



Chapter 4

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

This chapter should be cited as

ERIA Study team(2022), 'Post Covid-19 New Green Deal as Long-term Sustainable and Inclusive Growth Strategy', in Anbumozhi, V., K. Kalirajan, and X. Yao (eds.), *Rethinking Asia's Low-Carbon Growth in the Post-Covid World: Towards a Net-Zero Economy*, Jakarta: ERIA, pp.136-194.

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

1. Pandemic Recovery, Stimulus Packages, and Policy Architecture Types	137
1.1 Navigating the Pandemic and a Multiphased Recovery	137
1.2 Exiting the Emergency Phase and Early Economic Recovery	139
1.3 From Economic Recovery to Inclusive Green Recovery	141
1.4 Evolution of Stimulus Measures and Green Shoots	143
1.5 Multi-Speed Recovery and Uncertainties in Co-Benefit Policies	147
1.6 Stimulus Measures, Fiscal Space, and Macroeconomic Policy Framework	148
2. Green Industries, Technology, and Innovation	150
2.1 Economic Impacts of COVID-19 on Industry	150
2.2 Driving Industrial Recovery Through Stimulus Policy Measures	152
2.3 Reconciling the Economic Recovery with Green Industrialisation	155
2.4 Turning Digital Technology Innovations into Actions for Low-Carbon Green Growth	159
2.5 Unleashing the Transformative Power of Low-Carbon Green Innovations	161
2.6 Strategies to Foster Green SMEs for Inclusive Growth	164
3. Smart City Solutions and Inclusive and Low-Carbon Green Growth	166
3.1 The Pandemic Recovery and the Resilience of Smart Cities During the Pandemic Emergency	167
3.2 Cities as Transformative Agents for a Low-Carbon Circular Economy	169
3.3 Innovation, Inclusion, and Efficiency Narratives for Smart Cities in the Post-COVID-19 Era	171
3.4 Removing Financial Barriers to Innovative Low-Carbon Climate-Resilient Cities	174
3.5 Overcoming Governmental Fragmentation to Achieve the Goals of Sustainable Cities	175
4. Building Sustainable Financial Systems for a Green Recovery	178
4.1 Financing the Economic and Stimulus Packages	178
4.2 The Dynamics of Financing a Low-Carbon Resilient Future	180
4.3 Trends of Regional Green Bond Markets	183
4.4 The Role of Central Banks in Upscaling Sustainable Financing	185
4.5 Using Green Investment Banks to Scale Up Private Capital	188
4.6 Barriers to Mobilising Private Capital for Low-Carbon Green Growth	189
5. Powering the Economic Recovery Towards Low-Carbon Green Growth	191

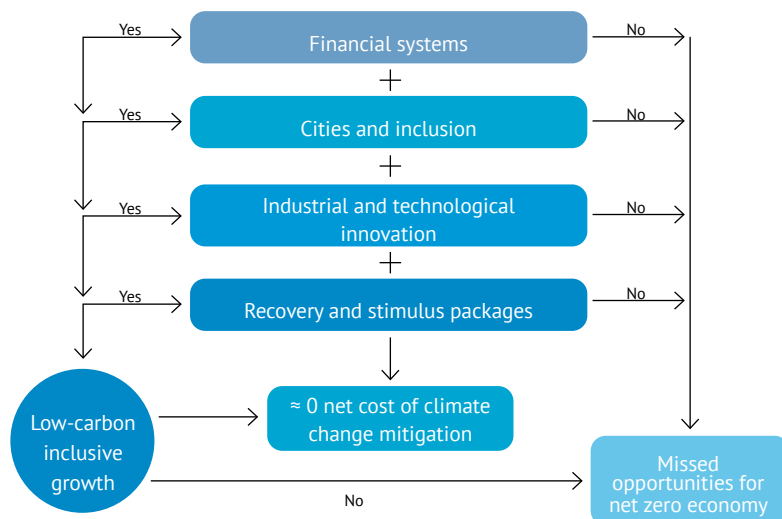


Transformation to a low-carbon economy is system-wide, entailing many policy pathways in various interacting systems. Chapter 3 makes this clear when describing and assessing the experience of cross-country policy implementation progress. The coronavirus disease (COVID-19) crisis opens up many opportunities 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	<ul style="list-style-type: none"> - Spread of infection - Complete lockdowns 	<ul style="list-style-type: none"> - Decrease or lull in economic activity - Travel restrictions and vaccinations 	<ul style="list-style-type: none"> - Containment or low level of infections - Herd immunity
Purpose of policy	<ul style="list-style-type: none"> - Emergency 	<ul style="list-style-type: none"> - Recovery 	<ul style="list-style-type: none"> - Sustainable and inclusive growth
Economic measures	<ul style="list-style-type: none"> - Deferment of tax payments - Cash transfers - Unemployment payments - Bailout finance 	<ul style="list-style-type: none"> - Economic stimulus for demand and job creation 	<ul style="list-style-type: none"> - R&D support - Public infrastructure investment in support of low-carbon growth
Option of green recovery	<ul style="list-style-type: none"> - Limited – finance with environmental conditions is good practice 	<ul style="list-style-type: none"> - Recommended – a balance between economic recovery and green growth is needed, using green investment and avoiding lock-in effects 	<ul style="list-style-type: none"> - 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

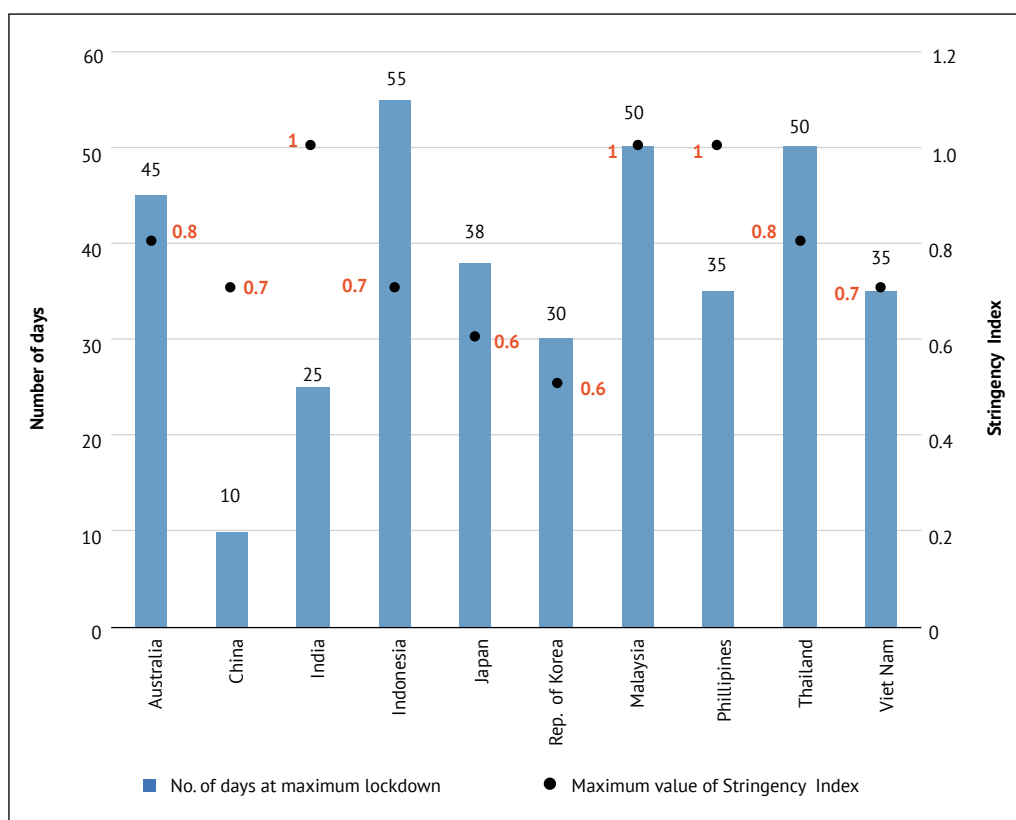
labour supply – and demand, especially savings amongst consumers who have secure employment and less opportunities for spending. Sectors have been affected very differently. Overall, some degree of Keynesian recession is likely, but certain sectors could quickly constitute supply constraints in the recovery, 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.

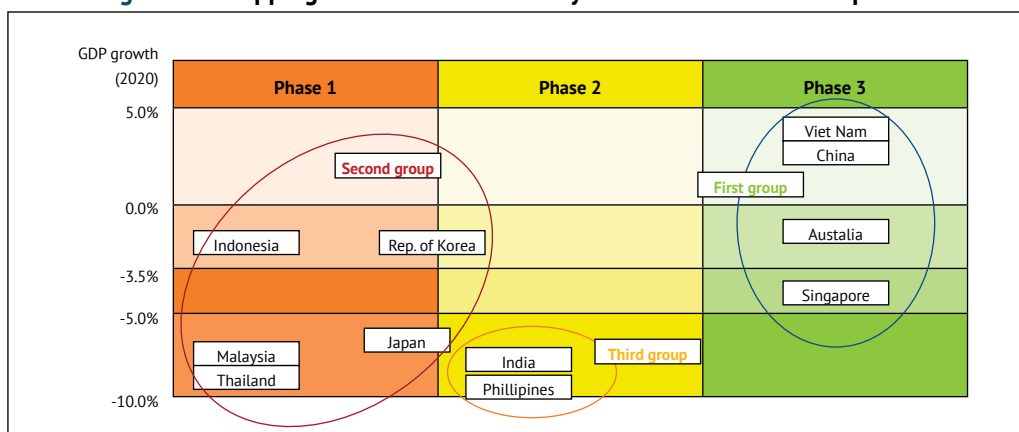
The lockdown stringency Index measures the level of the emergency, based on an average of five subsector indexes – retail, services, industry, travel, and public gatherings – normalised to lie between 0 and 1, with 1 indicating that the sector is fully closed and zero signifying that it is fully open (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	<ul style="list-style-type: none"> - 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 - 1–14 jobs created per US\$1 million invested
Transport	<ul style="list-style-type: none"> - Improving the efficiency of the vehicle fleet, electric cars, high-speed rail and urban transport, cycling infrastructure, electric vehicle recharging, and mass transport
Buildings	<ul style="list-style-type: none"> - Enhancing the energy efficiency of buildings and appliances with short payback periods - 10–15 jobs created per US\$1 million invested - Increasing access to clean cooking; lowering liquefied petroleum gas prices
Industry	<ul style="list-style-type: none"> - Supporting SMEs for energy efficiency improvement, enhancing the energy efficiency of motors and agricultural pumps, and adopting resource recycling and circular economy practices - 10 and 18 jobs creation per US\$1 million invested
Fuels	<ul style="list-style-type: none"> - Reducing methane emissions (cost-effective reduction of greenhouse gas emissions); supporting the biofuel sector (hit hard by COVID-19) - Sustainable biofuels create around 15–30 jobs per US\$1 million invested

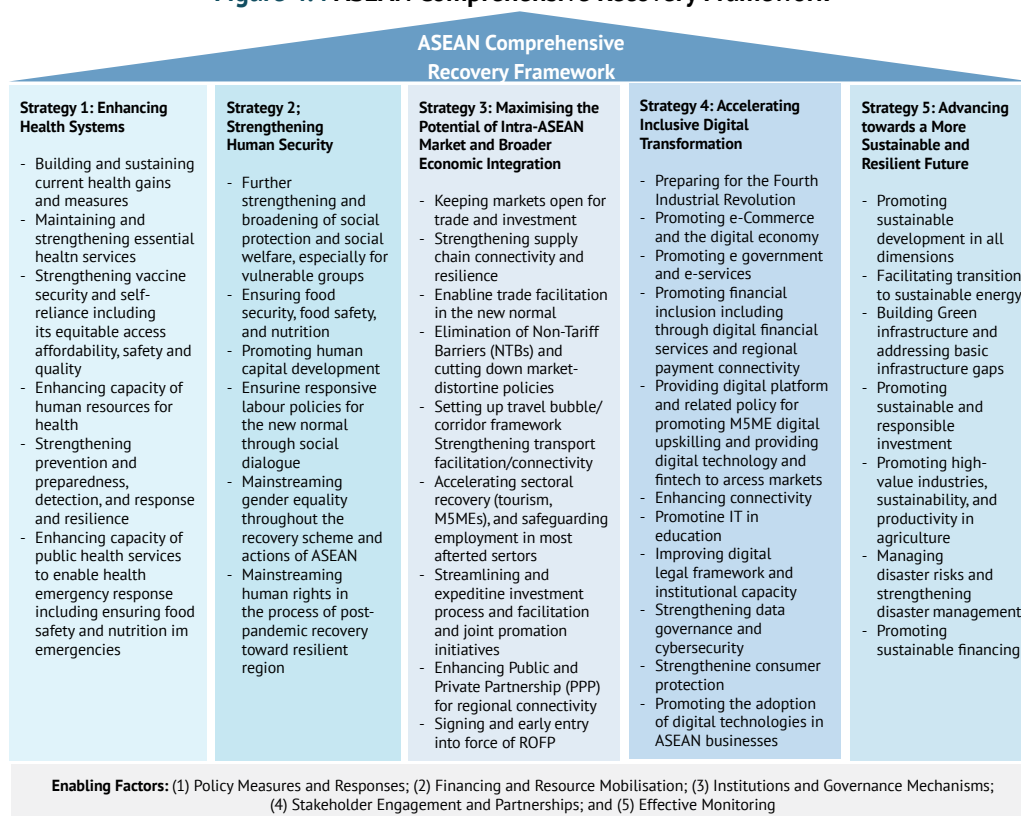
COVID-19 = coronavirus disease, IEA = International Energy Agency, SMEs = small and medium-sized enterprises.

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 = 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 <ul style="list-style-type: none"> - 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. - GDP: -2.1% (2020), modest drop 	<ul style="list-style-type: none"> - First stimulus (February): cash payments for social assistance, food, etc. - Three principles: health/life, purchasing power, and bankruptcy 	<ul style="list-style-type: none"> - Measures are a mixture of emergency support and fast recovery - Second stimulus (March 2020): exports and imports, and financial sector support 	<ul style="list-style-type: none"> - No special package. Third stimulus (March 2021) includes some green components, such as microgrid construction. - 'Net zero by 2060' announced in August 2021
Malaysia <ul style="list-style-type: none"> - 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. - GDP: Biggest drop was -7.7% in Q2 2020 but started recovery with a decline of 2.7% in Q3 2020. - GDP: 5.6% (2020) 	<ul style="list-style-type: none"> - First stimulus (February 2020): tax relief and loan deferment for people. Guarantee and loan moratorium for business. - SME Aid programme (April) 	<ul style="list-style-type: none"> - Second stimulus (March 2020): greater support for people and business than during the first stimulus, with more focus on economic recovery - Short-term recovery plan: improving people's skills, tax relief, digitalisation support and financing for SMEs, and promoting a 'Buy Malaysian' campaign 	<ul style="list-style-type: none"> - 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 <ul style="list-style-type: none"> - First peak ended in March 2020, but increased in April 2021 and peaked in August 2021. - GDP: -6.1% (2020) 	<ul style="list-style-type: none"> - Phase 1 stimulus (March 2020): tax relief, cash payments, SME support 	<ul style="list-style-type: none"> - Phase 2 stimulus (March 2020): filing of tax returns in addition to the first phase packages - Phase 3 stimulus (April 2020): SMEs through banks, households, liquidity for financial sector 	<ul style="list-style-type: none"> - No special packages - Agriculture (e.g. bio circular economy); energy (e.g. electric vehicles); environment (e.g. green tourism); digital transformation
Viet Nam <ul style="list-style-type: none"> - 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. - GDP: Q2 2020 was lower but still positive in 2020 (2.9%). Economic impact is mostly through trade. 	<ul style="list-style-type: none"> - Labour support, e.g. through cash payments - Support to business through bank credits, tax payment extensions, and loan payment deferrals 	<ul style="list-style-type: none"> - 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) 	<ul style="list-style-type: none"> - 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 <ul style="list-style-type: none"> - 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. - GDP: -9.9% April-June 2020; and started recovery; -4.8% (2020) - Unemployment: uneven impact on non-regular workers 	<ul style="list-style-type: none"> - Supplemental budget (April and June 2020): employment support, working capital support, rent support, and medical care support 	<ul style="list-style-type: none"> - Basic policy for 2021 budget preparation (July 2020): some climate measures (e.g. hydrogen, quality infrastructure) included but not high priority - Ad hoc measures: Go to Travel campaign (suspended in December 2020 due to the increase in new infections) 	<ul style="list-style-type: none"> - No special measures - (Recommendation) - Innovation, fiscal system reform and market mechanism, local economy and local finance, global/regional approach
China <ul style="list-style-type: none"> - First wave ended in February 2020 and second wave was not observed - GDP: dropped in January-March 2020 but was already above the 2019 level in July-September 2020. Positive 	<ul style="list-style-type: none"> - Social security reduction, refund of insurance payment 	<ul style="list-style-type: none"> - Six guarantees, including employment, livelihood, food and energy, and industrial supply chain - Tax reduction, cash handouts, infrastructure construction - Local economy support by local governments (fund transfers to local governments) 	<ul style="list-style-type: none"> - 'Net zero emissions by 2060' announced in September 2021 (details not released). Concrete measures will be part of the next five-year plan. - Optimisation of energy structure, transportation, technology innovation, support measures: e.g. green finance, carbon market.
Republic of Korea <ul style="list-style-type: none"> - 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. - GDP: -1.0% (2020) 	<ul style="list-style-type: none"> - Emergency relief grant: cash payments to all, medical leave subsidies, subsidies to vulnerable people and business, unemployment assistant fund 	<ul style="list-style-type: none"> - Part of Green New Deal: no specific short-term recovery package 	<ul style="list-style-type: none"> - Aiming for smart, green, and safe country. - Digital New Deal (e.g. 5G, digital learning, remote healthcare) - Green New Deal (e.g. green infrastructure, low-carbon energy) - Stronger safety net (e.g. digital skills training) - 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 <ul style="list-style-type: none"> - 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. - GDP: -7% in June 2020; -2.4% in 2020 - Unemployment: 1.3 million jobs lost in April but recovered 	<ul style="list-style-type: none"> - Financial assistance for retaining workers and amendment of credit regulations for avoiding bankruptcy 	<ul style="list-style-type: none"> - No special package, but included in 2021 budget under items such as infrastructure investment 	<ul style="list-style-type: none"> - No special package but aligned with Technology Investment Roadmap Discussion Paper: hydrogen, energy storage, CCS, etc. - (Recommendation) - Clean recovery (renewable industry): investment in wind and solar
India <ul style="list-style-type: none"> - First wave ended in September 2020, but number of infections increased in 2021 and reached 40,000 people per day in August 2021. - GDP: -8.0% (2020) - Emissions: first drop in 4 decades 	<ul style="list-style-type: none"> - Food security system - Economic relief measures (cash and food) - RBI's finance to banks - Economic package (US\$280 billion) 	<ul style="list-style-type: none"> - Self-reliant India: economy, infrastructure, system, vibrant demography, and demand 	<ul style="list-style-type: none"> - No special package - (Recommendation) - Potential: Power sector, transportation, industry
EU <ul style="list-style-type: none"> - 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. - GDP: -6.6% (2020) (Euro area) 	<ul style="list-style-type: none"> - By member states 	<ul style="list-style-type: none"> - Green Deal under Multiannual Financial Framework and Next Generation EU: 30% of expenditure is allocated to climate change - By member states: France focused on manufacturer support and stimulus for buying products such as cars. 	<ul style="list-style-type: none"> - Green Deal by EU: EU released 'Fit For 55' in July 2021, which includes a comprehensive climate policy. - By member states: Germany announced a futuristic investment package in addition to stimulus and crisis management packages and expressed a strong international responsibility 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

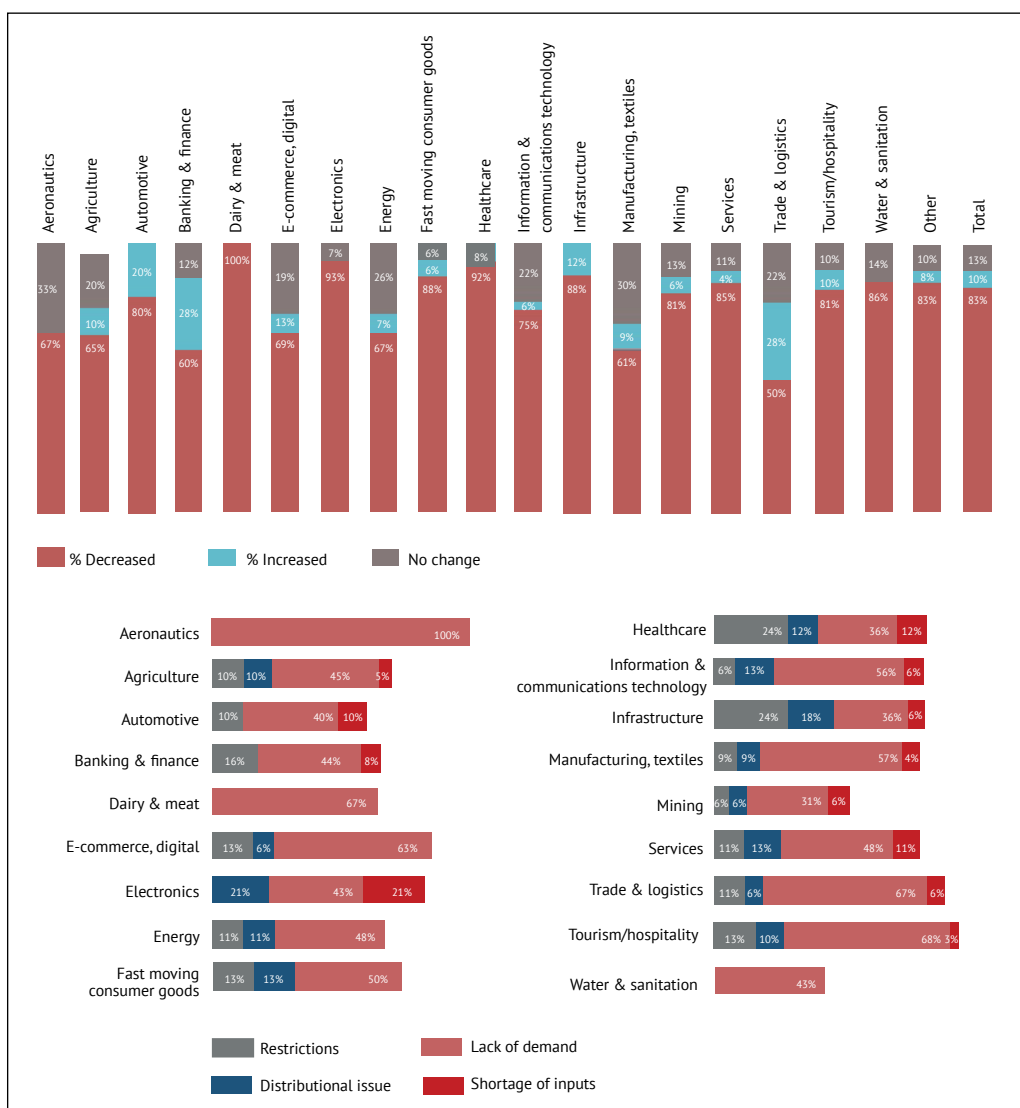
The COVID-19 pandemic and associated lockdown measures instantly affected industry operations, with significant variation across sectors. Almost all firms in Asia experienced a negative impact due to the pandemic, with impacts on output, revenue, and/or sales. Figure 4.5 shows the distributional impact 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: AIC (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 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 Injection of US\$40 billion of lending for SMEs	Loans can be unsecured and for 5-year terms	Tax credits Relief for certain tax obligations, including deferring tax payments up to 4 months	Temporary cash flow payments up to US\$100,000 'Job maker' hiring credit	'Job keeper' payment 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 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 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 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 NBFI	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 Social media infrastructure	Gradual tax reduction in manufacturing industries	Tax suspended for hotels and restaurants VAT reduction Tax loss compensation for local governments		Regulations relaxed on imports 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 moratorium 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 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 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 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 contributions 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 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

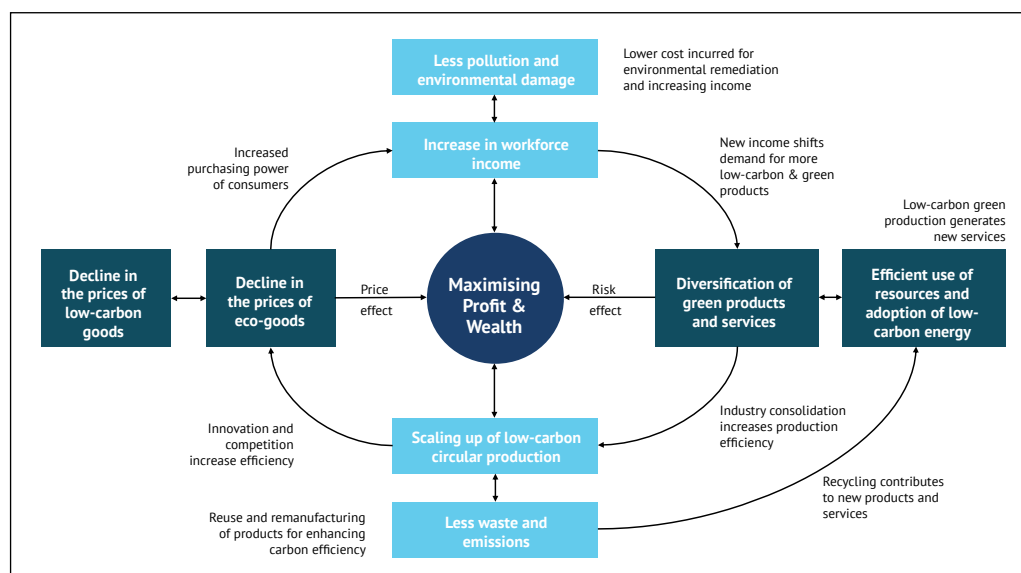
Inclusive, resilient, and low-carbon green growth is essential in the post-COVID-19 era, as it could unleash dynamic and competitive economic forces that generate employment, enable the efficient use of energy and raw materials, facilitate international trade, and become a driver of shared prosperity (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 licencing	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 subsidies				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

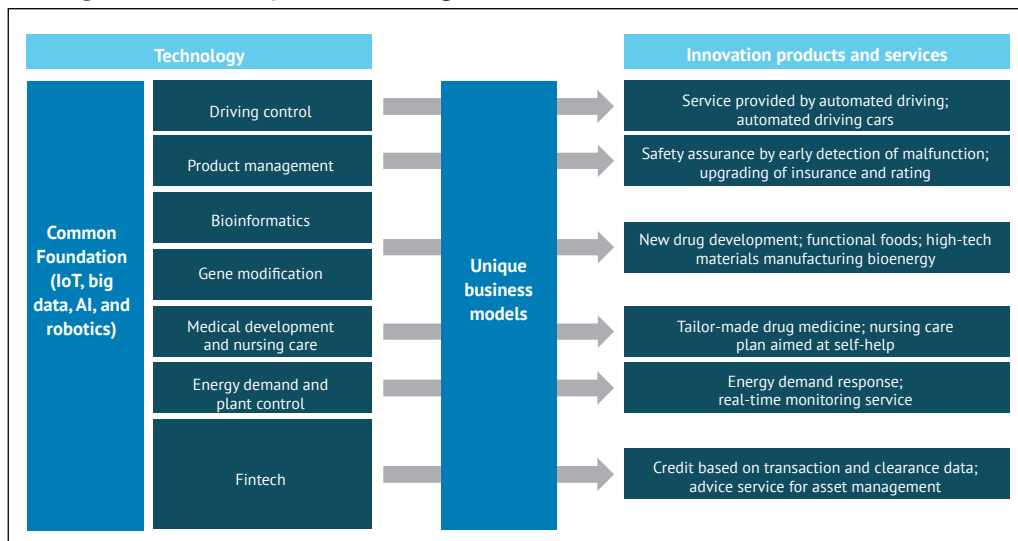
automation, widespread integrated and near-instantaneous digital interconnectivity, internet of things, and artificial intelligence are already increasing productivity and reducing emissions. This will substitute energy and physical capital for the input of human energy and capital. In aviation and ocean 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 (CO₂) 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: artificial 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 CO₂ (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).

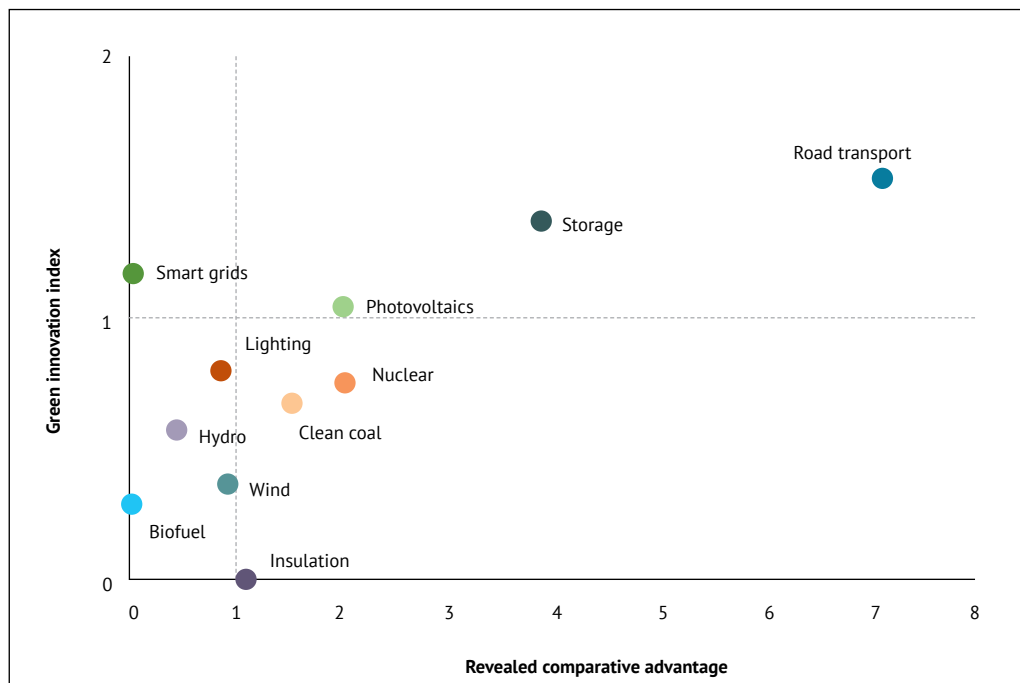
Despite pockets of progress in areas such as energy storage, fuel cells, hydrogen, and photovoltaic energy, the current levels of low-carbon innovations fall short of what is needed to reach a net zero economy, as visualised by major East Asian economies such as China, Japan, and Korea during the pandemic 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	-	620,000	-	73
Philippines	941,174	4.3	900,000	3.5	38
Singapore	506,782	3.6	-	-	-
Thailand	639,630	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.

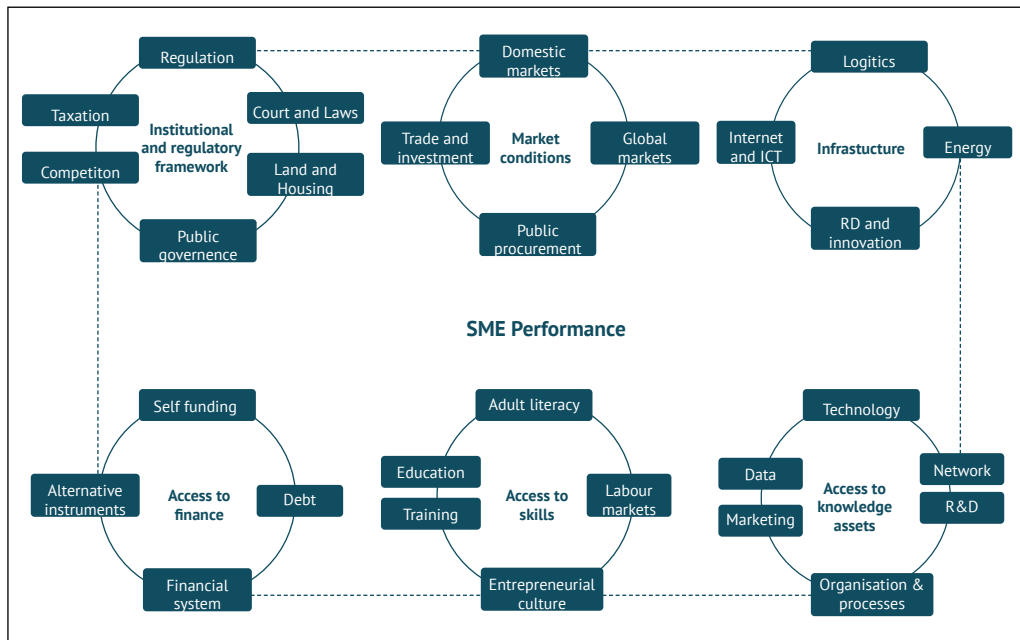
Source: ERIA (2015).

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 be 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 contact 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; QJUE 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 as 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.

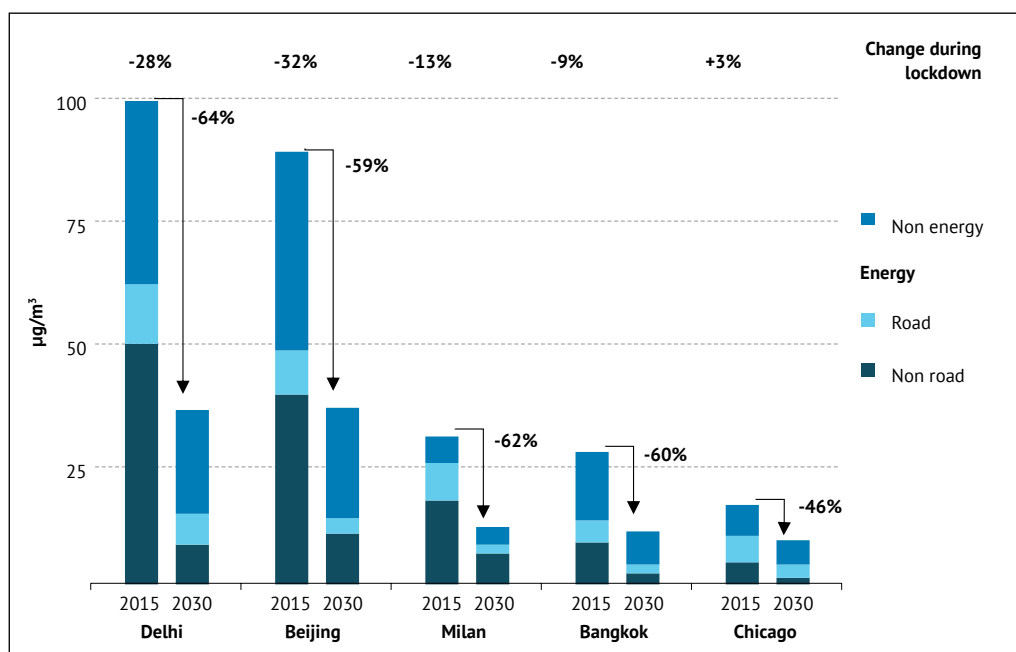
3.2 Cities as Transformative Agents for a Low-Carbon Circular Economy

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 CO₂ emissions fell by 8% in the first three quarters of 2020, according to IEA (2020), with daily emissions of CO₂ 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 CO₂ 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 (Sangkhom, 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	<ol style="list-style-type: none"> 1. Characterise and analyse local context and resource flows, and identify idle assets 2. Conceptualise options and prioritise amongst sectors with circular potential 3. Craft a circular vision and strategy with clear circular goals and targets
ACT	<ol style="list-style-type: none"> 4. Close loops by connecting waste/residue/water/heat generators with off-takers 5. Consider options for extending use and life of idle assets and products 6. Construct and procure circular buildings, energy and mobility systems 7. Conduct circular experimentation - address urban problems with circular solutions 8. Catalyse circular developments through regulation, incentives and financing 9. Create markets and demand for circular products and services - be a launching customer 10. Capitalise on new IT tools supporting circular business models
MOBILISE/ MONITOR	<ol style="list-style-type: none"> 11. Coach and educate citizens, businesses, civil society and media 12. Confront and challenge linear inertia, stressing linear risks/highlighting circular opportunities 13. Connect and facilitate cooperation amongst circular stakeholders 14. Contact and learn from circular pioneers and champions 15. Communicate on circular progress based on monitoring

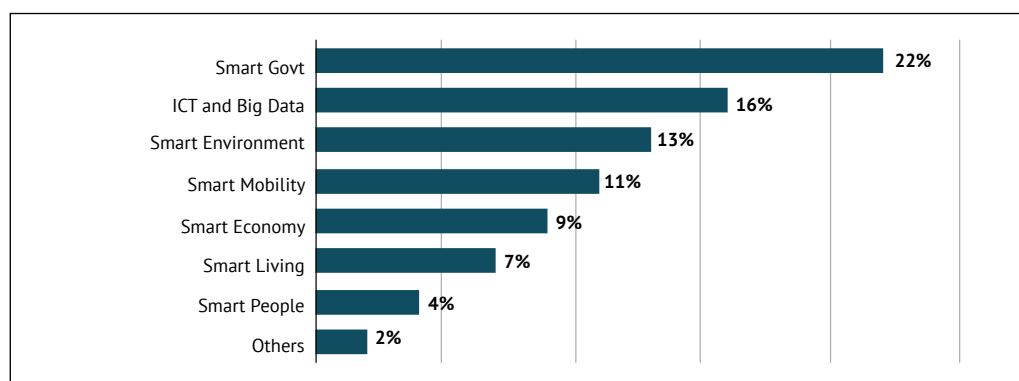
ICT = information and communication technology.

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 Enterprise management Logistics Transaction
Citizen-related smart city domains	Education Healthcare Public transport Smart traffic Tourism
Environment-related smart city domains	Renewable energy Smart grid Building and housing Waste management Water management Pollution control Public spaces
Government-related smart city domains	Emergency response E-government Public safety Public service 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.

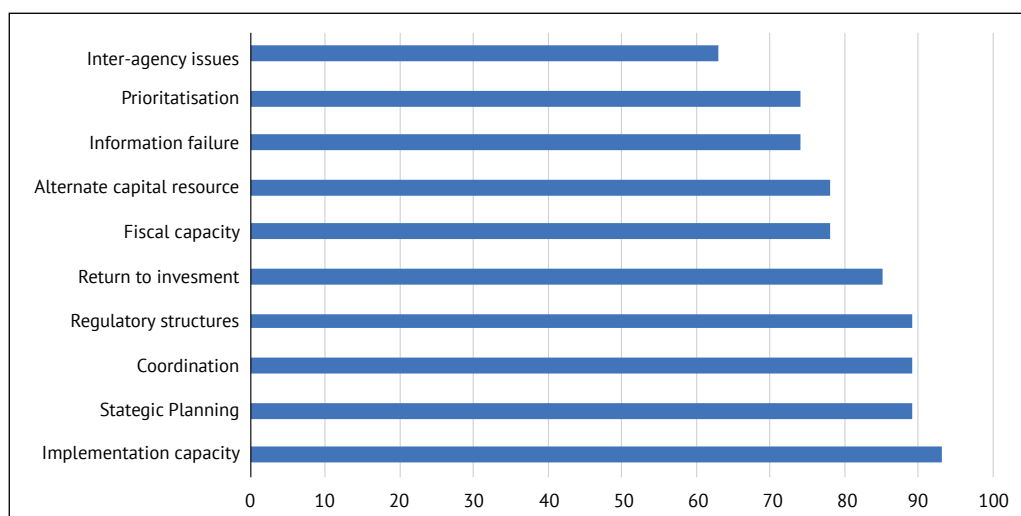
Through digitalisation and the collection of large amounts of data, followed by the translation of these data into strategic infrastructure investments, cities can support climate-resilient, low-carbon growth. Evidence-based decision-making and continuous monitoring of energy use and emission reduction 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 financiers 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

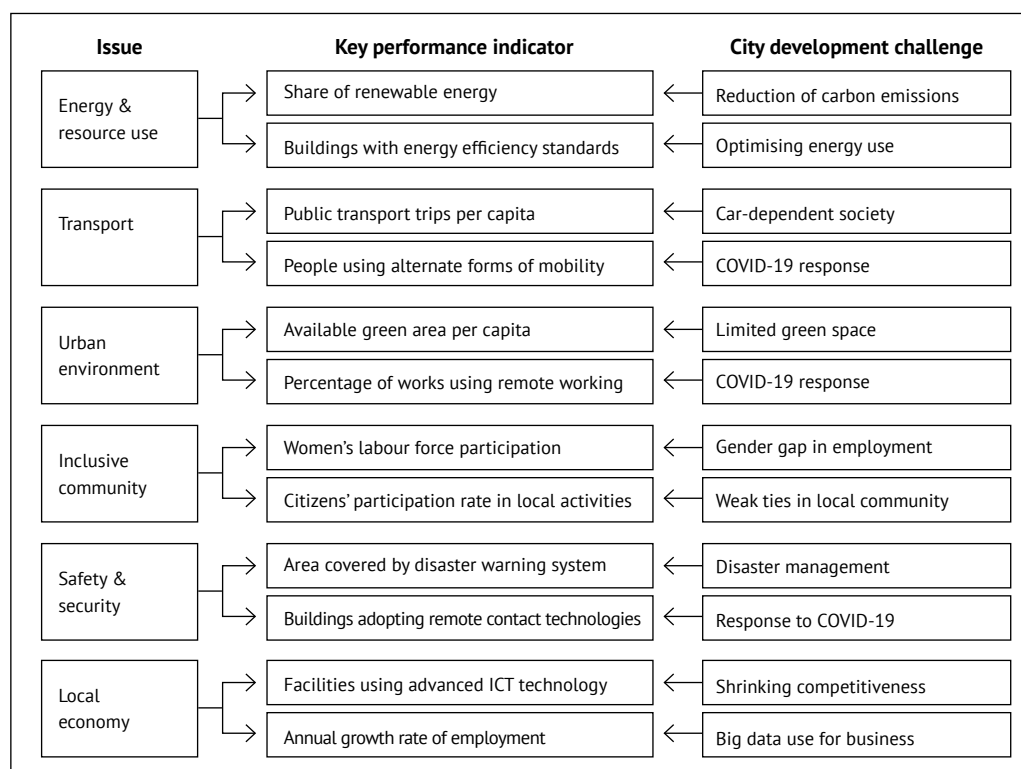
8–21 jobs per US\$1 million spent on energy efficiency measures, in comparison to three jobs in the fossil fuel sector. Governments need to support cities so that informal workers and other vulnerable groups impacted by the pandemic receive their share of the benefits of the low-carbon transition in 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



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

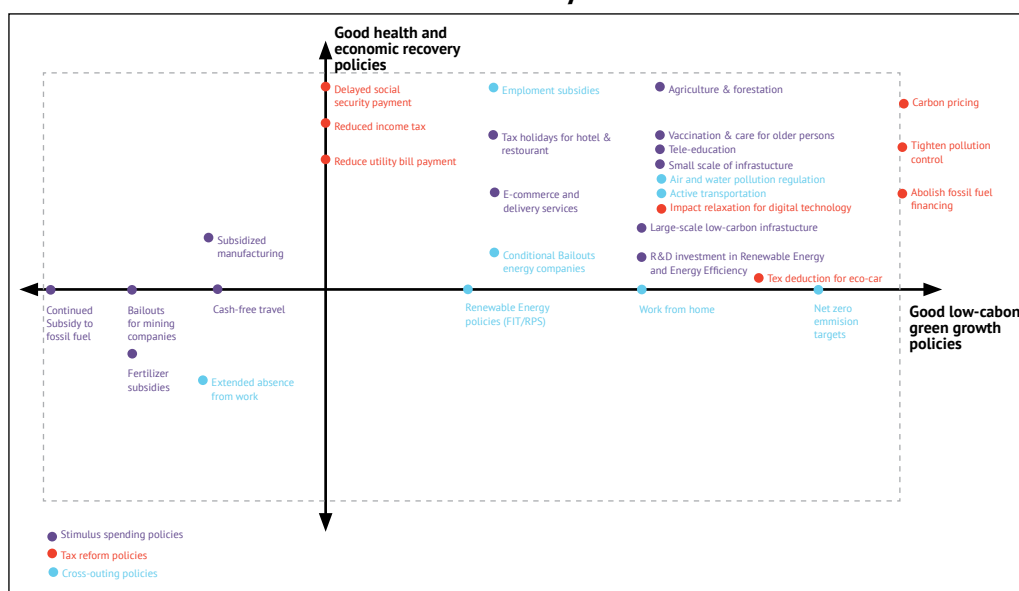
During the pandemic crisis, not all forms of macroeconomic policy frameworks or stimulus measures are created under equal conditions with same objectives. The health crisis has been accompanied by an unprecedented economic downturn, amidst existing climate risks. Supply and demand for goods and services 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.

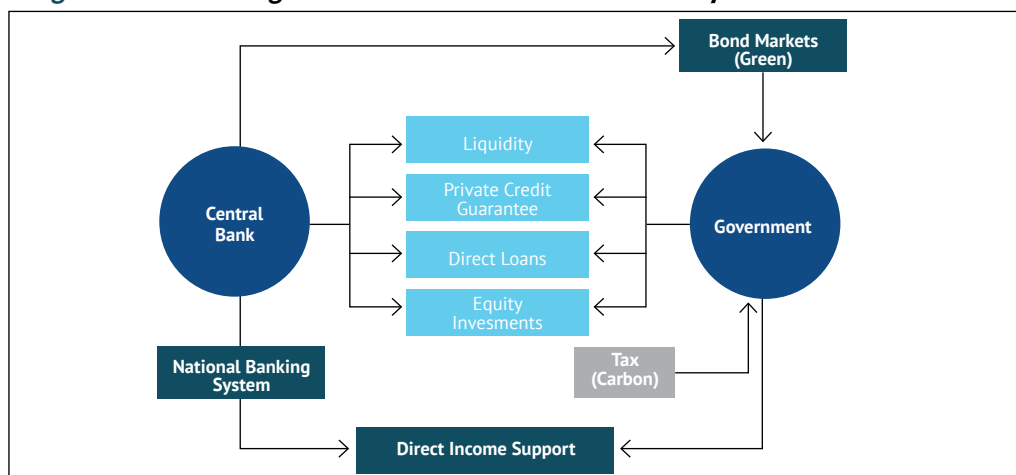
2021). The current policy actions taken by countries are considered to be much more comprehensive than those employed following the 2008 financial crisis, which had a higher financial outlay for low-carbon green stimulus spending.

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.

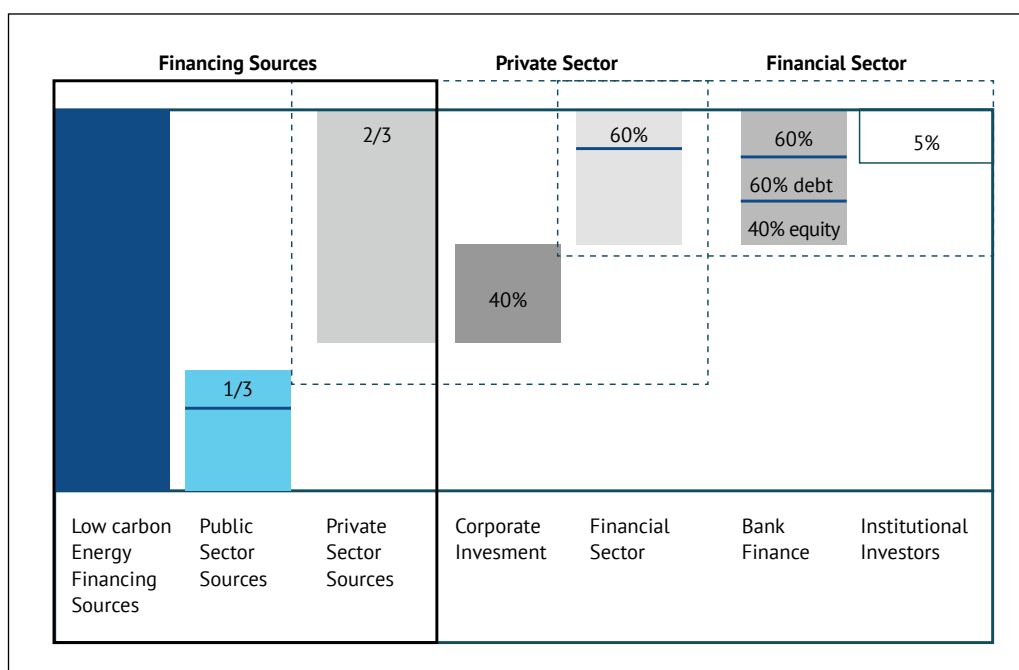
Figure 4.15 Financing Channels for the Pandemic Recovery in ASEAN and East Asia

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 subsidies. 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,

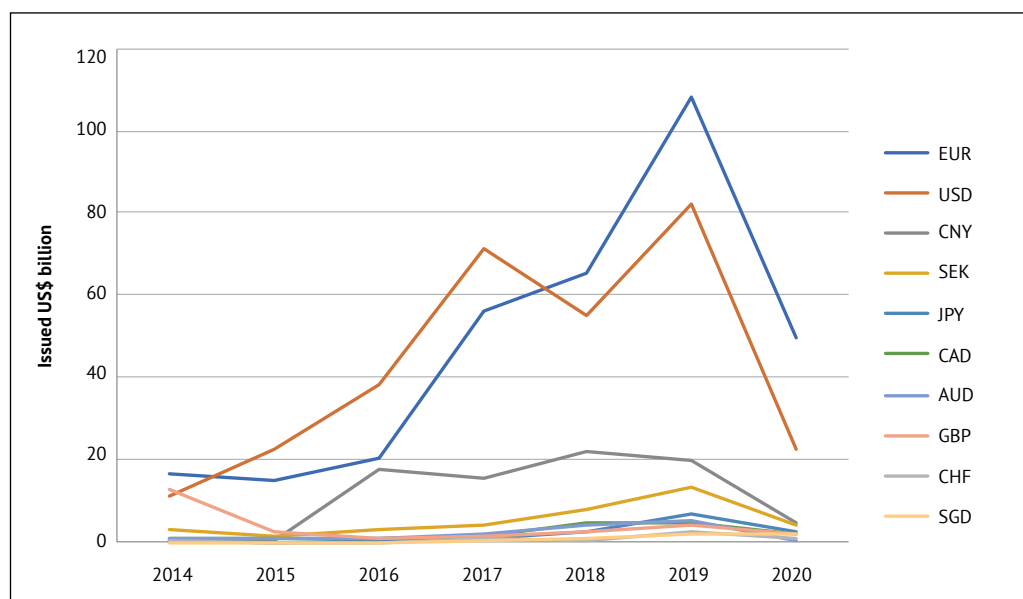
transport, land use, industry, and ICT investments. Subcategories could be developed to include many low-carbon services such as universities, finance, and business consulting.

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.

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.

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 rationalisation	Increase grid reliability	Green job creation	Part of national green growth policy	Increase sustainability
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%
	Currency risk	33%	32%	29%
Market	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.