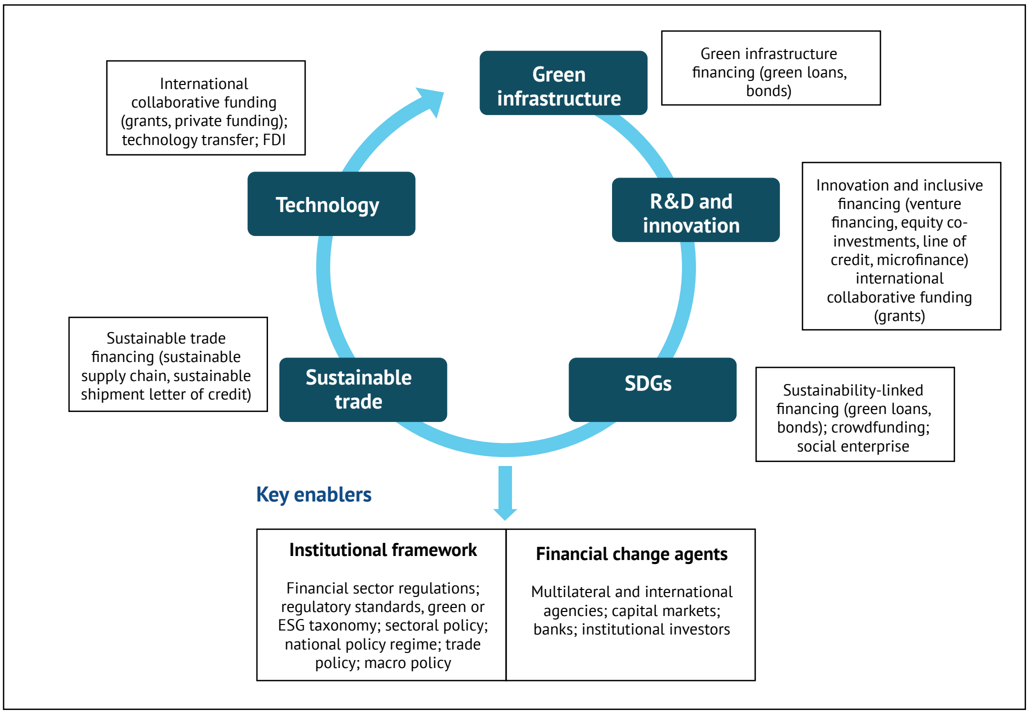
Regional cooperation in finance must quickly take the necessary measures to kick-start long-term recovery plans, especially in supporting banks and capital markets to finance green growth. This includes improving financial institutions' capabilities to fund green businesses and investments. Amongst others, new instruments like the bond and sukukmarket could facilitate green transitions as a recovery plan targeting new growth areas. From the regional perspective, the development of new financing instruments can be targeted. For instance, the global green bond and loan market has seen an upsurge of 50%, from US$171 billion in 2018 to US$258.9 billion in 2019. Within ASEAN, with regulatory support, issuance doubled from US$4.1 billion in 2018 to US$7.8 billion in 2019. (Climate Bonds Initiative, 2019). Using such an instrument offers huge potential, as ASEAN and the Asia-Pacific only represent 3% and 12% of the global total issuance, respectively. Policy development concerning green debt issuance, as well as the formation of an ASEAN+3 Bond Market Forum and

ASEAN Bond Market Initiative, have catalysed green financing (Climate Bonds Initiative, 2019).

What is important in regional financial cooperation is that financing the green growth path should be holistic and not limit finance to green infrastructure development. It should also encompass other activities that catalyse the transition to green growth. Figure 5.8 depicts how regional financing could be made more transformative in supporting the long-term recovery amongst countries and, at the same time, move towards the new engine of growth – i.e. making the green transition in various areas and activities. One critical area is infrastructure development financing to support the green transition.

Various efforts are already under way in the regional context for financing infrastructure development, with international development agencies such as ADB taking an active part in financing. For instance, ADB committed US$6.5 billion in climate financing in 2019, and targets cumulative climate financing of US$80 billion by 2030 (ADB, 2020). Within ASEAN, the only regionally owned green financing for upscaling climate change initiatives is the ASEAN Catalytic Green Finance Facility, which was established in 2019 under the ASEAN Infrastructure Fund (AIF). From 2019 to 2020, three projects were financed by the AIF (US$40 million), ADB (US$820 million), and co-financing partners (US$410

**Figure 5.8 Regional Cooperation Agenda and Financing Opportunities for the Long-Term Green Recovery**




ESG = environment, social, and governance; FDI = foreign direct investment; R&D = research and development; SDG = Sustainable Development Goal.

Source: ERIA Study Team.

million). These projects will bring together private project financing in the targeted countries. There are also initiatives to create national green de-risking finance facilities by identifying bankability gaps and finding various financing instruments to close the project financing gaps.

Chinese investments have become critical to many developing countries in infrastructure development, with the Belt and Road Initiative (BRI), the Asian Infrastructure Investment Bank, and the Silk Road Fund supporting the financing gaps. For instance, one of the largest BRI investments is in the energy sector, totalling US$20 billion, of which 35% was for hydropower and 23% for solar in 2020 (Nedopil, 2021). The shift to renewable energy is encouraging, and if other investments follow the same trend, this regional cooperation could bring significant changes in green infrastructure financing. Further, the signing of the RCEP could expand access to BRI financing by providing market access and by financing areas such as e-commerce, financial services, and services trade.

Other than financing infrastructure development, financing technology, innovation, and R&D activities is critical. This could include financing technological adoption costs, and capacity building by providing technical assistance as well as technological policy support. For instance, the heavy reliance on public grants and public funding mechanisms to support renewable energy is not sustainable, and guarantees for renewable energy specific risks with private funding systems should be established at all stages – early stage, demonstration, deployment, diffusion, and commercialisation. A vibrant private financing system that includes venture capital, equity, debt, and insurance could shape the nature of green technology, R&D, and innovation. Regional cooperation in driving the next generation of technologies and R&D activities, e.g. hydrogen could allow countries to leap technologically. A specific financing support system is required to provide for more focus on climate change related technologies based on regional needs. Box 5.3 illustrates the European Bank for Reconstruction and Development's Finance and Technology Transfer Centre for Climate Change programme, which is a global initiative to promote the transfer of technology for developing countries and countries in transition through networks.

Energy-efficient investment for Southeast Asia, China, and India totalled US$20 billion in 2015 and is projected to increase to US$2.62 trillion over 2017–2030,[13] with 72% in renewable energy and 28% in energy efficiency (Treco, Stephens, and Marten, 2018). Such investment would allow countries to take an active part in the global value chain of these new technologies, which would have various positive spillovers. Importantly, technology transfer and FDI play a critical role. Malaysia's experience in building a solar industry ecosystem through multinational corporations and active state intervention in completing the entire industrial ecosystem by driving foreign and domestic investment is a key lesson on how cooperation can work to accelerate a green industrial policy (Chandran, 2019). Industrialisation that comes with urbanisation should be transformed to move towards

[13] The estimated figure is the total investment for China, India, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam.

**Box 5.3 Technology Transfer Financing**

The EBRD's Finance and Technology Transfer Centre for Climate Change programme focuses and assists countries to implement climate technologies to reduce their carbon footprint and mitigate climate change challenges. In doing so, it provides grants as well as technical support to assist the transfer of technology with the participating regions. The collaborative networks established by the EBRD allow information and knowledge sharing, which is crucial given that various stakeholders are involved in financing technology transfers. Indeed, the programme helps to facilitate technology support requests by participating countries so that technical know-how and other support can be provided.

An outstanding case study is the technology transfer financing awarded to Elemental Holding S.A., a Polish company involved in the recycling of platinum-group metals and electrical waste. A loan of € 25 million from the ERBD was instrumental in financing the construction of a recycling facility to treat lithium-ion batteries for electric vehicles and other waste-containing metals in realising Poland's move towards a low-carbon economy. The deployment of the facility is also co-financed by the Polish National Centre for Research and Development, while technical cooperation support is provided by the Taiwan Business–EBRD Technical Cooperation Fund and Spain. As of April 2021, the EBRD has invested € 10.8 billion in 456 projects in Poland.

GEF = Global Environment Facility, Gov't = government, UNDP = United Nations Development Programme.

Source: ERIA study team based on UNDP (2021) and Lee (2021).

supporting low-carbon urban development. Box 5.4 shows these low-carbon urban development initiatives in Malaysia.

Regional cooperation in the international tax system is much needed to counter the challenges of the digital economy as well as to mobilise resources. A commitment on international exchange of information is also critical to have a more transparent system that could tackle tax evasion. The establishment of a Regional Hub on Domestic Resource Mobilisation and International Tax Cooperation in Asia could be a point of reference. This would allow international private financing to support the industrial development process.

Likewise, viewing society as an agent of green innovation would require regional cooperation to take a bold approach in catalysing green growth as well as creating jobs and inclusiveness. Social enterprise and community-based innovation, as well as social innovation, plays a critical role in solving and providing environment-related solutions. Regional cooperation in financing such activities could broaden the focus to reduce the carbon footprint at the community level – impacting the environment in many developing countries. For instance, the launch of the ASEAN Social

### Box 5.4 Regional Financing for Low-Carbon Urban Development

Low-carbon urban development, especially in cities, is critical to the minimisation of carbon footprints. Malaysia launched the Low Carbon Cities Framework in 2011 and has worked with various local councils and agencies to promote low-carbon cities. The aim of the framework is to provide a guide for developers, local councils, town planners, and other stakeholders to achieve carbon reduction in cities. Various measures and initiatives – such as clean energy, integrated waste management, sustainable transportation, energy efficiency, pollution control, land use, and green buildings – are crucial in paving the way to low-carbon urban development. Malaysia uses various financing options in implementing low-carbon urban development. These include co-financing with private sector entities such as private banks, pension funds, insurance funds, and Islamic investors. Other financing entities and channels include social impact investors, corporations (via corporate social responsibility initiatives), and debt as well as equity financing as part of project financing and longer tenor funding. Credit enhancement options, such as partial loss guarantee and political risk guarantee options, are considered to attract foreign investors.

In 2015, the Green Technology Application for the Development of Low Carbon Cities was established with the support of the Global Environment Facility and the United Nations Development Programme to implement a low-carbon cities project. The aim of the project is to remove barriers to low-carbon urban planning and development by establishing policy support for promoting integrated urban planning, building awareness and institutional capacity, and investing in low-carbon technology. Consequently, many cities have set low-carbon action plans to help track low-carbon actions, with a number of urban areas having signed partnerships with various actors. Currently, 52 local authorities have been part of the Low Carbon Cities Framework to reduce their carbon footprint.

| Institution | Amount ($) |
|---|---|
| GEF | 4,354,794 |
| Federal and local gov’t | 55,258,266 |
| UNDP | 354,000 |
| Cost sharing | 50,000 |
| Leveraged co-finance – private sector | 164,136,278 |

GEF = Global Environment Facility, Gov’t = government, UNDP = United Nations Development Programme.

Source: ERIA study team based on UNDP (2021) and Lee (2021).

Enterprise Development Programme by the ASEAN Foundation, with the support of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), offers opportunities for social enterprises to build capacity, fund projects, and network to address environmental problems by promoting responsible consumption and production and supporting actions for climate change impacts. At the country level, in Malaysia, the AirAsia Foundation established a social enterprise hub to promote 30 social enterprises around ASEAN. The foundation provided 26 grants totalling US$20,000 each in seven countries. This can be regarded as financing social impact investment within the sustainable development goal framework that countries adopt. Regional development institutions can also play a critical role. Similarly, social impact investment can be established out of venture capital model that seeks to support social, environmental, and economic challenges. Indeed, intermediaries operating as accelerators, investment vehicles, and social investment wholesalers can be positioned to take a more regional approach. These financing models can be better positioned if there is harmonised regulatory framework and more transparency within regions. Likewise, Korea has positioned science, technology, and innovation (STI) policy and financing for social problem-solving R&D programmes in the areas of environment and energy. Regional R&D support and financing through the university network can be redirected towards financing academic research in these areas. ASEAN cooperation in S&T has made various efforts, but lacks resource mobilisation and funds for supporting S&T. A financial roadmap to leverage cooperation in S&T is critical, while financing a bottom–up low-carbon approach such as grassroots innovation is essential so that participation can be critically engaged directly with society. For example, community-based movements such as local exchange trading schemes, the Bollington Carbon Revolution, and Transition Towns are already making impacts. Having regional financing available for such innovative approaches would accelerate the green path transitions.

One positive development caused by the pandemic is the acceleration of digitalisation efforts amongst countries. Firms have quickened their efforts to use technology to stay competitive during the pandemic. This provides a critical juncture for regional cooperation in financing the digital value chain that would ultimately lead to sustainable trade. Regional supply chains and value chains can be transformed through financing digitalisation efforts to limit the impact of trade on the environment and support the low-carbon agenda. Nevertheless, the conception and the driver for financing a sustainable supply chain or even greener logistics are limited in Asia. Bancilhon, Karge, and Norton (2018) estimated that the global sustainable finance market was US$660 billion, with revenue opportunities of US$6 billion for a sustainable supply chain in 2017. New technological revolutions such as blockchain and fintech could revolutionise the management of the challenges of tracking green practices along the supply chain. The potential is limitless, but efforts are scarce regionally. Individual countries' financial stability overrides financial innovation in most cases, causing new types of financing to progress slowly. As a region, more can be done if collective action results in risk-pooling collaboration amongst financial regulators, commercial banks, investment funds, retail investors, and other agents in the financial sector. Amongst the tasks to consider are adequate reporting of risk, a risk assessment system, and integrating green investment risks into financial sector prudential regulation. ASEAN as a region aspires to promote financial inclusion via digital financial services and regional payment connectivity as a strategy in its ACRF. However, it requires greater services liberalisation efforts, especially in the financial sector.

Trade financing has also been key in catalysing green development. Technology embedded in capital goods and the provision of green-related services facilitate the move to a green growth path. Indeed, efforts towards making trade sustainable could contribute significantly to global low-carbon and climate change initiatives. Globally, in goods trade, interfirm trade credit supports 60% of trade financing, while banks support the remainder. Letters of credit are the most common instrument, with other instruments including documentary collection and supply chain financing and guarantees. Nevertheless, financing gaps in trade are still a huge problem – and more so for sustainable trade financing. The global trade finance gap is projected to be US$1.5 trillion in 2019, and the Asia-Pacific accounts for half of the trade finance applications (ADB, 2019a). Instruments such as green supply chain financing and sustainable letters of credit are still in their infancy. Blockchain technology acts as a digital enabler that allows more effective management of the green supply chain and promotes transparency to support green financing. It facilitates sharing of critically needed information for green management, allowing traceability, which is difficult in conventional supply chain settings. Blockchain technology also facilitates better management of stakeholders, reviews returns in real time, and is transparent in managing the proceeds where risk can be minimised amongst investors. This technology also saves costs. For instance, issuing green bonds through the standard process costs around US$6.4 million, while the cost is reduced to US$692,000 with blockchain automation issuance (HSBC and Sustainable Digital Finance Alliance, 2019).

One of the key developments in financing, as a result of the pandemic, is the formulation of the ACRF, which emphasises, amongst others, the promotion of sustainable financing as one of the key strategies – with actionable plans on ASEAN sustainable capital markets; sustainable banking principles; and green, social, and sustainability bond standards. A critical aspect of financing the SDGs requires such a framework to leverage public and private financing institutions to play a major role.

## 4.2. Key Enablers of the Regional Financing Architecture

### 4.2.1.Facilitating an Institutional Framework

Key enablers of the financing ecosystem are the formulation of a clear institutional framework and the positioning of financial change agents within the ecosystem. While there are efforts to have regional institutional settings to facilitate progress, with the involvement of multidimensional agencies, progress has been slow in Asia and largely fragmented as it requires coordination efforts in many other areas. In fact, financing needs for infrastructure development could not be met effectively given the lack of private financing participation. These new opportunities can be sized if, regionally and nationally, the policy regimes and a holistic framework of financing can be developed to support all areas of financing. The regional operational architecture should be developed with this perspective in mind. Therefore, the policy and institutional framework should not be based solely on infrastructure financing but also on other activities that support green infrastructure. For instance, financing infrastructure development could also bring opportunities in technology, R&D, sustainable trade, and meeting some of the SDGs. In addition, involving various stakeholders through consortium financing would be viable. In reducing the risk of financing, governments could set and commit to regional efforts to transfer risk effectively by engaging in risk-pooling instruments or contingent credit lines and funds to boost public–private investments. Moreover, government subsidies for insurance for green deals could be sponsored through publicly supported private schemes at the regional level if an adequate framework is available.

**Table 5.5 Key Funding Mechanisms for Environmental Projects**

| Fund | Details |
|---|---|
| Climate Change Fund | The Climate Change Fund was established in 2008 to provide grant funding for climate-related projects, research, and development, to assess causes and consequences. Funding is provided for projects that lead to the reduction of greenhouse gas emissions or adaptation to climate change. |
| Clean Energy Financing Partnership Facility | The Clean Energy Financing Partnership Facility was established in 2007 and provides grant funding to member countries in the region for improving energy security and transitioning to low-carbon economies, through cost-effective investments in technologies and practices. |
| Asia Pacific Carbon Fund | The Asia Pacific Carbon Fund was established in 2007 as part of the Carbon Market Initiative. It provides financial assistance for clean energy projects. |
| Future Carbon Fund | The Future Carbon Fund was established in 2008 and provides funding for projects that will generate carbon credits for greenhouse gas reductions after 2012, to improve energy efficiency and renewable energy. |
| Water Financing Partnership Facility | The Water Financing Partnership Facility provides financial resources and technical support for water services and river basin water management. |
| Poverty and Environment Fund | The Poverty and Environment Fund is a multi-donor trust fund which promotes the mainstreaming of environmental considerations into broader development strategies, programmes, and projects. |
| Global Environment Facility | The Global Environment Facility, established in 1992, provides opportunities for 'inclusive economic growth with local and global environmental benefits'. This is done through innovation testing, scaling investments, and mainstreaming sustainable technology and infrastructure.* |
| Urban Environment Infrastructure Fund | Established in 2009, the Urban Environment Infrastructure Fund supports the efforts to address the 'huge unmet needs of the region for both basic and economic infrastructure'. The fund focuses on climate change mitigation, urban environmental transport, water, and solid waste management services.** |

| Fund | Details |
| --- | --- |
| Investment Climate Facilitation Fund | Established in 2008 as a response to the challenges of 'promoting investment and tackling climate change through energy efficiency', the Investment Climate Facilitation Fund is focused on promoting sector development and regional investment.*** |
| Green Climate Fund | Established under the Cancun Agreements by 194 countries in 2010, the Green Climate Fund focuses on promoting and financing sustainable climate change architecture in developing countries.**** |
| ASEAN Catalytic Green Finance Facility | The ASEAN Catalytic Green Finance Facility – an initiative of the ASEAN Infrastructure Fund – was launched in April 2019 to accelerate green infrastructure investments in Southeast Asia.***** |

ADB = Asian Development Bank, ASEAN = Association of Southeast Asian Nations.

* ADB (n.d.), Global Environment Facility (GEF). https://www.adb.org/what-we-do/funds/global-environment-facility (accessed day month year).

** ADB (n.d.), Urban Environmental Infrastructure Fund. https://www.adb.org/what-we-do/funds/urban-environmental-infrastructure-fund (accessed day month year).

*** ADB (n.d.), Investment Climate Facilitation Fund. https://www.adb.org/what-we-do/funds/investment-climate-facilitation-fund (accessed day month year).

**** Green Climate Fund (n.d.), Accredited Entities: ADB. https://www.greenclimate.fund/ae/adb (accessed day month year).

***** ADB (n.d.), ASEAN Catalytic Green Finance Facility (ACGF). https://www.adb.org/what-we-do/funds/asean-catalytic-green-finance-facility/overview (accessed day month year).

Source: ADB website.

At the national level, countries should clearly show what types of financing are needed to meet the mitigation targets. This would provide adequate information for regional financial cooperation – through regional initiatives or private arrangements. Information on policies and regulatory systems, including public procurement, international standards, and targets for low-carbon infrastructure, would allow investors to build trust and work towards financing the green targets. Political stability and information on incentives and other provisions would incentivise the private sector to show interest in such an environment. Domestic market reactions to this would also be positive. Currently, there is a vast difference in terms of transparency across countries in Asia, and removing the gaps via learning and sharing best practices through regional cooperation would position the countries to function effectively in financing. A framework could be established within the regional context.

### 4.2.2 Multilateral Development Banks and Agencies

In the context of regional cooperation in low-carbon initiatives, various activities have been undertaken. For instance, since its establishment in 2011, the AIF has committed US$520 million for regional energy, transport, water, and urban infrastructure projects.

In 2019, as part of the AIF, ASEAN partnered with ADB and other major financing institutions to launch a US$1 billion financing facility to accelerate green infrastructure investment across Southeast Asia. The financing comes from the AIF (US$75 million), ADB (US$300 million), KfW (US$336 million), the European Investment Bank (€150 million), and Agence Française de Développement (€150 million) (Reuters, 2019). The role of multilateral development finance institutions is critical in fostering the development of the low-carbon economy. For instance, organisations such as ADB, the Asian Infrastructure Investment Bank, the Islamic Development Bank, the World Bank, the AIF, the Credit Guarantee and Investment Facility, and the New Development Bank facilitate green infrastructure financing. These institutions offer concessional and market rate loans; and support private participation in investments via long-term loans, equity, guarantees, and technical assistance. ADB's funding methods, for example, include loans, equity investments, guarantees, grants, and technical assistance. ADB provides funding for climate change and adaptation through different projects. A number of funding mechanisms have been devised, as shown in Table 5.5.

Multilateral financing should be clearly linked to existing initiatives undertaken in the region. Moreover, if new initiatives emerge as part of the long-term pandemic recovery plans, they could be facilitated across regional blocs. For instance, the NDC commitment provides an estimation of how much funding is needed to achieve the climate change initiatives. The estimated cost of achieving the NDCs in developing countries is US$3.5 trillion[14] (Carbon Brief, 2015). Indeed, US$420 billion is expected to come from international financing sources. An example of a recent pilot project on climate change that has an integrated approach engaging various stakeholders with adequate investment criteria framework is the Shandong Green Development Fund. The project leverages the private, public, and international institutions to restructure Shandong to transit towards low-carbon and climate-resilient development. Importantly, the project makes the financing bankable by evaluating the project risk up front, and promoting technologies through an integrated approach to achieve the climate change challenges. It consists of US$300 million of international institutional financing and US$1.2 billion of public and private sector capital financing. It also uses the Green Climate Fund investment criteria and framework.

### 4.2.3. Private Financing

Kalirajan and Chen (2018) indicated that there is a huge imbalance in private financing across regions in domestic markets. Indeed, the full potential of private financing of renewable energy is not fully realised across Asia. For instance, most Asian countries can only achieve 60% of their renewable energy investment potential. It is therefore critical to mobilise private financing through regional cooperation. Nevertheless, regional private financing cooperation is largely subject to regional trade and financial integration. This problem is exacerbated during crises if the financing is supplied in a procyclical manner that limits the financing from coping to cope with capital account shocks. Studies have shown that during the Asian financial crisis, countries suffered due to the sudden reversal in capital flows (Cavallo, 2019). This has also been true during the pandemic, as investment flows into green initiatives have slowed and declined significantly. Moreover, financial flows are limited due to the existence of a larger risk

[14] Only about two-thirds of 111 countries quantified the financial needs.

**Table 5.6 Tools for Financing Renewable Energy, Southeast Asia**

| Tools | Descriptions |
|---|---|
| Concessional finance | Loans with below-market financial conditions (e.g. lower interest rates, longer grace periods, low or no collateral requirements) |
| Dedicated loan | Loans only dedicated to renewable energy investments (e.g. solar energy loan, energy efficiency tractor loan) |
| First-loss capital | Capital that is the last to be repaid in the event of default (e.g. junior equity or subordinated loans) |
| Mezzanine finance | Debt that can be converted into equity over a defined time period (e.g. convertible loans) |
| Patient capital | Long-term investment made to support the development of the SMEs |
| Carbon finance | Long-term and additional source of revenue received upon achievement of certified climate change outcomes |
| Co-investment | Capital provided alongside other investors to make larger investments |
| Fundraising platform | Large group of investors pooling resources to fund a project |
| Loan guarantee | Responsibility of the guarantor to repay the SME loans in the event of default |
| Output-based grant | Non-repayable money disbursed only upon achievement and verification of pre-agreed results |
| Project finance | Loans with specific financial terms and conditions adapted to capital-intensive investments (e.g. longer maturities, grace periods, repayment by cash flow generation, limited recourse loans) |
| Revolving credit facility | Loans that can be withdrawn, repaid, and redrawn |
| Syndicated loan | Pool of lenders investing together to provide larger loans under the same terms and conditions |
| Majority or significant minority shareholder position | Active involvement of the investors in the SME governance |
| Mobile phone payment | Loan payback facilitated by mobile phone payment for people living in remote areas |
| Technical assistance | Non-financial support provided to the SME (e.g. capacity building, training, pre/post-investment support on legal structure, financial reporting, business plan) |

SMEs = small and medium-sized enterprises.

Source: Nexus for Development (2018).

(accessed 18 March 2021).

exposure associated with regional financial contagion. However, regional cooperation in facilitating financing during times of crisis can effectively facilitate and support member countries within the region.

Cross-border private financing through bank lending activities could be encouraged if the spread of financial risk or perception of such risks across economies could be reduced or mitigated.[15] There has also been a steady increase in the issuance of green loans and bonds globally and in ASEAN. However, ASEAN's share of the issuance was only 3% of the global total and 12% of the Asia-Pacific region total in 2019. Within the member countries, financing development is uneven, with Singapore, Malaysia, Thailand, the Philippines, and

[15] Refer to Chapter 4 for details on private financing.

Indonesia leading the pack. Issues such as credit ratings, capacities, and the lack of an enabling framework limit market growth – restricting private sector participation across borders. Likewise, financing challenges include rethinking and unveiling policy and institutional barriers to encouraging such investment and financing. Studies show that cross-border capital flows, especially short-term portfolio and banking flows, are significantly affected by economic and policy shocks. In scaling up green financing, for instance, various policy and regulatory barriers still limit the movement of capital and lines of credit to firms and green producers.

Such cooperation should also reconsider establishing innovative private fund systems that reduce the risk-bearing capacity of the private sector and the region at large. For instance, blended financing arrangements would have the potential to reduce the risk and narrow the investment gaps that exist during the pandemic. This could be established through public funding and private arrangements across borders – sharing the risk to encourage the potential of sustainable investment. Cross-border cooperation should emphasise the administration of such initiatives by linking the public and private sectors as well as various stakeholders, such as insurance, sovereign wealth funds, and development institutions. Such efforts would require establishing an adequate framework within the regional context, which is currently lacking. Table 5.6 shows some of the financing tools used by renewable energy entrepreneurs in Southeast Asia.

### 4.3. Way Forward: Improving Regional Financial Cooperation

The existing ecosystem can be reorganised via policy intervention and collective actions. Regional cooperation in money and finance, based on the Asia-Pacific Regional Cooperation and Integration Index, remains weak and regionally diverse. For instance, cross-border equality liabilities and interest rate dispersion contributed to the weak integration in 2017 (ADB, 2021b). Indeed, a recent study showed that the degree of financial integration varied across regions such as East Asia, South Asia, Southeast Asia, and Central Asia (Montanes and Schmukler, 2018). The proposed Asia-Pacific Regional Cooperation and Integration Index Enhanced Framework could be a good starting point to track the integration efforts. However, the regional integration of money and finance indicators could be aligned to support other critical aspects of the framework – such as technology and digital connectivity, environmental cooperation and regional public goods, regional value chains, infrastructure and connectivity, and trade and investment – to ensure that a green growth path is supported. We suggest a few broad critical areas that regional cooperation could focus on, given its limited presence in accelerating the financing for green growth path.

#### 4.3.1. Green Financing Architecture and Capacity Development

A leadership role within regional blocs is required to facilitate regional initiatives. In other words, an integrated one-stop coordinating agency approach is needed. The agency should facilitate and support project identification and structuring as well as a financing and regulatory framework that aligns with individual countries' public finance for green projects. Most successful regional green financing has been due to the central role of international financial institutions. These entities could play an intermediary role and coordinate efforts effectively at the regional level in investment and capital facilitation. Technical assistance is crucial in building such financing infrastructure. Regional blocs such as ASEAN could foster critical cooperation and link international institutions with their member countries, which could align their project needs with domestic capital mobility. Innovative financing instruments are critical for improving bankability – requiring member countries to work on co-financing agendas, financial harmonisation, technical assistance, and capital market access.

Sustainable financing and green financing are taking shape, with more financial institutions participating actively in supporting green projects. The current green financing framework comprises the Green Bond Principles, Social Bond Principles, Sustainability-Linked Bond Principles of the International Capital Market Association, Climate Bonds Standard and Certification Scheme, green taxonomy for the European Green Deal, Green Loan Principles of the Loan Market Association, and Asia Pacific Loan Market Association. In terms of recovery, stimulus packages that provide aid for the private sector could make the aid conditional on sustainability and green impacts. This would also help financing institutions to reorganise themselves to the new market opportunities that the recovery poses. As discussed, strengthening the regional framework for new financing instruments such as the loan, bond, and sukuk market could facilitate green transitions as a recovery plan, targeting new growth areas.

Similarly, the financing framework could also cover the larger regional cooperation agenda in green infrastructure development, R&D, innovation, technology, and others. Amongst the current missing mechanisms are policy coordination, harmonisation of regulations and standards, operational framework, and practicality, as well as capacity development. These mechanisms are required for ensuring long-term financing, and in managing project financing as well as uncertainty in project development cost, and equity financing. A financing framework and institutional cooperation should be established to minimise the risk related to politics, policy and regulatory uncertainty, grids and transmission, technology, currency, refinancing, liquidity, and resources.

The initiative to develop the financing architecture and capacity building could leverage some of the existing institutional settings, such as intergovernmental organisation, multilateral institutions, and other entities within the context of ASEAN. Action on streamlining regulatory requirements, negotiating a revenue and cost sharing model for cross-border investments, capital mobility arrangements, and resolving individual countries' procurement arrangements could accelerate the financing flows.

#### 4.3.2. Incentivising the Shift from a Financial Institution-Based Compliance Model to a Cooperation-Based Approach and ESG Compliance Model

Reconciling corporate social responsibility objectives and the SDGs within the context of financing allows us to move from thinking solely of the dominance of an institutional risk compliance-based model to a more sustainability-linked financing focus. At present, financial institutions are mostly risk averse and are targeted towards maximising shareholder returns, which in return perceive green financing as risky – especially if it involves unknown technologies. Potential transformation, by engaging in socially responsible activities with the idea of introducing progressive values that shape the way that financial institutions behave in the future, should be explored. The rapid proliferation of sustainable financing, specifically sustainability-linked financing, moves beyond the instrumental concern of individual corporations to a broader developmental approach. This landscape is changing fast, given the new initiatives such as environmental, social, and governance (ESG) reporting and taxonomy.

Nevertheless, acceptance of such ideas is still largely lacking in many developing countries. These efforts could be accelerated at the regional level through the formulation of an adequate framework that allows private sector participation. Many financial institutions are already gearing up to sustainable financing, and at least an adequate framework should allow better utilisation of such financing to benefit the larger environmental concerns. However, incentivising financial institutions to embark on such activities requires regional institutional efforts to minimise reputational risk.

For instance, the establishment of an ESG framework and taxonomy provides a clear direction for the Asian region on how to incentivise investors and firms to be more environmentally and socially responsible. Another way is, regionally, to engage in shared stakeholder responsibility. This requires innovative institutional arrangements that reward financial institutions for engaging in shared responsibility, such as sustainability financing. In addition, it is vital to establish and operationalise a new taxonomy with clear measures of the concept of sustainability, financing, and potential financing instruments. A risk mitigation framework is also required when cross-border financing is one of the options. Amongst others, institutional capacity in finance auditing and a sustainability financing assessment are crucial to ensure that financing meets its purpose. Regionally, more work on measurement and developing appropriate indicators for the evaluation and monitoring mechanism is unavoidable. All these must be institutionalised. In doing so, sectoral technology mapping – especially in the renewable energy sector or low-carbon energy technologies – is required. Sector- and technology-specific initiatives are required to execute and mitigate the financial needs gaps. Indeed, accelerating financing support requires identifying innovative fund systems with the private sector, as well as formulating a risk-bearing system and developing third-party risk assessment capacity. Current broad policy initiatives, such as financial integration as well as sustainable financing, should be expanded to include sectors, technologies, and key actors within the context of the region.

The call for clean energy investment must also mitigate the issues of stranded assets to facilitate firms to invest in clean energy. For instance, despite the potential of renewable energy in Asia, many governments and the private sector are reluctant to move into renewable energy and continue to depend on high-carbon assets because of the inability to mitigate the risk of stranded assets, which could lead to significant non-performing loans. A regional cooperation framework for identifying stranded assets, assessing such risks, and gradually making the transition to clean energy should be considered. Financing institutions could play a role in helping to evaluate the risk and identify mitigation strategies for projects with stranded assets. Complex dynamics concerning reversibility and risk typologies are critical to understand if firms, especially state-dominated energy power companies, can be resilient to environment-related risks. Another option involves the financing of cross-border renewable projects, which could help provide financing opportunities to manage financial exposure due to the stranded assets risk. Regional cooperation in financing the transition plans is critical.

### 4.3.3. Organising and Building Regional Financing for a Green Innovation System

Revitalising the STI system means unlocking talent mobility and adopting technologies, as well as innovating to tackle the greatest challenges – net zero carbon emissions and other sustainability problems. Financing R&D and innovation activities is critical for the development of the green growth path. A regional science and innovation financing system for carbon and storage technologies, digital technologies, and other new emerging technologies is required to accelerate the green growth path. Nevertheless, the challenges in building a functional green innovation system remain as the existing policy frameworks within the countries differ greatly due to different development stages. Indeed, IPR are critical for developing countries to build a green STI ecosystem. Cooperation in areas of intellectual property law and IPR enforcement are not discussed in depth in most trade agreements, given their complexity. One important move is the ASEAN[16] Framework Agreement on Intellectual Property Cooperation, signed in 1995, which paved the way to the formation of the ASEAN IPR Action Plan, 2016–2025. However, challenges remain in the areas of intellectual property law, policy, and regulation, which require greater regulatory cooperation and coordination to link IPR to the building of a functioning STI ecosystem. Efforts towards regulatory harmonisation and, more importantly, a framework for regional competition policy are still far from complete (Jusoh, Ramli, and Damuri, 2019). More importantly, the financing needs for IPR engagement have not been adequately addressed. Issues like IPR as collateral (IPR-backed financing) within the ASEAN financial system could be one such priority area for cooperation. Likewise, best practices in financing as well as in creating adequate valuation models and intellectual property market platforms are important.

Capital markets play a critical role in financing innovation. For instance, utilising initial public offerings (IPOs) for financing innovation requires policymakers to look at the IPO process so that it can be aligned with the evolving structure of the financial markets. Financial market structure has evolved significantly, but not the

[16] ASEAN has embedded STI in its vision. It launched the ASEAN Plan of Action on Science, Technology and Innovation in 2016 after the launch of the ASEAN Economic Community.

IPO process. For instance, the existing regulatory obligations in the capital market should be reviewed and updated. IPOs are also reported to be less attractive because of the mismatch in valuations between the public and private markets (ICMR, 2021). Similarly, capital markets also lack variety, and should diversify and incorporate so-called 'new economy companies' (ICMR, 2021).

Alternative capital market mechanisms have emerged strongly, e.g. venture capital. Estimates indicate that US$3.6 billion was raised by Southeast Asia based venture capital firms in 2019 (DealStreetAsia, 2020). In ASEAN, Singapore leads the way with 59% of the ASEAN total. The potential of venture capital in the context of green and low-carbon development can be further reorganised by instituting a favourable venture capital ecosystem. However, the venture capital ecosystem is predominantly government-backed in developing countries, and it requires regional cooperation to facilitate cross-border funding. A cooperative framework for driving private and public funding would be mutually beneficial for the respective countries in the region. These efforts should also consider and align with incentive systems – such as financing schemes for SMEs, tax rebates, and loan and insurance schemes – to accelerate start-ups in the respective countries. Building the venture capital ecosystem regionally would also help finance green deals. In November 2019, the ASEAN Coordinating Committee on Micro, Small and Medium Enterprises noted the increasing importance of supporting the start-up ecosystem, especially to spur entrepreneurship, but specific venture capital financing industry strategies are largely missing. Variations in the regulatory and legal framework, financing infrastructure, and market conditions remain the key challenges for the venture capital industry. For instance, within the regulatory and legal framework, diverse tax treatment, licensing requirements, and compliance costs deter the progress of the venture capital markets. The de-risking efforts should consider public–private partnership schemes, risk mitigation instruments, sector liberalisation reforms, and the identification of priorities. Thus, potential areas of regional cooperation should focus on regulatory harmonisation, a shared policy response, and information exchange for the venture capital markets. Along the way, mapping the regional private equity firms, and accelerator and incubator programmes across the region, specifically in ASEAN, increases understanding of the ecosystem for an effective regional policy response. Specifically, the regional cooperation and policy response could focus on the creation of a single platform for market access, facilitate the expansion of the venture debt sector, and establish an information gateway and intergovernmental unit within the existing framework for participatory engagement.

The role of technology transfer and FDI is critical in supporting the national innovation system. The challenges of cross-border financing should be rectified regionally. Addressing the financial intermediaries' heterogeneity, risk profile management, and framework to mitigate the global asset price risk would allow better facilitation of capital flows into the region. Technology transfer should be seen in a broader context, considering tangible and intangible assets – from knowledge transfer to that of physical technologies. For instance, licensing arrangements, the export and import of technologies, managerial resources (including production technology), managerial expertise, and marketing and logistics tools form some of the channels of technology transfer. Indeed, specific financing tools could focus on process technology transfer such as inventory management, quality control, schedule control, facility administration, and environmental management systems, which are critical to move forward to a greener path.

Regional initiatives that have a clear plan for technology transfer to benefit the region are recommended. For instance, in areas of human capital development, tapping and upscaling individual nations' support and financing of activities related to training and upskilling at the regional level – incorporating multinational corporations' commitment through cross-border investment – is one example. Facilitating forward and backward linkages through a financing mechanism could be another option to facilitate technology transfer. Public sector technology transfer also remains low. Collaboration between actors within a country ecosystem – such as universities, suppliers, firms, and research institutions – could be encouraged by establishing a matching financing mechanism. This could also be established regionally. International collaboration in Asia and the Pacific, measured by the intra-regional share of research outputs, has progressed since 2006 (ADB, 2021b), but important actors such as firms and businesses have not participated significantly. Private sector participation is critical.

## 5. Conclusions

It is necessary to reach collective and binding decisions on the NZT for global emissions and the time trajectory of emission reductions. Therefore, effective intra-regional and interregional cooperation are crucial to promote and sustain low-carbon energy systems growth. The focus of this chapter is on intra-regional cooperation in Asia. Given the strong regional blocs such as ASEAN, the RCEP, and Asia-Pacific Economic Cooperation (APEC), Asia is in an excellent position to work under a regional cooperation framework to maximise market-based and non-market-based opportunities.

Regional cooperation – not only through ODA, which is decreasing, but also through other means of communications and cooperation such as joint ventures – is important in creating the enabling conditions for carbon-neutral energy systems growth and sustainable development. The development of new technologies and the distribution of proven technologies are the twin engines to bring about a carbon-neutral society. International and regional cooperation is necessary for innovation, technology development, and distribution. Subregional incubation centres for technology development would help; though there is no need to create new centres, it is necessary to harmonise the mindset of the existing subregional institutions towards promoting low-carbon growth. The private sector should transfer proven technologies to developing countries at concessional rates, but should be compensated for the difference between the commercial and concessional rates. To implement this process, an important priority is to create specialised subregional funds to address key climate change issues. Financing at the subregional level does not require new structures or institutions: it is possible to reform existing financial institutions, such as ADB, with a clear focus on subregional interests.

Development of capacity is needed, particularly in the banking sector, because staff attached to banks and capital markets need to have professional knowledge about low-carbon growth, carbon trading, and carbon tax. Capacity building is also needed to contribute to R&D in net zero emissions to improve the attitudes of consumers, producers, and policymakers towards carbon-neutral energy systems growth. In this context, what is needed is a virtual university/research institute/secretariat involving selected top universities/research institutions. Established regional institutions such as the ASEAN Secretariat, UNESCAP, and ADBI need to play a coordinating role. A rapid digitalisation shift creates vulnerabilities for people with low digital literacy to fall victim to scams and other crimes. Policymakers must not forget the importance of digital education as they increase service provision. In addition, although digital services such as fintech may provide promising solutions, risks regarding data protection and privacy should be taken into account when formulating an appropriate policy framework. In this context, the role of regional cooperation is crucial in strengthening the responsibility of developed countries in the region to help developing economies frame adequate policies related to data protection and digital services.

In a globalised world, international trade is central to reaching the objectives of the Paris Agreement as it facilitates the availability of climate-friendly technologies and products with lower levels of embedded carbon at competitive costs and on a larger scale. It facilitates the diffusion of low-carbon innovative products. Trade liberalisation stimulates the development of this market and enhances the spread and affordability of, for example, clean energy or energy efficiency technologies. However, the evidence-based empirical analysis of this study has revealed that renewable energy goods exports have not been flowing without constraints such as non-tariff measures in the Asian region. Nevertheless, the potential for improving technical cooperation in harmonising the production process of renewable energy goods and eliminating non-tariff measures is very high through effective functioning of the RCEP regional cooperation mooted by ASEAN. Drawing on the evidence-based research, as the exports of many countries are carbon intensive, it may be argued as fair to impose carbon tariffs on carbon-intensive imports to discourage such carbon-intensive exports.

Many Asian and Pacific countries do not have developed capital markets, so financing through capital markets for low-carbon industries is limited. Various innovative financial products and services, from private institutions, could be useful in the development of capital markets. To motivate strong private sector involvement in low-carbon growth, it is necessary to support the establishment of new and innovative regional private financing mechanisms – especially for risk transfer and insurance instruments. For this to occur, regional R&D efforts are necessary through the proposed regional virtual university/research institute/secretariat, and these require regional funding with liberal assistance from countries enjoying large foreign reserves within Asia.

The carbon market in Asia is fragmented, which is not conducive to meeting the NZT within the regionally prescribed time frame. None of the AMS, except Singapore, has implemented a carbon tax, although ETSs have been under consideration in Indonesia, the Philippines, Thailand, and Viet Nam. Unification of the market under a grand regional coalition scenario could improve regional financing for low-carbon energy systems growth. Regional cooperation in this context should facilitate (i) eliminating risks and barriers to market entry, as low-carbon financial flows and stocks remain marginal; (ii) connecting the financial system (banks, institutional investors, and cross-border national institutions) to the long-term needs of the energy sector; and (iii) improving not only the national but also the regional understanding of the efficiency and effectiveness of meeting the NZT within the regionally agreed time frame.

The solid message of this chapter is that low-carbon energy systems growth cannot be handled by any single country effectively, but requires considerable cooperation across countries in the region and beyond. Efficient coordination is crucial for the success of cooperation amongst different policymaking sub-groups within the region. Many weaknesses can be observed in the regional governance structure that limit the region's ability to tackle cross-cutting issues such as climate change. For example, the AWGCC has delivered a number of collaborative projects on climate change involving Dialogue Partners in recent years. However, it is evident that the AWGCC lacks a clear mandate to coordinate beyond the AMME working groups. It appears that the possibility of dialogue on climate change in the long run disappearing from the responsibility of the AMME and the ASCC blueprint may not be ruled out.

Nevertheless, it is important to note that countries in this region have in the past been able to work on cooperative initiatives and programmes in areas such as cross-border energy exports through cooperative projects like the Theun–Hinboun expansion project, the Xekaman 3 hydropower plant, and the Nam Ngum 2. The diversity of countries in the region offers much greater opportunity and is imperative to advance cooperation beyond energy exports, specifically in areas such as smart city models, digitisation, and investing in the EV production network. Further, in terms of technological development, areas such as clean and green hydrogen need to be developed and implemented for strengthening regional cooperation to achieve the NZT soon.

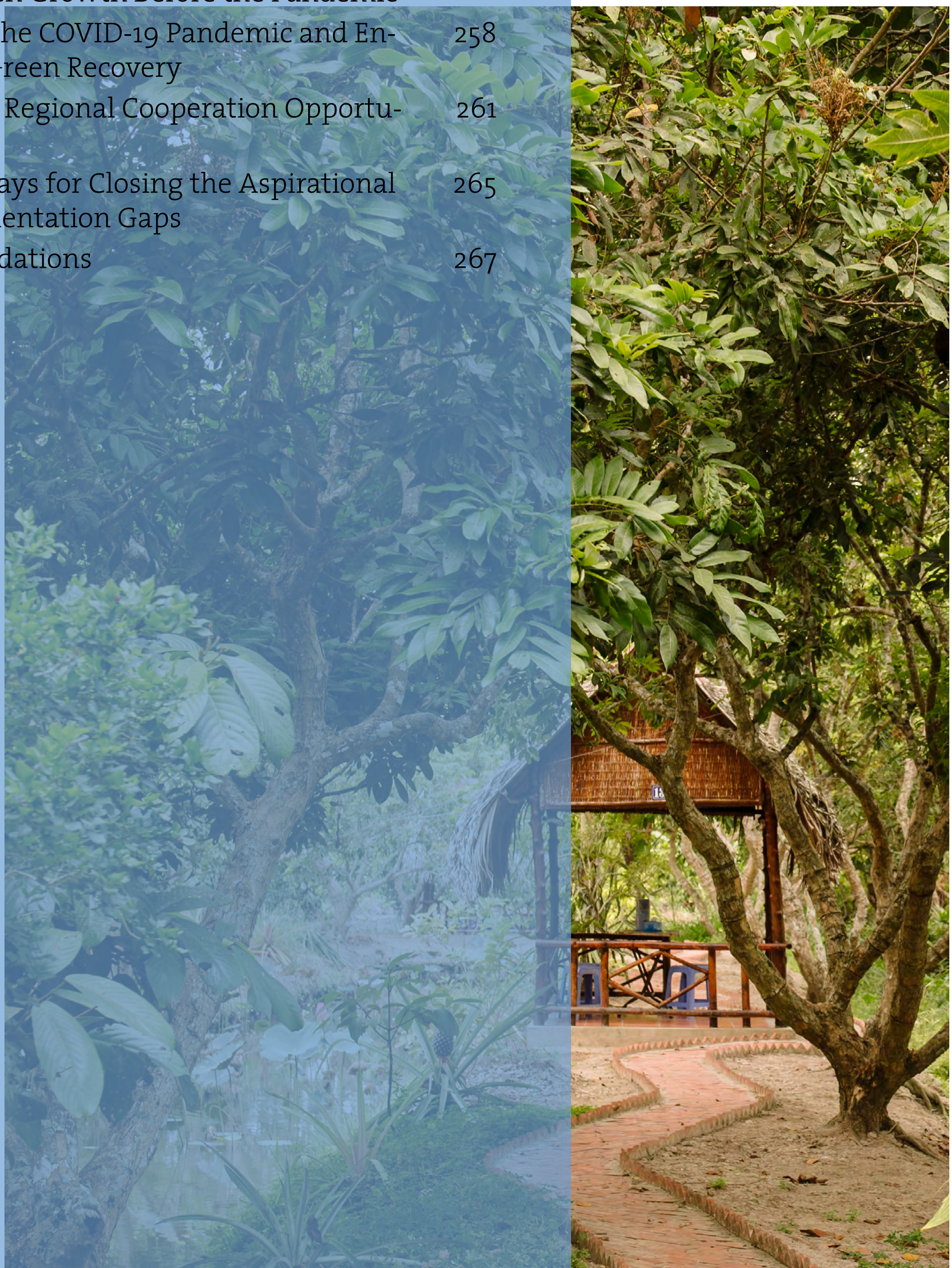
The policy recommendations to strengthen regional cooperation to achieve the NZT by the middle of the century are (i) a regional low-carbon transition fund that could broaden and deepen the risk-bearing capacity of the private sector; (ii) the formulation of a finance performance warranty programme, which would target low-carbon technology providers, with insurance on the financial availability and guarantees for the performance; (iii) the recruitment of independent third parties to assess the effectiveness of low-carbon energy policies and AEC trade policies internationally and regionally to spur private finance action domestically; (iv) voluntary carbon credits to direct private financing to climate action projects that would not otherwise materialise; (v) effective regional coordination to establish a quality energy infrastructure programme with net zero emissions aspects that also brings job growth in member countries; and (vi) strengthened implementation of economic and social policy strategies, which are developed with regional expertise and consensus, at each country level in the region with strong political will.

# Chapter 6

## Conclusions and Policy Recommendations

## Chapter 6
## Conclusions and Policy Recommendations





This final chapter will first summarise the salient findings of the preceding five chapters, with a focus on critical concerns which the developing countries and emerging economies of the Association of Southeast Asian Nations (ASEAN) in the region are confronted with in making the transition to a low-carbon green growth paradigm in the post-pandemic era. The chapter then proposes concrete actions to help countries to address these issues, with the aim of achieving broad-based consistency in the short-term actions responding to the coronavirus disease (COVID-19) pandemic and long-term structural actions towards net zero and resilient economies.

Managing development transformation and responding to crises of various sorts is a common and constant feature of economic endeavours across Asia. The emerging economies of ASEAN, China, and India, as well as the advanced economies of Japan, the Republic of Korea, Australia, and New Zealand, have enjoyed remarkable growth since 1980 despite two financial crises – the 1997 Asian economic crisis and the 2008 financial crisis. Before the onset of the third crisis – the COVID-19 pandemic – Asia's gross domestic product (GDP) per capita income was projected to continue to grow. The major development focuses of Asian countries will be on overcoming the structural challenges of inequality and the middle-income trap, and the increasingly pressing need to halt the adverse impacts of climate change and environmental degradation. As part of the post-2008 global financial crisis response, countries in the region were expected to take initiatives to adopt a new paradigm of low-carbon green development. The adoption of the new paradigm was discussed in the ADB–ADBI (2013) publication, and the experience of almost a decade is reviewed in this book.

The COVID-19 pandemic first hit Asia in late 2019. This is the third major crisis that Asia has encountered in 3 decades and it continues to cause widespread impacts across the region. Countries have been dealing with health-related emergency responses, combined with measures for sustaining livelihoods and supporting economic recovery. Many countries have experienced multiple waves of COVID-19 infections, with new variants posing additional risks, and are vulnerable to prolonged economic impacts. Continued lockdown and travel restrictions have kept carbon emissions from soaring during the pandemic. Speedier rollout of vaccines and continued fiscal support for industries and households are also facilitating the economic rebound, and thus energy and resource use in key economies. The pandemic has caused temporary changes to the trajectories of energy and resource use and carbon emissions, as well as the investment patterns of low-carbon infrastructure development. Nevertheless, methane emissions from oil and gas fields and agriculture, as well as the land use sector, have continued to increase – even during the crisis (Worden et al., 2017). From a climate change mitigation perspective, all countries – both emerging markets and developing countries – have retained their 2030 Paris Agreement nationally determined contribution (NDC) targets, and several advanced economies have joined the global call for 2050 net zero emission targets. However, several countries in the region have not increased their ambitions from the time of signing of the Paris Accord in 2015.

The region-wide efforts to deal with the pandemic impacts are unprecedented. It is all the more noteworthy that countries are dealing with the dual challenges of managing the short-term health security emergency and the looming long-term human and environmental security concerns. The pandemic is not a setback for the region's efforts in the transformation journey, as perceived by some. Rather, it is a once-in-a-generation opportunity to catalyse and recalibrate the accelerated pace of low-carbon green development to build a sustainable, inclusive, and resilient Asia. This has been reflected in the commitment of one-fifth of the world's 2,000 largest public companies to meet net zero targets (Black et al., 2021).

## 1. Regional Megatrends and Motivations for Low-Carbon Green Growth

Sustainability and low-carbon development have received unprecedented policy attention over the last 2 decades because of the co-benefit policy goals of air quality improvement, energy security, and economic competitiveness. This coincided with the countries in Asia making progress towards regionally integrated production and services networks, and becoming an active part of global supply chains. A major policy agenda has been to converge the interests of growth, climate change, trade, and social inclusion. Governments, the private sector, and communities have set low-carbon targets and undertaken initiatives to reduce carbon intensity and to enhance environmental performance and shift patterns of growth to become more inclusive.

Policy actions to mitigate climate change and steer green growth gained momentum in 1997 when the Kyoto Protocol was signed. Efforts peaked in the 2015 Paris Agreement but are continuing through refinements to the implementing strategies, such as the updated NDC targets and the ambitious goal of achieving net zero emissions by 2050. Asian countries have been an active part of the global pursuit of a low-carbon economy and are addressing social development challenges together. With the clear quantification of emission reduction targets, countries are developing and adopting implementable actions, with policy measures, before and after specific target dates. NDC implementation plans, as reported by countries across the region, comprise more than 300 policy announcements that vary widely in stringency, scope, and mix. Regulations on renewable energy supply and energy efficiency are in place in most of ASEAN and East Asia. However, where regulatory frameworks exist, they often achieve emission reductions as co-benefits of economic, environmental, and social policies that emphasise inclusive and sustainable development (e.g. policies that encourage renewable energy uptake in off-grid areas, energy savings by low-income households, and investment in air quality improvement).

For an increasing number of countries in the region, decoupling emissions from economic growth is becoming part of the economic transformation. For example, the ASEAN Plan of Action for Energy Cooperation aims to achieve a renewable energy target of 25% in 2025. The net zero emission targets of China, announced in 2020, aim to reduce energy consumption by 2050 and attain the emission peak before then. China has committed to reach net zero emission targets by 2060. India's National Action Plan on Climate Change includes a solar mission that aims to create an enabling policy framework for the deployment of solar power to off-grid consumers. Other ASEAN Member States (AMS) such as Indonesia, Malaysia, and Thailand target contributions to national energy supply from low-carbon resources, measures and incentives for energy efficiency, the preservation of natural resources, and promoting growth across all sectors of their economies. Japan formulated its net zero emission targets to be achieved in 2050 through guided investments in innovations in niche technologies such as green hydrogen as well as carbon capture, utilisation, and storage (CCUS) – and their diffusion across the world. The Republic of Korea has set green growth as its national development strategy, providing an enabling environment for new creative green industries. Regional cooperation and integration, which are often focused on economic and trade policies, have helped in the arbitration of national level efforts and have complemented commitments made at the global level. Chapter 2 revisited these megatrends. The trends and strategies employed before the pandemic outbreak were based on the idea of decoupling economic growth and carbon emissions through integrated technology and financial policies. Nevertheless, global assessments reveal that the NDCs committed to at the 2015 United Nations Climate Change Conference (COP 21) by almost all countries are not sufficient to keep the world below a temperature increase of well below 2°C, and more ambitious targets are required (Raman, 2016).

## 2. Characterising Policy Innovations for Low-Carbon Green Growth Before the Pandemic

Both developing and advanced economies in the region have responded to calls for low-carbon green growth with several types of policy instruments of varying significance. Table 6.1 classifies the policy instruments being practised in several countries, which are replicable and are already being scaled up across the region.

**Table 6.1 Classification of Low-Carbon Green Growth Policy Instruments Practised in ASEAN and East Asia**

| Technology-based | | Fiscal-based carbon pricing |
|---|---|---|
| Fiscal | Regulatory | |
| Investment subsidies<br>Preferential tax treatment<br>Government investment in venture capital<br>Public investment vehicles<br>Demonstration grants<br>Public research and development<br>Tax credits/holidays<br>Feed-in tariffs/premiums<br>Public procurement<br>Subsidies for energy efficiency purchases | Technology performance standards<br>Renewable fuel/energy efficiency standards<br>Building regulations<br>Automobile regulations<br>Information standards | Emission trading mechanisms<br>Carbon tax<br>Hybrid trading-tax schemes<br>Renewable energy certificate trading |

ASEAN = Association of Southeast Asian Nations.

Source: ERIA study team.

Those policies can be categorised as regulations, market-based instruments, and voluntary schemes. Chapter 3 took a closer look at policy initiatives at the national, sectoral, and subnational levels before the pandemic. Policy initiatives taken before the pandemic clearly indicated that the main ingredients for a successful transition towards a low-carbon economy are available and could be upscaled. The salient features can be summarised as follows:

- Emerging and advanced economies acknowledge the need to approach low-carbon green growth from a broader development perspective, as is shown through the emphasis on a wider and varying set of pledges, policies, and programmes. Climate mitigation targets, resource efficiency standards, and regulations on fossil fuel use are being continuously updated, while new market-based instruments such as emission trading systems are being developed.

- National governments pay attention to the integration of low-carbon energy targets in a broader context, acknowledging the strong links between climate policies and other environmental and inclusive development issues. Aligning climate policies with the three pillars of broader economic transformation – co-benefits, economic resilience, and social inclusion – while maintaining the overall objective of emission reductions, is a promising way for sectoral level decarbonisation as well as achieving a net zero economy.

- Policymakers acknowledge the broader challenge of implementing a low-carbon circular economy, aiming for actions that affect not only the economic competitiveness and technological realms but also the everyday decisions of individuals. Behavioural changes and lifestyle choices are therefore a major issue, and awareness and communication strategies to mobilise actors at the national and local levels are envisaged.

- Given the difficult changes needed to achieve NDC targets, current policy initiatives have recognised the need to grasp the 'low-hanging fruits' – opportunities with low up-front costs – such as resource efficiency. The implementation of NDCs and net zero targets is easier if policies have multiple benefits, but as mentioned later in the chapter, both implementation and ambition gaps remain.

- Implementation deficits remain a challenge to be addressed in several countries. A strong financing strategy, banking sector, and public–private partnerships will be imperative to ensure the continuity of emission abatement strategies and to reinforce the realisation of NDC targets by 2030, either through regulations or market-based initiatives. Various private funding channels and financial instruments are also being tested in an incremental way.

## 3. Impacts of the COVID-19 Pandemic and Enablers of a Green Recovery

The COVID-19 pandemic is confronting conventional development strategies, with new investment risks being posed to different stakeholders in varying magnitude across the economic sectors (ERIA, 2020). The impact of the pandemic is felt through both supply and demand for energy and resource use, altering countries' emission profiles in the short term. After a fall in demand of about 1%–3% in 2020, regional electricity demand is bouncing back in 2021 – well ahead of what can be provided by low-carbon energy resources such as renewables. The rebound effects of energy demand are leading to increased output from coal-fired plants, which still dominate the primary energy supply in several countries. Oil and natural gas demand are also expected to bounce back more quickly, driven mainly by an increase in industrial demand and use. The full impacts of the pandemic on employment, household income, and structural change are still not comprehensively assessed, but are expected to bottom out in 2021, with some countries starting their recovery earlier than others, while several others are still struggling to contain the spread of the virus. The effects of the pandemic are more visible in the transport sector, where oil demand in 2021 is set to remain well below 2019 levels because of lower consumption of automobile and aviation fuels.

Chapter 4 analysed the economic recovery patterns and composition of stimulus packages in ASEAN and East Asia, which is happening in a phased manner but in an uneven pattern. The focus of governments during the emergency and recovery phases was on saving lives and livelihoods due to the huge impact of the pandemic on jobs, incomes, and economic growth. Hence, only a small portion of the stimulus packages is designed to be responsive to tackling climate change or meeting the aspirations of a net zero economy. As of mid-2021, governments in the region have committed about US$5 trillion in COVID-19 related relief funding, mostly providing emergency support and economic recovery. Both the content and scale of the economic recovery stimulus packages matter for low-carbon green growth. Less than 1% of the value of the packages is targeted towards low-carbon energy and climate-resilient infrastructure development. The government stimulus in a few pioneering economies is providing support for investment in integrating renewables into grids; improving energy efficiency through digital technology penetration; and accelerating the research, development, and deployment of niche technology areas such as green hydrogen and CCUS.

It is understandable that a small proportion of emergency response financing was allocated to finance green investment and climate change operations. There is always a social safety imperative to address urgent healthcare needs – saving lives and protecting livelihood income. At the same time, synergies between the short- and long-term response actions must not be overlooked. For example, a stressed public health system is a short-term concern that will require a long-term perspective when undertaking urgent stop-gap measures. Managing medical waste during the pandemic response period will require long-term solutions. At the macroeconomic level, the consistency of public spending capacity in the short and long term must be carefully observed. Overspending on short-term actions will not only limit the fiscal space for long-term public investment solutions, but also add to the public financing management burden later.

Some of these short-/long-term trade-off and synergy issues are reflected in the ASEAN Comprehensive Recovery Framework (ACRF) of 2020, which aims to boost aggregate demand and employment through five broad strategies. The main purpose is to lift the productivity and competitiveness of AMS and bring about the transformational changes needed for inclusive, sustainable, and resilient growth. Further, stimulus packages and the implementation of the ACRF can exploit transformative opportunities brought forth for human security, digital technologies, the innovation potential of industries, and global supply chain resilience. The pandemic recovery must be driven by appropriate policy interventions that fully capitalise market potential, but has to be part of coordinated actions by governments, industries, cities, and financial institutions.

Chapter 4 discussed the above aspects and analysed how governments, industries, cities, and financial systems are playing a leadership role in driving the recovery. Aligning their actions with low-carbon economy transition goals can contribute to more resilient and inclusive growth. The key findings are as follows:

- Early implementation of targeted spending on the economic recovery and investment in the low-carbon transition boosts stakeholder confidence, counteracts the trade-off pressure, and creates needed co-benefits and spillover effects. While governments, industries, cities, and financial systems have accumulated experience, deep knowledge, and the means to emerge from this crisis stronger and in a sustainable way, there is a significant risk that the economic recovery could go the other way too. Going back to the carbon-intensive and polluting 'old normal' would be the most dangerous path. Postponing the necessary interventions, new innovations, and essential investments could increase the cost of tackling climate change and would lead to a significant deterioration of the social discipline we all need to manage future risk.
- Alignment with the long-term objective of low-carbon green growth during the economic recovery phase has become critical for governments to avoid an unintended high-carbon lock-in. Empowering city and local governments to plan and implement low-carbon, climate-resilient, and circular economy action plans is an essential part of the green transformation, revitalising the local economy and building social cohesion.
- ASEAN and East Asia's experience across different sectors of the economy has revealed that digital technological change could become a catalyst for accelerating the low-carbon economy transition with smart supply and demand management approaches. Several governments provide special support for continued information and communication technology models and training on implementing best practices of small and medium-sized enterprises (SMEs). However, formulating guidelines and technical standards to conquer the cost barrier of digital technology that has low-carbon benefits remain a challenge. Some Asian governments and industries have cooperated successfully in generating a mutually reinforcing cycle of market reorientation and cost reduction along the global supply chain during the pandemic. This has contributed to the large-scale development of digitalisation, which has efficiency improvement as well as the danger of becoming a new source of carbon emissions.
- Advancing sustainable financing can and should seek to leverage the trajectory of low-carbon green growth in the post-COVID-19 sustainable growth phase. However, one of the effects of the pandemic has been the increase in levels of public debt, limiting the ability to mobilise funds for

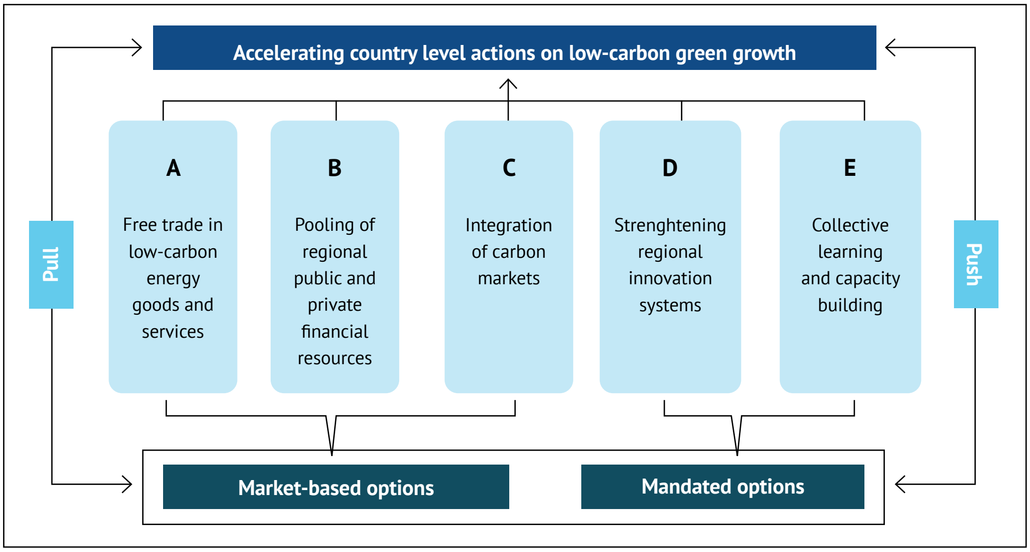
recovery, including for low-carbon energy. The financial strains in 2020 were particularly visible amongst resource exporters, although these have been eased somewhat by the rally in commodity prices in 2021. To mount a serious effort to mobilise low-carbon investments and get on a path towards net zero emissions, governments need to engage institutions such as green investment banks and climate bond markets to increase financing of climate change investments now while costs are still cheaper than later. In this context, it is worth mentioning the efforts of the Glasgow Financial Alliance for Net Zero, which brings together more than 160 firms with assets in excess of US$70 trillion from the leading net zero initiatives across the financial system to accelerate the transition to net zero emissions by 2050 at the latest (UNFCCC, 2021).

- Rapid technological, economic, and societal changes during the pandemic are generating uncertainty around a number of variables that could affect the nature of demand for low-carbon infrastructure, technology products, and services. The current institutional settings and coordination process amongst the key stakeholders are simply not adequate to fit into the low-carbon transformation needed. Overcoming the institutional inertia means addressing the issue of silo mentality in policymaking, as well as a series of status quo political economy factors such as employment in the fossil fuel industry; the competitiveness of other industries that use fossil fuels, such as the cement and steel industries; and the removal of pervasive subsidies and capacity gaps with public procurement systems.

## 4. Harnessing Regional Cooperation Opportunities

There is significant potential to reduce greenhouse gas (GHG) emissions in a cost-effective and people-centred way through regional cooperation. Chapter 5 examined the importance of inter- and intra-regional cooperation. International cooperation could happen at three levels – local/city, sectoral, and regional – to harness the co-benefits of climate change mitigation, thus reducing the cost of implementing actions, with an increased degree of integrated structurisation. At the regional level, windows of opportunity for cost-effective implementation of national actions arise through interlinkages and interaction between economies to scale up the liberalisation of trade in low-carbon goods and services, integration of carbon markets, development of clearly articulated financing strategies, and improved governance for promoting innovation and institutional capacity building, as illustrated in Figure 6.1.

**Figure 6.1 Regional Cooperation Architecture for Accelerating Low-Carbon Green Growth**




Source: ERIA Study Team.

A regional cooperation agenda aligned with the above actions and other critical areas – such as decarbonising fossil fuel industries, controlling forest and land use change, and empowering city governments – could be important conduits for upscaling finance and investment in the post-pandemic era. While the richest ASEAN and East Asian economies will be able to mobilise domestic and international private finance, other small developing countries will probably need to attract resources for innovation and capacity building from official development assistance. In many developing countries, the institutional capacity is underdeveloped to unleash the potential of carbon markets and the introduction of carbon pricing mechanisms.

Nevertheless, feasible policies could be implemented, such as taxing the most polluting fuels and saving money by phasing out fossil fuel subsidies that could be used to provide development help for fossil fuel owners.

A wide range of technologies at various stages of development could contribute to low-carbon green growth. The liberalisation of trade and reduced tariff rates would overcome cost barriers and accelerate innovation and technology transfer. Table 6.2 presents a framework of policies to do this. New opportunities, all of which have the potential to generate job growth and provide competitive advantage, include (i) the production and export of offshore solar, wind, and storage technology; (ii) trade in electric vehicle technology and establishing a hydrogen supply chain; and (iii) decarbonising the fossil fuel industry with niche technologies such as CCUS. The recently established Asia CCUS Network, hosted by the Economic Research Institute for ASEAN and East Asia (ERIA), aims to establish efficiency standards and hold capacity building workshops for CCUS.

Cross-border energy trade is placed to grow as regional mechanisms such as the ASEAN Power Grid are gaining

### Table 6.2 Regional Cooperation for Low-Carbon Technology Transfer

| Type of economy based on carbon-intensiveness | Trade in low-carbon goods and services | Foreign direct investment | Information sharing and licensing | Intellectual property rights | Green industrial policies |
|---|---|---|---|---|---|
| **Domestic policies** | | | | | |
| Low carbon-intensive: Lao PDR, Cambodia, Myanmar | Liberal access | Non-discriminatory investment promotion | Improve information flows about public domain and mature technologies | Basic protection and minimum standards only | Basic education; improve infrastructure; reduce entry barriers |
| Low to medium carbon-intensive: Indonesia, Thailand, Viet Nam | Liberal access | Non-discriminatory investment promotion | Improve information flows; limited incentives for licensing | Wider scope of IPR protection; employ flexibilities | R&D support policies; improve infrastructure; reduce entry barriers |
| High carbon-intensive: Brunei, Singapore, China, and India | Liberal access | Upstream supplier support programmes | Improve information flows; limited incentives for licensing | Apply full TRIPS | R&D support policies; improve infrastructure; reduce entry barriers |
| **Advanced country (Japan, Republic of Korea, Australia, New Zealand) policies towards developing and emerging Asia** | | | | | |
| Low carbon-intensive: Bangladesh, Lao PDR, Cambodia, Myanmar | Subsidise public good-type imports; free trade | Incentives for outward flows exceeding those for FDI | Subsidise transfer of public domain and mature technologies | Forbearance in disputes; differential pricing for exports of IPR products; competition policy assistance | Support for general low-carbon technology policies; public and public–private research facilities |
| Low to medium carbon-intensive: Indonesia, Thailand, Viet Nam | Free trade; no controls | Incentives equal to those granted for own disadvantaged regions | Assistance in establishing joint venture partnerships; matching grants | Differential pricing of public good-type IPR protected goods; competition policy assistance | Support for general low-carbon technology policies; fiscal incentives for R&D performed in developed countries |
| High carbon-intensive: Brunei, Singapore, China, and India | Free trade; no controls | Incentives equal to those granted for own disadvantaged regions | Assistance in establishment of joint venture partnerships; matching grants | Differential pricing of public good-type IPR protected goods; competition policy assistance | Support for general low-carbon technology policies; fiscal incentives for R&D |

FDI = foreign direct investment, IPR = intellectual property rights, R&D = research and development, TRIPS = Trade-Related Aspects of Intellectual Property Rights.

Source: ERIA Study Team.

more interconnections and renewable energy is being integrated into the grids. Regional energy trade with hydrogen – including hydrogen-based fuels such as ammonia – is also well placed to grow. However, experience with establishing efficient regional energy markets suggests that it requires infrastructure standardisation and a change in regulatory measures, which take time to be developed and unified. Intra-regional trade in hydrogen today is limited, with only a small number of cross-border pipelines. Almost all the hydrogen and hydrogen-based fuels traded today are produced from fossil fuels.

Another outstanding and significant interregional cooperation issue relevant to both advanced and developing economies is the prospect of the extensive transfer of low-carbon technology with appropriate policy enablers such as intellectual property rights. Patent protection limits the ability of domestic industries in ASEAN to redesign and adapt externally developed technologies to local conditions, hence their diffusion is lower. To overcome this, industries and research institutes in developing economies could be involved in regional collaborative partnerships from the research and development (R&D) stage, such as hydrogen fuel. Achieving extensive technology transfer and foreign direct investment (FDI) will require multisectoral policy arrangements, as shown in Table 6.2. In such a regional cooperation arrangement, willingness on the part of developed countries to forgo some commercial advantage for their own industries becomes inevitable.

The cost of key low-carbon technologies such as solar, wind, hybrid vehicles, building insulation, and energy storage is getting progressively cheaper. The pace at which this happens is linked to cumulative deployment – the more a technology is deployed, the greater the reduction in cost. Policies on innovation, intellectual property rights, trade, and FDI play a crucial role in this process, particularly in determining how quickly some new, innovative clean technologies in high-carbon sectors such as shipping, aviation, and heavy industry are being scaled up.

The integration of regional markets is a prerequisite for reducing the cost of climate change mitigation, but challenges exist. For example, new aggressive emission targets for NDCs at the 2021 United Nations Climate Change Conference (COP 26) and net zero emission targets in some countries could create incentives for polluting and high-carbon industries to move to developing countries with less ambitious emission caps and limited regulatory oversight – ultimately shifting where emissions are released, but not their absolute total. While regional cooperation represents a new opportunity for increased FDI and technology flows into emerging economies, the carbon border tax adjustments being considered by some advanced economies could have consequences on developing Asian countries accessing these export markets that were previously open. The introduction of carbon labelling and associated regulations could shift this to developing Asia's comparative advantage – bringing more transparency to carbon footprints that are often presented in the aggregate, such as when multinational companies report the footprint of their final products from a region as if it were one uniform good or service.

Regional cooperation also creates new cost-effective implementation of NDC targets through mutual learning. The major economies of developing ASEAN, China, and India share two important characteristics: high rates of economic growth and the need in the post-pandemic phase to address their sustainable developmental gaps. Achieving further decoupling of GHG emissions from economic growth, particularly methane emissions from oil and gas fields as well as the forestry sector, will create many socio-economic policy challenges. The exchange of knowledge about how to overcome these challenges will be mutually beneficial, particularly about least-cost technology innovation and adoption, reform processes, and the minimisation of mitigation costs. The coordination of national policies amongst developing countries, emerging economies, and advanced economies could reduce the prospect of an interregional shift in high-carbon industries and intra-regional carbon leakage. If and when national carbon prices arise, regional links could reduce mitigation costs by exploiting areas of comparative advantage in reducing carbon emissions from avoided deforestation, including forest fires, or improving the efficiency of coal-fired power plants and capturing carbon emissions from oil and gas fields.

## 5. New Pathways for Closing the Aspirational and Implementation Gaps

Governments have to deal with the pressing priorities of post-pandemic recovery, inequality, and climate change. The pandemic brings several uncertainties that prevent the green recovery from being on a solid footing. A principal concern is that there are serious strains on corporate and household investments, including energy efficiency investments, in countries that have been hard hit. In 2020, lower fuel prices, supply chain disruptions, and lack of funding lowered spending on more efficient buildings, low-carbon equipment, and vehicle technologies. Although the energy intensity improved across the region prior to the pandemic, the rate of improvement slowed noticeably during the pandemic, by 0.8%–2.0% in 2020 (Susantono et al., 2021).

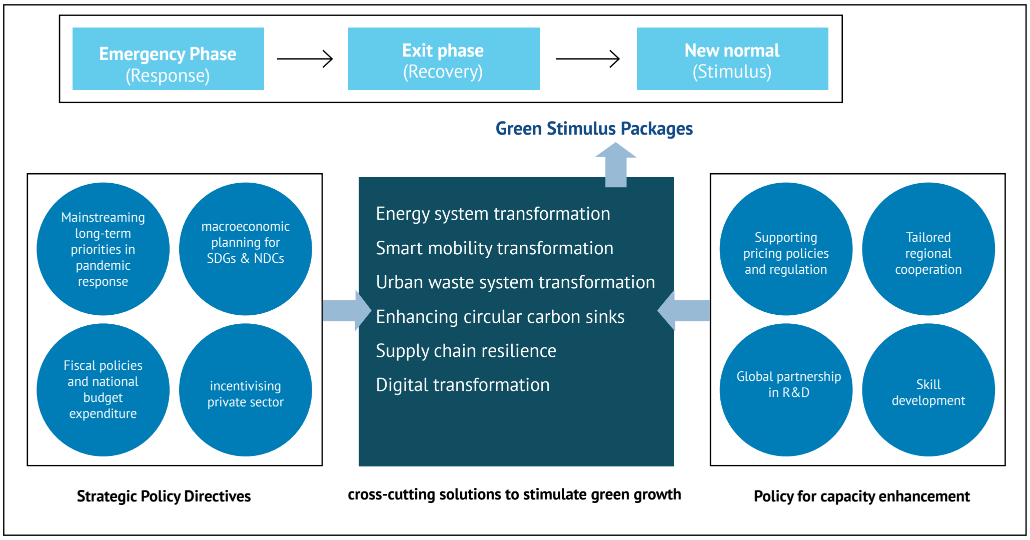
On the social development front, COVID-19 has hit the poor the hardest and worsened inequality. The number of people living in poverty in developing countries in the region is estimated to have increased for the first time in 20 years, and as many as 40 million more people could fall below the poverty line if the pandemic is not contained during 2021. It is alarming to note the loss of 81 million jobs in Asia, which is considered as a dynamic and vibrant region (ILO, 2020).

Concerning climate change, the recently released Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2021) clearly established the GHG-caused climate changes. The report warns that the planet is irrevocably heading towards warming by 1.5°C over pre-industrial times in the next 2 decades, and that global GHG emissions need to fall by about 45% from 2010 levels by 2030, reaching net zero around 2050. For this to happen, the world requires urgent, rapid, and far-reaching transitions in energy, industry, buildings, transport, land, and cities.

Governments will have to make tough policy choices while closing two gaps – implementation and transformation. Closing implementation gaps involves delivering real progress against established NDC targets, and rapidly improving and strengthening the implementation capacity to deliver on more ambitious targets. This is what is needed in view of the pressing short- and long-term concerns of climate change, inequality, and recovery. Closing implementation gaps is tightly connected to closing the transformation gaps, which is required to redesign the economic systems at a more fundamental level by delivering innovative low-carbon products and services, changing financial markets, and altering governance models.

As the pandemic is contained, AMS will need to focus on the ACRF to stem the economic impacts. As they do, it will be vitally important to help them build the foundation for a more resilient, sustainable, and prosperous future. The quality, content, and strength of the stimulus investments will determine sustainable development outcomes for decades to come. As shown in Figure 6.2, action across six revolutionary areas could deliver the transformation needed: (i) energy system transformation, (ii) smart mobility transformation, (iii) transformation of urban waste systems, (iv) enhancing circular carbon sinks, (iv) supply chain resilience, and (vi) digital transformation.

**Figure 6.2 Outlook for Integrating Long-Term Low-Carbon Green Growth Objectives in the Pandemic Recovery and Stimulus Packages**




NDC = nationally determined contribution, R&D = research and development, SDG = Sustainable Development Goal.

Source: ERIA Study Team.

Investments in these six areas in the recovery and new normal phases of the pandemic crisis will maximise co-benefits in at least three major ways: (i) boosting demand; (ii) creating quality jobs across the earnings spectrum; and (iii) maximising emission abatement, which requires continued education and specialised skills training.

However, addressing the implementation gaps requires new policy directives on public budgeting, enhancing financial systems, and realigning climate objectives with a whole economy approach. Developing countries and emerging markets have a unique opportunity, but require policies that enhance the capacity and capability of institutions including local governments. While there is encouraging momentum to drive systemic change in the financial system towards environmental, social, and governance (ESG) investments and corporate reporting on ESG metrics, governments and the private sector must continue to work together to create better climate-related risk mitigants and investment enablers.

Investments will need to be fast in scaling up, labour-intensive in the short run, and have high economic and environmental benefits in the long run. A key challenge will be the cost of the preparatory works for these new initiatives during the economic recovery phase. The low-carbon infrastructure initiatives may be more complex interventions from the perspective of inter-ministerial coordination and cooperation. Securing these immediate investments requires quality human resources – engineers, legal or contracting experts, and other international advisory services – whose cost may exceed the available budget resources. To overcome this, grant-based resources from bilateral or international financial institutions or global green funds could be helpful.

Aligning short-term stimulus measures with long-term sustainability goals will involve trade-offs. In countries with inadequate or less ambitious climate mitigation targets and financing policies, new short-term investments are likely to reinforce unsustainable trajectories. Almost all ASEAN and East Asia countries entered the pandemic emergency phase producing significant carbon emissions, and air and water pollution. Many countries also lack sectoral targets to absorb the targeted technology interventions. As a result, the recovery packages announced during the exit phase risk reinforcing the status quo, which is significantly tilted towards negative environmental outcomes, thus amplifying climate risks in the medium term. However, challenges common to both developed and developing countries include the required behavioural changes by households and the affordability of new low-carbon technologies. For developing countries, stimulus packages should have balanced implementation of climate change adaptation and emission reduction measures, while improving economic growth and poverty reduction.

To date, low-carbon green growth research and policy actions have been mainly taken in high- and middle-income countries. However, low-carbon green growth could be an opportunity for low-income countries to leapfrog by becoming part of innovation networks at the regional level. Nevertheless, local low-carbon green growth research needs to be better tailored to the economic structures of the countries involved.

Future growth in lower-income countries is often heavily agriculture-based initially and can be made strongly pro-poor and low-carbon. Forestry has been a major source of income for some low-income countries, and, given the great importance of forests as a carbon sink, the potential value of avoided deforestation and reforestation could be a significant source of finance for those countries through mechanisms such as the carbon offset mechanism and the Reducing Emissions from Deforestation and forest Degradation (REDD+) programme, although considerable progress still needs to be made in developing these international mechanisms. For example, there is an urgent need for Indonesia, Malaysia, and Myanmar to stop losing a large area of forest cover.

In middle-income economies, policies for pro-poor green growth can be devised. Government revenues from low-carbon industries could be distributed to pro-poor sectors, such as agriculture, health, and education; and to support skills development in sectors that are crucial for the poor, such as agriculture and forestry. This would also provide opportunities to involve isolated communities in decision-making and share profits on a local level, such as through rural electrification with renewable energy.

## 6. Recommendations

Developing ASEAN and East Asia must be at the centre of the global agenda on low-carbon and green growth in the post-pandemic era. At the continental level, Asia has much at stake in the global fight against climate change – the region is the most populous, has had high economic growth and a rising share of global emissions, and is the most vulnerable to looming climate risks.

This book makes two important observations. First, developing countries and emerging economies – ASEAN, China, and India – as well as advanced countries are already moving towards a low-carbon transition, but not fast enough and still a long way from the Paris Agreement goals. Second, it is cheaper to mitigate emissions now than paying for climate damage and tipping points. Furthermore, the post-pandemic recovery presents a golden opportunity to step up such aggressive efforts.

This book calls for a more broad-based approach with focused efforts to meet climate mitigation targets, as expressed in the NDCs by 2030 and the net zero economy by 2050; and to aim at achieving the peaks as soon as possible. In terms of the transition from the pandemic response to the post-pandemic recovery, it is too early to judge the efficacy of many of the recovery packages as the pandemic is not over. However, it is imperative to align the incentives and mandates of all public institutions with low-carbon green growth objectives. A focused and critical assessment of initial policy actions offers lessons to speed up stimulus packages to ensure an effective response. What has emerged from the cross-country review is that isolated or sector-focused policies will not be sufficient for the switch to low-carbon, inclusive, and resilient growth.

Moving towards longer-term sustainable development goals requires structural changes and innovative approaches. This book highlights the level of effort made before and during the pandemic. Much more effort is urgently called for from the developing and emerging economies of Asia. The countries considered in this book are most dependent on carbon-intensive sectors for their economic growth, and will become the principal sources of future emissions if hard regulatory and tax reforms not implemented now. The next-generation recovery packages could be designed to upscale low-carbon investments to avoid locking in emission-intensive infrastructure, as Asia's energy demand is surging again. While the transition to a net zero economy offers fertile ground for innovation, governments must establish regulatory certainty and incentives for the market-based approaches needed (e.g. carbon pricing) to make the required, often long-term and risky, investments by the private sector. The analysis of the Sixth Assessment Report of the IPCC Working Group 1 (IPCC, 2021) showed that even if net zero emission targets are reached, global warming will continue to increase for the next 50 years because GHG emissions are cumulative. The implication for the developing countries of Asia is that as a major bloc of the global economy, they need to make more substantial efforts to cut emissions.

The book's analysis points out that for developing Asia in general and ASEAN in particular, resource-efficient, low-carbon green growth is not only imperative – it is also feasible and attractive. This is elaborated in the following 10 key messages.

**1. Developing and emerging economies in the region are already acting on the transition towards a low-carbon economy in a progressive way.**

Close examination of carbon emission profiles and policy actions help illustrate how, despite having very low per capita GHG emissions, many developing and emerging economies of ASEAN and East Asia are making efforts towards substantial reductions in carbon emissions, resource use, and energy consumption against a business-as-usual trajectory.

From a climate change mitigation perspective, countries are keenly aware of the opportunities associated with low-carbon green growth and the risks of being locked into high-carbon infrastructure. Decoupling economic growth from carbon emissions is increasingly a policy goal being prioritised for national benefit rather than as a result of international pressure or concern.

Importantly, from the perspective of many low- and middle-income countries, the assessment shows that low-carbon green development can support a range of other co-benefit policy goals, including local environmental protection, poverty alleviation, energy security, economic competitiveness, the development of new industries, employment creation, investment in knowledge and innovation, and health benefits from lower air pollution. This combination of reasons helps explain the strong interest from many developing countries in low-carbon growth trajectories.

**2.Stronger transformative policy actions are required for achieving low global warming levels.**

The current NDC targets, incremental actions, and trajectory of each country are designed in the national context when considered against the respective country's baseline – but they are not ambitious enough. None would lead to the realisation of a low-carbon development pathway consistent with emissions of 1.5°C climate stabilisations targets and a net zero future by 2050. The overall picture is that GHG emissions are still growing – reflecting rapid increases in GDP and per capita income growth, and the associated demand for energy, transport, and natural resources consumption.

Furthermore, the lack of substantial decoupling of emissions in the energy and transport sectors, combined with a lack of effective sectoral technology road maps, means that some countries will be in high emission growth in the short term and that the region will use up the global emissions 'budget' at an alarming rate. For countries in the region to adopt even more ambitious abatement targets, it will require new approaches such as embracing the concept of the circular carbon economy; supporting the development of new technologies such as hydrogen, CCUS, and electric vehicles; and reducing the cost of existing clean energy and energy efficiency technologies.

All countries will need to explore more radical approaches to economic development, including more holistic waste management, conservation of forests, stricter codes for new buildings, more aggressive targets for the tourism sector, large-scale low-carbon resilient interventions along supply chains, and the pricing of the environmental externalities of fossil fuel production and consumption.

**3.Low-carbon green growth planning can be further mainstreamed into national development plans.**

The country assessments of policies and practices have demonstrated that it is possible to integrate low-carbon development objectives into sectoral plans, and across sectors – rather than treating low-carbon green growth as an add-on to be solved through stand-alone climate policies and energy investment projects. Precisely because climate change and the COVID-19 pandemic are economy-wide challenges, an integrated approach as part of the economic recovery could help to build bridges between different parts of government, and the long-term perspective required could provide a useful challenge to the status quo.

Making low-carbon green growth a nationwide issue to be tackled by national development plans, rather than the preserve of any particular line ministry, was a key lesson before the pandemic, and one that could have lasting consequences in terms of government coordination on climate change, energy, economic, and fiscal policy at the national level. Central to this was the strong priority given to intergovernmental and stakeholder engagement in setting new targets for NDCs, greening the stimulus packages, and supporting their immediate implementation. This is important in building consensus around hard decisions on carbon pricing and the introduction of other market-based instruments.

**4.The potential to accelerate the low-carbon transition as part of the COVID-19 pandemic recovery is high.**

The region's leading economies have been implementing economic stimulus packages that inject several billion dollars directly into sectors that have a large and lasting impact on carbon emissions – agriculture, industry, energy, transport, and waste. There is potential for large-scale reductions in GHG emissions in these sectors, a significant percentage of which could come at a negative cost, meaning they will actually contribute to the economic recovery and job creation. This includes measures such as increasing cogeneration, improving vehicle efficiency, and reducing electricity system losses. However, even win-win investments frequently face hurdles that require a concerted policy response. Nevertheless, there is a lack of decisive actions to use the stimulus to take specific sectoral action in many countries.

Public health systems in many areas of the region are weak and vulnerable, and cannot stand the stress test of health emergencies. A major overhaul of health systems – both infrastructure investments and management systems strengthening – needs to be programmed. This is an important opportunity to adopt low- and/or net zero carbon approaches to plan, design, and implement the health system improvement by engaging stakeholders of different disciplines.

There is clearly a leadership role to be played by central governments and the private sector through strong technological and innovation policies that can help attract the required investments in low-carbon solutions during the pandemic. Transitioning to a zero-carbon future at the regional level is a process that needs new targets to be set, strong institutional mechanisms, and political commitment. The ACRF offers a promising blueprint for targeted spending on low-carbon resilient infrastructure. Implementing the options identified as part of the ACRF would send a strong a signal to investors on ambitious action towards net zero and for the city governments to build the capacity, including innovation, needed to harness the potential of digital technologies.

### 5. Financing new infrastructure investments must be transformative and well prioritised towards a net zero future.

With a few exceptions, the overall response of countries during the pandemic economic recovery demonstrates little prioritisation of low-carbon infrastructure planning and a low level of willingness to act now. Outcomes so far range from minor policy shifts to transformative technology interventions that support new investments. However, where low-carbon resilient planning has been successfully mainstreamed into development policymaking or economic recovery packages, more longer-term outcomes can be expected. Although there are many low or negative cost opportunities to reduce or avoid GHG emissions, there is still probably a net cost to adopting a low-carbon pathway, at least in the short to medium term, even if this is relatively small in comparison to the economic growth that can be expected over the same period with the introduction of new low-carbon technologies. The scale of funding required necessitates the use of a wide range of financing mechanisms, including incentives where appropriate, to direct investment into low-carbon technology development, early-stage start-ups, and R&D supporting innovation; and to stimulate private sector investment. International climate finance will also be important, but prioritisation will be required because of its limitations in the face of such high demand. Increased funding for low-carbon circular economy projects also require transformative policy changes such as carbon pricing and emission trading systems, as they are likely to generate new revenue.

### 6.Mainstreaming low-carbon green growth into national development programmes and city planning needs new forecasting tools and capacity building.

Not all countries and cities in the region have good quality data and modelling capacity to visualise different policy pathways towards a net zero future, along with the net costs and benefits. To be effective in this context, scenario-modelling tools available at the global level need to be open access so that the assumptions can be customised to local conditions. In many low-income countries, appropriate planning tools do not exist, leading policymakers to make a number of suboptimal decisions. It seems likely that, in a world where substantial action on low-carbon technology transfer and investments is partially funded through international financial mechanisms linked to the United Nations Framework Convention on Climate Change (UNFCCC) process, transparency in terms of data acquisition will also be crucial for the monitoring, reporting, and verification of actions undertaken at the country level. Academia, officials, and the corporate sector involved in low-carbon/zero emission planning activities can help to continue this effort by improving and consolidating the tools that are available; enhancing the capacity of countries to collect, verify, and incorporate useful data; and ensuring that best practice is shared. Finally, there is increasing interest in integrating resilience considerations into future work, potentially leading to low-carbon, circular resilient economic growth. Many energy, transport, and agricultural systems are sensitive to external shocks such as financial crisis, pandemic, and climate impacts. As many of the low-carbon infrastructure investments and decarbonisation of fossil fuel industries are long-term in nature, research and capacity building is needed for progressive target setting and sharing the early experiences and best practices. There are potential synergies in considering alternate development pathways that deliver low-carbon, circular economy, and resilience benefits.

**7. Economy-wide low-carbon innovation and digital technologies hold the key for developing Asia to decouple future economic growth from its resource use in the post-pandemic era.**

Incremental improvement is not enough for the developing countries of ASEAN and East Asia. Existing and breakthrough technologies must be innovatively applied to realise the full potential of low-carbon green growth. Asia needs to invest more in innovation now if it is to be a low-carbon leader in the future. The COVID-19 pandemic has shortened the time needed for the Fourth Industrial Revolution, which has fundamentally altered the ways in which production is done, people work, and consumers are linked. The application of digital technologies is promising for reducing carbon intensity and altering future energy demand in the post-COVID-19 era. Education and training are as essential as R&D. Low-carbon innovations and the integration of digital technologies must support and reinforce the inclusive growth imperative. The analysis presented in this book points out that this can be achieved through regional cooperation. Moving towards interdependent low-carbon green growth policies will bring higher costs to some sectors, isolated regions, and weaker groups. Policy reforms – technological or fiscal – should ensure compensation for the vulnerable. Fiscal transfers, sector-specific approaches, and job generation should be part of the next-generation stimulus packages.

**8. Regional cooperation will make it easier and less costly to implement the national action agenda and pursue net zero targets.**

ASEAN and East Asia leaders have already reached a high level of consensus on regional economic integration and the importance of tackling climate change. This can be done either through market-based mechanisms to encourage low-carbon trade and investment flows between countries, or through non-market mechanisms such as joint region-wide initiatives. Regional cooperation architecture arrangements such as the ACRF, ASEAN Economic Community Blueprint, and Regional Comprehensive Economic Partnership promise vast domestic markets that provide excellent conditions for the formation of new green hydrogen supply chains and new green industries. Effective cost reductions through economies of scale in some Asian countries would help others to overcome the cost barriers for large-scale deployment if free trade in low-carbon technology goods and services is realised. Enhancing cross-border energy through grid interconnectivity could lead to a very different cost-efficient outcome in terms of renewable energy integration and the mobilisation of private finance. Countries will benefit from policies such as energy efficiency standards, labels, and certification for low-carbon goods only if non-tariff barriers in their trade regimes are removed. Scale, combined with high investment levels and the ability to implement decisions quickly based on the best available knowledge, means that many opportunities can be exploited ahead of competitors. Stronger incentives and price signals are needed to unlock the potential for emission reductions by industries and households. Given the advantage of its large market, ability to attract foreign investments, and abundant human capital, this region could quickly acquire, adapt, and master new technologies when regional level low-carbon innovation centres are established.

**9.Leveraging and catalysing the private sector requires special policy attention.**

The private sector will be a critical partner in delivering technology and finance at a scale required to meet the Paris Agreement targets or net zero emissions. Multinational companies can promote low-carbon behaviour across the supply chains that they manage; investors and private commercial banks are the main sources of investment for low-carbon infrastructure; and businesses and entrepreneurs provide the skills and knowledge leading to innovation in energy use and resource efficiency. Investors are increasingly aligned in greening their investments and reducing their ESG risks. For the private sector, the Paris Agreement has been referred to as a purchase order from 2030 for joint actions with governments. As the major private sector actors are bound by fiduciary duty to maximise the shareholder value of current assets, the existing regulatory pathways could slow the emergence and deployment of low-carbon energy technologies at the scale required. However, policymakers could work on at least three regulatory factors that could unleash the potential of the private sector towards a low-carbon transition. First, private financial institutions operate in a market environment where the prices for the commodity they replace (e.g. fossil fuels) are volatile and where the prices for the externalities they produce (e.g. emissions) are still very low. Markets for high-carbon based inputs will eventually be subject to downward pressure. Second, private investors in a low-carbon economy operate a capital-intensive business model because the foundational capital stocks are still being established. As a result, pioneering technology developers need to balance intensely competing demands for capital within firms. Third, low-carbon technology providers are often called on to provide cost-effective innovative solutions with long-lived assets that are subject to swings in commodity prices due to fiscal and public finance subsidies to high-carbon investments. Therefore, seizing the opportunities offered by the private sector will very much depend on efforts to design risk mitigants and investment enhancers. This will require policy interventions to consider the range of available channels to change the preferences, structure, and risk appetite of private investment.

In bringing forth private financing, central banks and regulators in the region will have a much more significant part to play than accorded at present. Central banks and regulators should be encouraging financial services firms to incorporate climate risk mitigation in their risk management practices and further fund the green finance market. This would be an additional push towards the low-carbon outcomes for which countries are aiming. Central banks and regulators should introduce climate risk mitigation measures as part of their business-as-usual regulation of the sector. Detailed measures should include elements such as climate risk stress testing (macro and micro); climate risk based supervisory reviews, including assessing the quality of climate-based risk management; helping the development of sustainable finance linked bonds and instruments; and mandating that a proportion of the assets and reserves placed at the central bank include green finance instruments. In the medium term, they should also consider including capital add-ons for financial institutions that have exposure to fossil fuel related industries beyond a certain level or which have not incorporated green measures and risk management policies and practices to the degree stipulated by the central bank.

**10. The journey towards low-carbon green growth during the pandemic recovery phase and post-pandemic new normal phase remains challenging; and continued efforts are needed to review and assess progress and give guidance on further actions.**

The pandemic is far from over, but the impacts will have lasting effects on economic development and the fiscal space available for enhancing low-carbon investment. Many countries are now considering new NDC targets or putting together new collective targets for the region at COP 26. These – along with new emerging paradigms such as the circular economy, cool earth, and green new deal – could be best seen as part of a modular but continuous progressive process towards a net zero economy and investment plans that outline common but differentiated country responsibilities. With the rich diversity of country experiences comes the opportunity for continued sharing of and learning about policy insights and good practices. All this calls for an institutionalised mechanism at the regional level. Now is the time for the emerging markets and developing countries of Asia to move beyond independent energy transition policies to interdependent regional low-carbon green growth policies for the benefit of all. Although many national and subregional initiatives are in place and being contemplated, it is useful to summarise these, as shown in Table 6.3, and monitor for new policy innovations. Successful implementation requires effective knowledge-sharing programmes covering good policy practices, to multiply the number of competent decision makers in government, business, and civil society.

## Table 6.3 Sector-Specific Policy Actions for Achieving Low-Carbon Green Growth in the Developing and Emerging Economies of ASEAN and East Asia

| Near-term policies | Medium- to long-term targets |
|---|---|
| **Energy** | |
| **Seek cost-effective, market-based solutions for the uptake of existing technologies**<br>- Invest in reducing the cost of existing low-carbon energy-efficient technologies such as solar, wind, and bioenergy<br>- Continue to focus on lowering energy intensity and improving carbon productivity by changing the energy mix<br>- Gradually remove energy sector (fuel) subsidies and introduce appropriate energy pricing through mechanisms such as feed-in tariffs and renewable portfolio standards<br>- Progressively amend laws to scale up renewable energy in a competitive market dominated by fossil fuels | **Develop an efficient and competitive energy sector with innovative technologies**<br>- Deploy new technologies such as carbon capture and storage and geothermal, using sector-wide approaches<br>- Aim for an energy mix in which renewable energy meets nearly one-third of primary energy demand<br>- Emerging Asia becomes a global showcase and leader in renewable energy, with more of the population having access to clean and green energy<br>- Implement cap-and-trade systems for the utilities sectors |
| **Energy efficiency** | |
| **Use a combination of regulations and market-based policy instruments to improve energy efficiency**<br>- Launch top-runner programmes for industrial technologies and electrical appliances<br>- Expand carbon reduction labelling programmes for high-impact sectors<br>- Develop a focused and well-packaged regulatory system for SMEs that integrates efficiency standards and targets by assisting with compliance mechanisms, including providing funds and matching grants with goals<br>- Develop sectoral guidelines and training to achieve energy efficiency standards | **Deepen sector-wide reforms to achieve efficient use of energy derived from non-renewable energy resources**<br>- Two-thirds of the manufacturers meet and use the top-runner standards<br>- Strengthen the instruments of an integrated economic and environmental assessment programme by drawing on international practices adjusted to the context of emerging Asia<br>- Provide training and capacity building to SMEs on new business opportunities<br>- Evaluate, expand, and strengthen the bank guarantee system |
| **Transport** | |
| **Develop new regulations, policies, and financing mechanisms to alter current fleet growth patterns**<br>- Introduce new performance-based targets and incentive systems (such as tax exemption for low-carbon vehicles) for the transport sector<br>- Progressively improve the fuel efficiency and pollution standards for passenger cars and light-duty vehicles<br>- Introduce retail sales of biofuels such as ethanol<br>- Develop a consistent framework for integrating externalities, such as local air pollution, and use that to promote efficient and seamless multimodal transport systems | **Remove market distortions**<br>- Provide subsidies to increase investments and reduce the production cost in manufacturing hybrid vehicles<br>- The entire vehicle fleet must meet standards set at a regional level<br>- Increase the number of retail service stations that sell hybrid fuels to 100% nationwide<br>- Achieve socioeconomic objectives through connectivity, strategic development of transport corridors, and green transport options |
| **Agriculture and forestry** | |
| **Identify and implement the immediate actions needed to restore carbon sinks**<br>- Introduce new market-based incentives for restoring degraded forests and providing rural employment<br>- Double the inspection capacity, and tighten illegal encroachment and forest logging<br>- Scale up pilot schemes for carbon sequestration and input (water and fertiliser) saving technologies<br>- Extend awareness of market-based instruments to isolated communities/poor farmers | **Bring all major ecosystems under sound management to significantly reduce the cost of climate change mitigation**<br>- Establish a fully functioning REDD+ systems<br>- Halt deforestation and land degradation 100%<br>- Ensure that sectoral mitigation opportunities are used to their full potential<br>- Establish fully functioning carbon markets at the national and regional level |
| **City-level measures** | |
| **Scale up coordinated policies for land use planning, urban finance, and city governance**<br>- Change regulations and standards in buildings that lead to inefficient use of energy and materials<br>- Pilot-test market-based mechanisms, such as carbon pricing and cap-and-trade, to encourage efficient use of public resources<br>- Encourage and provide advice on low-carbon lifestyle choices and mentoring programmes for neighbourhoods<br>- Remove barriers to mass transit networks, improving the inter-modality of transport and urban freight solutions, etc. | **Create carbon-efficient, and more habitable, smart cities**<br>- Achieve low-carbon status through improving overall resource use efficiency, benchmarked internationally<br>- Create fully functioning carbon markets in all megacities and municipalities<br>- Integrate technologies and business models for local wealth creation<br>- Roll out performance indicators for all regional governments |

| Near-term policies | Medium- to long-term targets |
|---|---|
| **Industry and trade** | |
| **Scale up and accelerate innovation**<br>- Integrate low-carbon targets and objectives into the state industrial policy<br>- Link industrial promotion incentives and innovations to carbon performance<br>- Reduce the tariff rate for low-carbon environmental goods and services, and strengthen intellectual property regimes<br>- Provide information and training on existing and emerging technologies, management practices, and related business opportunities | **Create competitive markets focused on high value added, low-carbon products and services**<br>- Industrial competitiveness reaches that of current advanced economies<br>- Global economic growth is driven by innovations implemented in Asia<br>- Asian economies employ world-class technologies and business practices in an open competitive market<br>- Strengthen social capital for eco-restructuring of Asian industries |
| **Fiscal** | |
| **Identify and implement immediate actions needed to introduce market-based instruments**<br>- Introduce carbon taxes or auction emission quotas in a broad-based, uniform cap-and-trade system<br>- Introduce budgetary reforms with a gradual increase in energy taxes and the elimination of fuel subsidies<br>- Introduce performance-based tax incentive systems for achieving sectoral emission targets<br>- Explore innovative financing instruments and accelerate R&D support for future industries through the climate change agenda<br>- Improve efficiency, transparency, and accountability in the financial sector, by including rating programmes and MRV systems linked to credit lines | **Develop revenue-neutral budgets for a carbon-neutral economy**<br>- Reduce social security contributions and corporate income tax to compensate in part for raising more energy tax and quota auction receipts revenue<br>- Introduce budgetary reforms to mobilise private capital<br>- Integrate capital, technology, goods, and labour markets |

MRV = monitoring, reporting, and verification; R&D = research and development; REDD+ = Reducing Emissions from Deforestation and forest Degradation; SMEs = small and medium-sized enterprises.

Source: ERIA Study Team.

This book analysed policy contributions and recommended shifts in public policy choices that will be required to avoid dangerous climate change. Based on current trends, national policies and new measures need to be much more ambitious to provoke a major economic transition. Taking collective action at the regional level would be in the political interest of all governments for these reasons:

1. A more direct region-wide push on energy efficiency, technology, investment, and deforestation is essential to add credibility to the NDC targets and national aspiration for a net zero economy without losing economic competitiveness.

2. Given the scale of investment required and the recent deterioration of public finances in many countries, only coordinated policies, price signals such as carbon pricing, and regional economic integration mechanisms could leverage private sector capital.

3. Since it will take time to agree on the details of a net zero economy road map, it is important to press ahead with concrete actions so that such a strong regional agreement can provide the international community with an insurance policy.

### Near-Term Recommendations for Asian Countries to Pursue Collectively

Asia has much at stake in the fight against climate change, as it is the world's most populous region and a rapidly growing continent with a rising share of global GHG emissions, with certain subregional areas amongst the most vulnerable to looming climate risks. Nowhere are production, resource consumption, and emissions growing faster than in developing Asia. High-priority actions have already proven effective in several parts of Asia and could be scaled up at a regional level in the post-pandemic sustainable growth phase. Collectively, Asia must be at the centre of the global agenda on low-carbon green growth.

A decision to act together immediately on the following seven common key issues listed in Box 6.1 would transform Asia into a test bed and role model for the world.

**Box 6.1 Regional-Level Actions for Accelerating Low-Carbon Green Growth in Asia**

**Bilateral and mega FTAs**

- Examine trade policies for their compatibility with climate goals. Bring clarity to vague notations of environmental sustainability in non-binding clauses on completed mega FTAs such as the RCEP, and start negotiating new agreements to curb the proliferation of market-distorting unilateral fuel subsidies and carbon border tax adjustments.
- Make future bilateral trade agreements more climate friendly, by building on the best practices seen in global FTAs, particularly in removing the non-tariff barriers attached to low-carbon goods and services.

**Regional energy trade and investments**

- Accelerate regional partnership towards enhanced cross-border energy trade that includes greater grid connectivity programmes; developing a global supply chain for low-carbon hydrogen fuel and electric vehicles; setting new targets for the integration of renewables; feed-in tariffs and renewable energy portfolio standards; and capacity building for decarbonising fossil fuel industries, including establishing standards for CCUS technologies.
- Promote international partnership to work towards applicable national efficiency standards, developed and applied to a limited but critical range of energy-intensive industrial and consumer goods, and buildings. Governments may also develop carbon reduction labelling for electrical appliances and industrial manufacturing processes, building on work under way according to a mutually agreed timetable.

**Regional carbon markets**

- Promote the linkage of national and city-level emission trading schemes, which will require the setting up of a framework to prepare the ground for the linkage of carbon trade schemes, including guiding principles for MRV systems.

- Foster learning between countries on different stages of considering and implementing carbon pricing schemes by creating a platform for dialogue and continued experience sharing.

**Regional innovation fund**

- Develop an ASEAN Plus innovation fund that could scale up public and private investment in R&D of next-generation low-carbon solutions – such as smart grids, smart cities, and smart agriculture – which integrate digital technologies for improved service delivery.

- Establish a network of national innovation hubs and incubation centres to help SMEs to accelerate the uptake of low-carbon technology. Provide financial support to start-ups to capture digital economy opportunities and help SMEs to meet the climate targets.

**Empowering cities**

- Redesign the institutional configuration, such as the ASEAN Smart Cities Network, to integrate energy, water, transport, and waste management strategies; and seize the immediate development benefits of low-emission resilient planning.

- Build low-carbon project finance capacity in cites to efficiently finance and deliver complex low-carbon circular economy projects.

**Financial systems**

- In a regionally coordinated way, diversify the government revenue stream in support of low-carbon green growth and align the budgetary incentives to discourage investment in carbon-intensive activities. Incentivise the disclosure of climate-related risks and increase the transparency in financial markets.

- Support the network of central banks and stock exchanges in developing a taxonomy for green finance, with appropriate green instruments that will include bonds, loans, and credit guarantees. Mandate them to better assess and manage climate-related risk that could threaten the financial stability of the system during the recovery and post-pandemic era.

**ASEAN Secretariat**

- Strengthen the ASEAN Secretariat with greater human and financial resources to monitor the implementation of ACRF strategies with greater real-time monitoring capacities.

- Shift the focus of long-term blueprints – such as the ASEAN Economic Community, ASEAN Socio Cultural Community, and ASEAN Agreement on Disaster Management and Emergency Response – that deal with climate change issues into a rolling short-term implementation programme that can carefully factor in current emission trajectories, existing development gaps, and the impact of the pandemic, as well as the effectiveness of stimulus packages in supporting the green recovery.

ACRF = ASEAN Comprehensive Recovery Framework; ASEAN = Association of Southeast Asian Nations; CCUS = carbon capture, utilisation, and storage; FTA = free trade agreement; MRV = monitoring, reporting, and verification; R&D = research and development, RCEP = Regional Comprehensive Economic Partnership; SMEs = small and medium-sized enterprises.

Source: ERIA study team.

It is indisputable that the world has turned its full attention towards stopping the spread of COVID-19, which raises an important policy question about the nexus between COVID-19, economic recovery, and climate change. A common perception in a people-centred recovery is that COVID-19 could delay the climate agenda due to the increase in health expenditure and the decline in international oil prices. Therefore, the relevant question is what would happen to the fight against climate change once the immediate danger to public health is eliminated. The analyses in the book have critically highlighted the urgent need for accelerating the reduction in GHG emissions, which also has a direct bearing on human health.

The lessons that global citizens have learnt from the COVID-19 pandemic may lead them to demand and expect similar urgency and action from their respective governments to achieve a net zero future. Given the financial and infrastructural rigidities that exist in many emerging markets and developing countries, this change requires urgent strengthening of regional cooperation to move harmoniously towards net zero targets.

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# Rethinking Asia's Low-Carbon Growth in the Post-Covid World:

## Towards a Net-Zero Economy

Asia's historical development is at a crossroads. Twenty months into the coronavirus pandemic, the cumulative economic and financial impacts are estimated to be much worse than those of the 1997 Asian economic crisis and the 2008 global financial crisis. Governments across ASEAN and East Asia have deployed a significant amount of emergency capital in their response to the pandemic, with an initial focus on protecting livelihoods. As countries move towards long-term deep decarbonisation and a circular Net Zero economy, recovery from the pandemic has offered a rare opportunity to realign energy, innovation, trade, and fiscal policies into macro-economic planning and national budgets towards a new sustainable development paradigm. This book reviews and assesses the low-carbon green growth policies, practices, and economic recovery packages and identifies implementation gaps and new opportunities. The detailed analyses embedded in the chapters cover a wide range of impact strategies at sectoral level and identify immediate economy-wide actions required to realise the Net Zero future. Based on a review of countries' experiences, this volume concludes that past climate actions have entailed progressive bottom-up, sectoral, low-carbon, green growth initiatives that are relatively fast and easy to implement and that provided incremental co-benefits. Realising the Net Zero Future by 2050 will require much higher levels of technology absorption, crowding in finance, and strong institution building. It urges public and private actors to harness the potentials of regional cooperation based on market principles, which will reduce the cost of transformation to the Net Zero economy.

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